ARE UNIVERSITIES SUPPLYING LEARNING SPACES THAT SUIT THE TECHNOLOGY AVAILABLE FOR TEACHING?

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DEDICATION

This thesis is dedicated to my

mother

who had the ability but lacked the support.

DECLARATION

I, the undersigned, hereby declare that the work contained in this report is my own original work.

Signed

Date

12 February 2014

ABSTRACT

Purpose – The report investigates the manner in which spaces are currently designed and provided for learning in the context of higher education institutions, and whether these designs take into account the technology available for use in an educational environment. It therefore looks at the impact that these spaces have on the learning process and the related ability of planners to provide the necessary spaces for teaching, in relation to the context of a technologically enhanced teaching environment.

Design/methodology/approach – A review of current literature is used to establish what types of spaces should be provided for teaching with technology in line with what is being done in universities abroad. Case studies of three universities will be used to gather data on the current trend in terms of the actual provision of space in universities. Interviews will be conducted with the participants of the case studies.

Findings – Once the case studies are complete, data will be analysed to assess how well the selected universities are doing in terms of providing space that is suitable for the latest technology that is used in the field of education.

Practical implications – In evaluating the spaces provided and the technology available, it will become apparent if the spaces provided are indeed relevant in terms of the technological world we live in.

Originality/value – Most of the current research documented in the literature examines technology and how it influences learning space design. As such, this report compares these concepts with the reality of space provision in universities today and questions the relevance of Space Norms in the age of E-learning.

Limitations –The report is limited to an investigation into Gauteng HEIs. Technology investigated is limited to types that are useful to teaching and is not an exhaustive range of technology available in the world. Spaces referred to are education spaces only. Institutions investigated are limited to face-to-face HEIs which are public institutions.

Keywords – E-learning, Net Generation, Space Norms, Digital Natives

Paper type – Research paper.

CHAPTER 1: INTRODUCTION TO THE RESEARCH REPORT

1.0 INTRODUCTION

This research report examines the provision of built spaces by Higher Education Institutions (HEI) for the purpose of teaching. It draws a comparison between space provided by HEI's and the types of spaces that the literature determines should be provided. It also looks at the Department of Education's space norms for HEI's and tests whether these norms are in fact adhered to by the institutions to which they apply.

It is common knowledge that in multiple arenas' technology is advancing rapidly and that as such, the manner in which the newest generation of students will choose to learn is likewise rapidly changing. Competition from institutions that offer online courses continues to grow and as such the older universities with large asset portfolios need to be able to adapt to remain competitive. The literature outlines various studies that have been undertaken with regard to the manner in which students use technology and as a result the way in which teaching methods should be adapted to students changing needs. Further, this paper examines the manner in which learning spaces are provided by universities and examines whether they are adapted to the technology available for enhancing teaching, which is directly influenced by modern educational programmes and methodologies.

1.1 BACKGROUND TO THE STUDY

1.1.1 THE SPACE NORMS

The framework around which the evaluation of the provision of space by HEI's and its effectiveness in the educating of students is built is based on the Department of Education's *Space and Cost Norms for Buildings and Other Land Improvements at Higher Education Institutions* (Space Norms).

In the introduction to Space Norms, it is stated that the norms were designed in the 1980's and updated in the 1990's, which will have to remain an on-going process due to constant changes occurring in the field of education. The 2009 version of the norms are the latest version and were last revised in 2007. Unfortunately, the methodology of revising the Space Norms with particular reference to technological advancements in the field of education are not described in the manual, and as such will be established through an interview process with the Department of Education.

The Space Norms are uniquely South African and serve provide a framework for the provision of space for various types of institutions and qualifications. They are therefore based on what is currently considered attainable with regards to student

numbers, contact hours and classroom areas. They are not prescriptive as to the design of the spaces; rather they are a high level guideline for the overall provision of built space that should be creatively managed by each individual institution.

1.1.2 ICT AND ITS EFFECT ON HIGHER EDUCATION

Traditionally the lecturer has been the disseminator of knowledge to students, but with the rapidly changing technology available for education there has been a paradigm shift in the way people teach and organise their classrooms from the traditional didactic delivery model to a more interactive model in which the learner has more autonomy. In the traditional scenario, lecture halls were configured for the teacher to be heard and students to sit quietly and take notes. The literature of cognitive theorists who have studied the ways students learn in terms of their social context and the physical processes involved in learning, see lecturers as facilitators for, "active student engagement, where learning occurs in many locations" (van Note Chism, 2002), implying that there is a need for small spaces that can be rearranged for group sessions, group project work and full class discussions. These spaces have to be able to link back to learning technology and should be comfortable and aesthetically pleasing. In their article *Envisioning and Navigating the Design Process of the Learning Space*, Wedge and Kearns (2005) describe similarly how the pace of change is at its historical apex and that the global access to information and the rapidity of change means that HEIs have to anticipate and cater for future change by supplying spaces for learning that are flexible and adaptable.

E-learning allows flexibility in learning and breaks down barriers of, "inflexible organisational structures*",* according to Shabha (2004) which implies that universities have traditionally been exclusive and that their future relevance is being challenged by the fact that the Net Generation (Net Gen) is able to access knowledge through technology, thereby circumventing the need for large unwieldy institutions. Universities can choose to implement E-learning, but the literature suggests that they will then need to be "structurally flexible" (Singh *et al.*, 2005), which will necessitate a revision of the ways in which learning spaces are designed and built.

It is common knowledge that buildings have long life spans, far longer than the life-cycles of technology, and as such Johnson and Lomas (2005) talk about the fact that the design of spaces needs to move out of the realm of the traditional architectural thinking around the provision of what quantum of space to provide per learner, to the collaborative design of understanding the way the Net Generation interacts and learns, based on their technological skills and anticipated future technological advancements (Johnson and Lomas, 2005).

1.1.3 THE CURRENT STATUS OF UNIVERSITY SPACE IN SOUTH AFRICA

This thesis will examine the use of ICT in education with the purpose of determining how universities are utilising technology and the rapid changes in technology, to determine what spaces to provide for the education process. The spaces provided by the university are thought to influence students' study performance and as such they should be designed for e-learning to allow the NetGen to be educated in a collaborative manner. Added to this is a study of the space norms provided by the government to determine if they relate space provision to technology, and then from here to examine the spaces provided by universities to see whether they conform to these space norms.

In South Africa, the HEI's that are contact institutions are required to provide space in terms of the Space Norms' calculations for each field of study. The Space Norms were developed before E-learning began to have a widespread impact on teaching and learning. This means that the built assets of HEI's were designed taking account a didactic teaching model and the relevant spaces required for this, with no regard for the impact that technology may have on teaching methods and therefore on the types and size of spaces needed.

1.2 PROBLEM STATEMENT

In the context of a rapidly evolving technology, how are higher education institutions adapting to the changing types of pedagogy in terms of the provision of suitable spaces to engage in E-learning?

1.3 RESEARCH QUESTIONS

The **specific research questions** this study employs are:

1. What technology, available today, is suitable for teaching?
2. What is the leading pedagogical epistemology of the day?
3. How is technology actually being used in terms of teaching and learning?
4. What is E-learning's impact on learning spaces?
5. What spaces are being provided for learning in today's HEIs?
6. Do these spaces allow for the use of the technology in teaching?

7. Does the provision of space by HEI's conform to the South African Department of Education space norms and do these norms keep up to date with changing pedagogies and teaching technology?

1.4 RESEARCH AIM

The aim of the report is to establish what physical spaces HEI's in South Africa are producing for the purpose of educating students and why they are producing these spaces. Specific to this study are the questions of how technology is used in education, and what its influence is upon the design of the types of spaces being provided.

1.5 RESEARCH OBJECTIVES

1. The first research objective was to establish which technologies, in general use, could be used for educational purposes and to establish if they are being used in South Africa HEI's.
2. Secondly a comparison was done between research that has been carried out in foreign HEI's with regard to the relationship between education and technology and the current philosophies of South African HEI's, to establish whether they are in alignment.
3. Finally, the issue of how space impacts learning and whether HEIs in South Africa acknowledge this in their design was explored.

1.6 DEFINITION OF TERMS

ASM- Assignable Square Metres is defined as the amount of space that can be used in a building measured within its interior walls and allocated to one of the ten assignable space use categories *i.e.* Classrooms, laboratories, offices etc. (Department of Education, 2009)

CESM – Classification of Educational Subject Matter – a taxonomic coding scheme of subject matter into 20 (first order) categories which form a single coherent system for categorising subject matter at any institution. Its purpose is for recording data and

comparing subject matter within institutions and with the Department of Education. The categories are not concerned with academic programmes but with various knowledge components. (Department of Education, 2009)

DoHET – Department of Higher Education and training

E-learning – all forms of electronically supported learning, teaching and general educational experience provided via a technological medium. This includes computer and network enabled transfer of skills and knowledge, web-based learning, computer based learning and virtual education using satellite TV, internet, CD-ROM.

HEI – Higher Education Institution.

HEMIS – The Department of Education is responsible for a Higher Education Information System which plays a central role in the collection and production of data required for quality assurance, national and higher education planning and the allocation of government funds to higher education institutions.

ICT – Information and Communications Technology, which refers to computers and software which allows the users to access, store, send and receive, and manipulate information.

LMS – Learning Management System, web-portals used by HEIs to enable remote communication between students and faculty.

mLearning – this term refers to mobile learning which is learning using mobile devices such as laptops, cellular telephones and tablets.

Net Generation/ Net Gen – "Net Generation students consider computers a natural part of their environment; the virtual world is an extension of their real world. …these students have the technical savvy to negotiate virtual environments with ease, making virtual simulations practical for both educational and training purposes," according to Jones (2002).

Space Norms – Norm is defined as a standard that is required, desired or designated as normal (Farlex, 2012). The Department of Education has developed a system to determine the relationship between space use categories and learning

programmes. The amount of space to be provided for each space use category relates to an area per full time enrolled student in a particular CESM category - These categories define the actual use of all areas found on a campus, there are eleven major categories (Department of Education, 2009).

1.7 RESEARCH METHOD

The research report utilises a review of the literature that has been undertaken on learning epistemologies, technology being used in the field of education and the types of university spaces that are suitable for learning with technology as a basis for contextualising the case studies. As this report will be qualitative in nature, the literature review forms part of the data collection process.

Case studies of learning spaces provided by various HEI's including an assessment of the application of the Space Norms will be undertaken using three HEI's in Gauteng. The case study method is ideal for explaining present circumstances and for in-depth describing of social phenomena in context (Yin, 2009).

The selected case studies will be used to develop a full understanding of the types of spaces currently being produced, and will be carried out in such a way that there is a possibility that their results may be generalised to other institutions in South Africa. Direct observations and interviews with the people involved in space provision as well as a review of case specific documentation (Yin, 2009) will form the basis of the data collection process.

1.8 THE IMPORTANCE OF THE STUDY

Universities have large asset portfolios of buildings, both on and off campus, which, due to the long term investment nature of property, as well as financial constraints, are not easily rebuilt or redeveloped. Therefore, they cannot easily be adapted to suit the use of ever changing technological developments. This indicates that HEIs need to contemplate what the future is likely to hold, and as such, design their buildings accordingly.

This study aims to add to the knowledge base of how technology is currently used in the context of the learning process and therefore how spaces are provided for teaching, as well as ultimately how the interaction of the two within an HEI can be resolved in order to improve the longevity of the buildings and in doing so, enhance the ability of an institution to attract students and funding.

1.9 LIMITATIONS

The research will be limited to case studies undertaken at three HEI's in South Africa.

The question of whether students in South Africa have access to technology for learning off campus will not be considered in this report.

The research is limited to public institutions in South Africa and to those in Gauteng.

Various technology used in the field of education will however be detailed in this report, but not the many ways in which it is advancing. It is taken that it is a fact that there are continual advancements and changes in terms of technological teaching aids, and that the use of technology has an impact on the use of the space and its ultimate provision.

The question of whether teachers are adequately trained in the use of ICT, or if the curricula are properly designed and adapted for its use are not considered.

1.10 THE STRUCTURE OF THE REPORT

This report is divided into six chapters as follows:

Chapter 1 is the introduction to the research topic with an outline of the aims and objectives of the report and contains a detailed list of research questions.

Chapter 2 consists of a detailed literature review which is separated into topics directly related to the research questions, for ease of reference.

Chapter 3 explains the research methodology undertaken and the reasons for the chosen method.

Chapter 4 outlines the case study findings in three sections with primary and secondary data separately identified, as well as a summary of each case.

Chapter 5 contains an analysis of each case, as well as a cross-case analysis.

Chapter 6 sets out the overall research conclusions and outlines potential topics of further research.

CHAPTER 2: LITERATURE REVIEW

2.0 INTRODUCTION

Educational writers refer to a changing pedagogy, a paradigm shift from didactic lecturing methods to a more collaborative style of learning or constructivism, in which students participate in the creation of knowledge.

2.1 THE WAY STUDENTS LEARN

In *Learning Theory and Online Technology,* Harasim (2012) sets out the table below to demonstrate that, "…three major learning theories influenced education in the 20th century: behaviourism, cognitivism and constructivism. The constructivist epistemology is a theory that knowledge is created during human interactions and is therefore not an absolute truth (Harasim, 2012). Harasim (2012) adds a fourth epistemology for the 21st century and calls it Online Collaborative Learning Theory. This theory embraces the technological age in which we live and challenges learning theories to move beyond didactic approaches and into the realm of learners becoming "knowledge builders" (Harasim 2012:89).

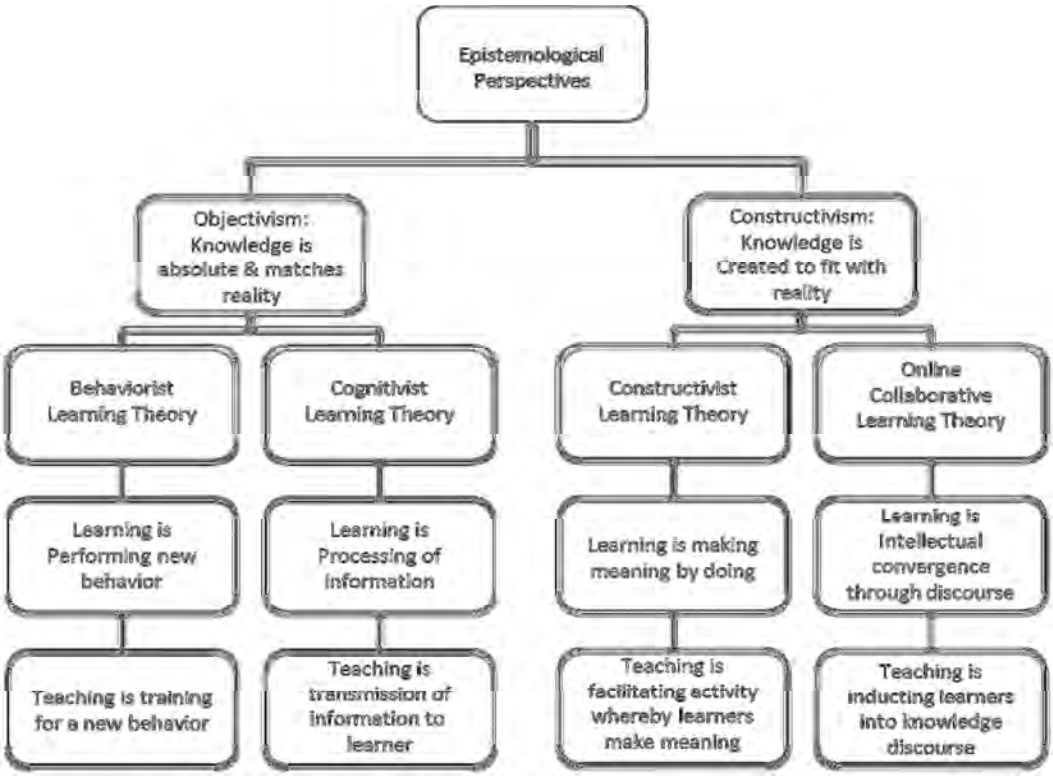

Figure 1. Epistemological Perspectives on Learning Theories (Source: Harasim, 2012)

The Russian psychologist, Lev Semyonovich Vygotsky (1896 – 1934) promoted the idea that collaboration was important in knowledge construction. "Constructivism – particularly in its "social" forms' means the active involvement or discourse of learners with teachers and peers in creating knowledge (Harasim, 2012). Quinn (2012) and Harasim (2012) share the idea that social media that enables students to interact and share information extends the idea of discourse to online discourse. The table below shows examples of online discourse technologies that are widely used today.

Figure 2. Examples of Online Discourse (Source: Harasim: 2012)

Seleverian & Stewart (2010; 261) talk about the difficulty of integrating technology into socially interactive education, due to its intimidating, exclusive and rapidly changing nature. This, however, does not seem to be the case for the Net Gen. Many authors such as Seleverian & Stewart (2010), Harasim (2012) and So *et al.* (2012) refer to the Net Gen as a group that is able to learn differently to the older generation. Given that the Net Gen has grown up surrounded by digital technologies, many observations have been made about their preferences and perceptions toward technologies and learning. For instance, prior research indicates that Net Gen students can search and process information rapidly (Oblinger & Oblinger, 2005) and

are good at multi-tasking and task switching (Carrier *et al.* 2009). Regarding learning styles and preferences, some researchers (e.g. Barnes *et al.*, 2007; Oblinger & Oblinger, 2005) have reported that Net Gen students prefer teaching methods in which they can learn in an active manner and have higher degrees of autonomy in their learning process. Additionally, they are known to be social and prefer interactive communication and collaboration as a mode of learning. It has been found that the Net Gen constantly and actively looks for information online, and spends a lot of time doing so. They also create information for pleasure and spend time socialising and playing games online (Harasim, 2012). This idea is echoed by Schifter & Stewart (2010) who posit that "digital natives" don't learn through traditional lectures and note taking but through,"…personal engagements with the subjects through multimedia in a constructivist style" (Schifter & Stewart, 2010:14). Chen *et al.* (2010) in quoting findings by Salaway & Caruso (2008) wrote about the fact that many students expect instructors to use internet technologies to enhance didactic classes for an improved learning experience.

The literature is therefore describing a type of learner in the higher education context which holds strong expectations of being able to be constantly in contact through the internet, with other students, friends and various sources of information. This leads to the question of how technology and education can be blended to accommodate these expectations.

2.2 TECHNOLOGY IN EDUCATION

2.2.1 THE IMPACT OF TECHNOLOGY ON LEARNING

People are generally aware of the fact that technology is constantly changing and affecting every aspect of our daily lives because of universal access to networked search engines that allow us to communicate through the use of email, mobile phones, short text messaging and social networks (Harasim, 2012). Norris (2011) took this idea further when pointing out that changes in communications behaviour

have affected today's university faculty, staff, students, and even administrators (Norris, 2011).

The 21st century has been referred to as the Knowledge Age, or "a time in which knowledge has key social and economic value" according to Harasim (2012) who points out that, although the Net Gen are raised in a technology rich environment, education has not changed significantly to reflect the fact that the Web is viewed as integral to work and socialising by the modern generation, and that the didactic form of teaching is still prevalent worldwide (Harasim, 2012). Seemingly contrary to this, are the studies done by Klopfer *et al.* (2009) that show that, "an overwhelming majority of teachers in Europe (90%) use ICT to prepare their lessons", and in their study Nechita & Timofti (2010) found that indeed lecturers do use ICT to create their lessons and through combined efforts improve their work using IT applications (Nechita & Timofti, 2010). However, the use of ICT in lecture preparation does not necessarily indicate that the way students are taught has changed, it can be that the teachers' merely use computers rather than paper to draft lecture notes and timetables.

Harasim feels that the adoption of new technologies to serve traditional teaching practices may not be bad in itself, but that "educators who restrict their use of the Internet and the Web to making traditional didactic teaching easier or more efficient are missing opportunities to introduce better, different or more advanced ways of learning" (Harasim, 2012:90).

Quinn (2012) and Harasim (2012) agree that social learning is a good thing as, "social interaction leads to tighter cycles of content engagement." Quinn (2012) talks about two types of social interactions in learning, those of learner-learner and learner-instructor. He believes that mobile technology can make learner-instructor interactions take place in context, but that the real power is in learner-learner interaction, so that learners who are able to collaborate on assignments may alter their understanding through public reflection and debate (Quinn, 2012). Learners do however need guidance on how to interact productively, and thus teachers must assume the role of instructor and facilitator. Teachers could take the role of a

facilitator and project manager and could move freely around the classroom helping students (Ringstaff & Kelley, 2002).

In his book *The Mobile Academy mLearning for higher education* (2012), Quinn outlines his earlier concept of the four C's needed for effective mobile learning: "Content: the ability to store content on a device; Capture: a system whereby individuals produce content"; as well as "Compute" and "Communicate". He later added "Context", in which the device is aware of where we are, "context sensitivity is an important opportunity". He cites an example of an architecture student standing in a location and being able access information about the history of that particular building. Quinn also states that "Context" could be provided in terms of the specific information appropriate to the task, not the location of the user, based on the application being used (Quinn, 2012:20). Tagging of the environment to provide context-specific content with the use or QR codes and calendar links that allow content to be provided when needed for specific assignments are examples (Quinn, 2012:54).

A huge benefit of mobile learning (mLearning) is its ability to improve productivity by allowing easy access to the support systems of a learning programme at any moment of a day and for that matter from any location (Quinn, 2012). Lectures can be captured and streamed live, or saved for later access. "Wikis and collaborative web-hosted documents can be accessed when convenient when mobile accessible" (Quinn, 2012:21). If students can tweet during lectures – using a hash-tag provided by the lecturer, a chat-window environment can be created in a real classroom. This makes the class interactive and mistaken thinking can be corrected without verbal interruptions (Quinn, 2012:80).

2.2.2.1 LIVING EXAMPLE OF TECHNOLOGY IN EDUCATION

Harper College in Illinois, a community college, converted a large unused space into a state-of-the-art laboratory for a nanotechnology programme (Grayson, 2009).This laboratory does not have all the facilities of a huge research university, so to overcome this, collaboration with students at Penn State and the University of

Minnesota is enabled virtually using video cameras. In addition access is provided to online learning and multimedia platforms, which assists in fostering collaboration with students from the other universities.

Harper College is also developing a virtual hospital for its nursing training programme which will create a realistic environment for students get a real world feel for their field. The new space will be multi-disciplinary, as students in medical technician programmes (ultrasound, general diagnostic, graphic technology) will also use the new virtual hospital for training (Grayson, 2009). The area will look and feel like a real hospital, but with a great deal of technology and simulators built in to allow the students to perform various functions e.g. drawing blood and taking blood pressure. The educators will be able to simulate various events and control situations that students are exposed to. They will also be able to monitor the students using video cameras (Grayson, 2009).

2.2.2.2 FUTURISTIC

Device convergence, where one product has the multimedia advantages and functions of many products, leads to the question of the role in the future of cell phones, PDAs, MP3 players, and computers in the context of education, according to Brown & Long (2006). Cell phones have indeed been used in the education process, but largely as short message communicators; for example in class quizzes (Brown and Long, 2006). Norris believes that, as these devices are becoming more powerful to allow for greater convergence, they will actually change the way that learning takes place (Norris, 2011).

As pointed out by Katz, and cited by Norris (2011), networked connectivity enables individuals who are not associated with the university to find information in non-traditional ways in contrast to the fact that knowledge used to be exclusively available through faculty and researchers on campus (Norris, 2011:4).

At first, Web 1.0 was a system of producer-developed content, Web 2.0, one of user-generated content and we will soon get to Web 3.0, which will be characterised by system-generated content where-by the system will have access to models of the students' needs and preferences and will be able to use rules to combine content in

a customised learning experience (Quinn, 2012). Social websites are already using this technology to "direct" content to users based on their interests.

Norris (2011) contends that the, "…technology-driven reshaping of scholarship will continue to be a highly positive force, on balance. It will enable profoundly networked individual faculty and teams to increase their connections with peers and sources of fresh knowledge, and to raise their attractiveness to funders" (Norris, 2011:4).

Higher education institutions need to meet the requirements of modern culture, which is more accessible, adaptable and cut-throat, and they have to encourage the use of IT. They need to meet students' requirements, operate internationally and develop collaboratively, as well as rethinking the way learning environments look, act and work. They need to develop new ideas on the importance of information and foster originality, research and the imagination of educators. The ways in which lecturers will need to operate cause us to consider their own educational needs, including that they be instructed in ICT usage for educational purposes (de la Serna, 2004; Paredes & Estebanell, 2005; Pablos Pons, 2007).

Higher education institutions will have to adapt to the use of technology in education by ensuring equal distribution of technology tools among teachers, encouraging lecturers to keep utilising technology, improving student: teacher ratios, creating collaborative learning spaces and providing technical and financial assistance to enable the use of both virtual and physical learning and research (García-Valcárcel and Tejedor, 2009).

2.2.2 TYPES OF TECHNOLOGY

Today most people have mobile devices, including the increasingly popular smart phone, which can be used in various ways for educational purposes. Technology which is portable, accessible and belongs to students could be used in teaching, as could static technology that would need to be integrated into the design of the university and operated by faculty members.

M-learning is a term used for learning through the use of portable technologies such as handheld computers, MP3 players, notebooks and mobile phones (Norris, 2010; Quinn, 2012). M-learning allows the learner to be flexible and mobile, in-line with the

needs of an increasingly mobile general population. M-learning is moving beyond laptop devices to smart phones, iPads, and new concept devices. Many people already use smart phones as cameras, GPS devices, personal organisers, for conducting Web searches and sending text messages (Norris, 2010).Therefore the, "…resources that students carry with them are potentially powerful academic tools whose capabilities go well beyond their value for recreation and entertainment" according to Brown & Long (2006:9.7).

Quinn (2012) talks about the many forms that mobile devices take and describes a model of a device that can be used for learning, this he calls the "convergent model", where a device has: "A processor or on board memory, an operating system, a suite of apps, can communicate with the user, has a way the user can communicate with the device, has a way the device can communicate with the digital world and has ways in which the device can sense the ambient world *i.e.* camera/gps" (Quinn, 2012:45).

MP3 players are one such resource. In an experiment done by Duke University, five major uses of the MP3 player were identified:

- Course content dissemination: dissemination of prepared audio content such as lectures, songs, historical speeches, and foreign language content;
- Classroom recording: personal lecture/discussion capture;
- Field recording: field notes, interviews, and so on;
- Study support: replaying audio content, whatever the source, for studying purposes;
- File storage and transfer: simple file transfer and backup, especially for media files (Brown & Long, 2006).

Quinn (2012) emphasises the importance of how information is displayed on mobile devices, in that not all media forms are available to all devices because of their limited screen size and memory capacity. Documents are the, "most pervasive form of content" because they are so easy to prepare for mobile technology. Audio and video are seen as being dynamic content (Quinn, 2012), but in these formats there are trade-offs between size and quality for use on mobile devices.

As the capacity of USB flash memory drives (UFDs) increases these data storage devices can serve as “self-contained portable application environments” (Brown & Long, 2006: 9.3). In order to increase the usefulness and flexibility of university computer laboratories, UFDs could be connected to a basic PC, students could carry their digital computing environments on their UFDs, equipped with operating systems, a suite of applications and even security tools (Brown & Long, 2006).

Software applications that have been designed for social interaction can also be used for teaching. Micro blogging such as Twitter and instant messaging technologies enable more than one person to have a single conversation. Skype for example allows Instant Messaging, Voice over Internet Protocol and video conferencing. These applications allow students to interact with each other and faculty in a far broader manner in terms of both type of interaction and time of day (Norris, 2011). Integrated social media networks like Facebook, support blogs, wikis, discussion fora and media repositories, can have individual and group profiles and allow interactions around common topics, the sharing of information and digital collaboration. This type of technology together with Web tools such as Google, email and wikis can be used for online collaborative learning (Harasim, 2012).

Outside the university campus, mobile technology can assist with field research which can be done effectively with the use of smart phones and similar devices to collect data and record phenomena. Some lab-based scientists in academic research labs use tablets for data capture, management and manipulation, according to Norris (2011). Today the most relevant features of education enhanced by technology are that educators can provide additional virtual feedback, introduce simulated scenarios for study and collaborative learning in groups of both students and teachers, without having restrictions on time and place of interactions (Harms *et al.*, 2010).

Universities have become “technology-rich environments” where students, faculty and researchers can access “ambient technologies” embedded in classrooms and research laboratories. Examples of such technology are projectors and projection screens for video-conferencing and artificial/augmented reality facilities with sensors and artificial intelligence (Norris 2011). Virtual reality (VR) is another type of ambient

technology useful for teaching, Pantelidis & Vinciguerra (2010) define virtual reality as: "… a highly interactive, computer-generated environment" which can be graphics-based, text-based or a combination of both (Pantelidis & Vinciguerra 2010:151). Set-ups that include simulations, active learning, role playing, internships, imitation and real world replications are part of virtual reality in the field of education.

According to Brown and Long (2006), technology is changing too quickly for colleges and universities to provide a robust and up-to-date technology infrastructure, but with most students providing their own devices, it simply becomes a matter of the universities providing connectivity and learning support. The focus should be on "software implementation and interoperability rather than buying and deploying standard technology" (Brown & Long, 2006: 9.9). Students with their own laptops or other computing devices will need applications to support their coursework. In today's technology environment money is spent on buying applications rather than hardware.

2.3 THE IMPACT OF SPACE ON LEARNING

Scott-Webber (2004) was quoted as saying "Built environments impact behaviour and we must know for which intended behaviour we are designing" (Jamieson *et al.*, 2005:17).

The literature reviewed has focussed on the way students study and how IT has changed this, in this section space is examined to discover whether it has an impact on learning, and if so, how can new spaces be correctly designed and existing spaces be restructured to enhance learning. Certainly the literature acknowledges that space does have an impact, but how well the impact is understood is questionable. Brett and Nagra (2005) pointed out that Van Note Chism and Bickford (2002) looked at the ways in which the physical learning environment has an impact on learning and how it can be designed to promote learning. Van Note Chism and Bickford (2002) are also credited with identifying a range of factors other than room layout, such as furniture, room sizes, and room shapes, which have an influence on learning.

Although Brett and Nagra (2005) found some studies that identified strong preferences for social arrangement around computers which had a positive impact on studying, they also quote Banning and Cannard (1986) as saying that, "…among the many methods employed to foster student development, the use of the physical environment is [*sic*] perhaps the least understood and the most neglected" (Brett & Nagra, 2005: 283). Although he was describing a media centre, not a classroom, Sinclair (2007) states that the space should be, "…open, free comfortable, inspiring and practical", these seem to be good design principles for classrooms in an age where information can be disseminated via the internet and the classroom can become a place where, "…interdisciplinary, project-based learning" (Ringstaff & Kelley, 2002) can take place.

In considering the connection between learning behaviour and learning space design, higher educational institutions are generally sceptical that there is a direct link. Bennett (2006:14) proposes a view in which the architectural or environmental design renders students more likely to act in certain ways when learning. He calls this "architectural or environmental probabilism" and believes we are more likely to realise a good return on investment in learning spaces if we better understand what aspects of design will assist students to learn more effectively.

The JISC study on *Designing Spaces for Effective Learning* argues that space does have an impact on learning. It studied various aspects of campus design and noted that by incorporating IT and students' preferred methods of studying; a positive impact can be made on students' performance. If learning spaces are designed with student well-being in mind, e.g. light and airy, students will be more motivated to spend time in the learning space. Wireless connectivity in open-plan areas that allow social interaction will encourage students to continue their learning outside the structured classes (JISC, 2006).

Educational researchers (e.g. Biggs, 1999; Ramsden,1992) identified different student approaches to learning such as "surface approaches to learning" in which facts are memorised without understanding, and "deep approaches" to learning which are based on a detailed grasp of knowledge in a subject and an active understanding of the meaning of issues or concepts. These approaches characterise

the, "…context dependent ways in which students engage with learning tasks and their learning environment" (Brett & Nagra, 2005: 282). This means that the design of learning environments will influence which approach to learning a student will take. Brett and Nagra (2005) point to the fact that collaboration and interaction between students will enable various meanings to be explored through each individual's perspective and in this way the social constructivist principles of education will foster deep learning. Nechita and Timofti (2010) talk about "cooperative activities" enhancing learning and through this it was discovered that group work, discussion boards and wikis enhance learning by allowing interactivity; meaning that learning spaces (both classrooms and informal campus spaces) have to adapt in order to help catalyse this type of learning. (Brown & long, 2006).

For collaborative learning to take place, open-plan environments can often be developed in less effectively employed spaces such as entrances to buildings and spaces between buildings, by adding Wi-Fi, access to refreshments and informal seating (JISC, 2006). From the data it has been found that these areas are valuable for their inherent encouragement of the sharing of information and conversation (JISC, 2006).

Without interaction between the educator and pupil, merely presenting students with electronic technology does not bring about valuable education. According to Vonderwell (2003:78), "Social interaction among learners plays an important part in the learning process and can have a significant impact on learning outcomes" (Weiss, 2010:90). Chute *et al.* (1999:206) have found that collaborative learning environments where the student is the central focus of the education process occur where students are able to connect to a network of information resources, and give the learners the impression that they are at the heart of the learning process. According to Weiss (2010:90) students, "…are considered the facilitators, the instructors and collaborators in the course". Jamieson *et al.* (2005) echo this thought when they refer to the increasing need of institutions to see their students as adults and to shift the focus to "student-centred" learning with a consequent reduction in teacher-centred, didactic instruction.

Jamieson et al. cite Biggs, 1999; Marton & Booth, 1997 as authors who have focused on students' experience of learning but they themselves are of the opinion that in the design process, the pedagogical approach and the students' experience are largely ignored (Jamieson *et al.*, 2000).

2.4 STUDENT PREFERENCES

In order to understand the students' experience of learning the literature was examined and it was found that surprisingly little information is available with regard to what spaces students' would actually like to see provided. However a study by Brett and Nagra (2005) set up a computer environment designed to encourage collaboration in self-study and to examine students' perceptions about, and use of the environment. This study showed that extensive computer-based multi-tasking was happening with students using several applications at once, some work-based and some social. The Brett and Nagra (2005) study found that 25% of learning was collaborative in nature and the students valued the collaboration and that it did not affect their concentration. They concluded that, "The main implication therefore is that considerations of what types of learning approaches we wish to develop and support need to be factored into our university computer-based learning spaces" (Brett & Nagra, 2005: 290).

It is worthwhile allowing learners to take part in the design as this will encourage them to spend time in the space that they feel they have a stake in developing. According to the JISC (2005) study, some institutions have introduced local radio transmissions in learning zones within the internet café because of students' preference for studying with background music (JISC, 2005).

2.5 THE DESIGN OF HEI SPACES SUITABLE TO HOUSE ICT IN LEARNING

Having considered how students learn, what technology is available for learning and what impact space has on learning, it is now logical to analyse how the spaces for

learning should be designed. The literature (Jamieson *et al.* (2000); Brown and Long (2006); Shabha (2004); Brett and Nagra (2005)) can be described as having five design themes, these are that spaces provided should have flexibility; should allow social learning, access to technology; be integrated and financially viable.

2.5.1 FLEXIBILITY

Jamieson *et al.* (2000) set out principles that they feel should be applied to the design (alongside other architectural design principles) of higher education institutions in order to create flexible spaces that can accommodate the changes in technology and the impact that technology is having on teaching and learning styles. Their principles of design can be summarised as: design for spaces to have multiple uses concurrently and consecutively, maximum flexibility, integrated functions, design to maximise user control and student ownership of the learning experience.

Brown and Long (2006) postulate that rooms should be flexible (as do Jamieson *et al.,* 2005) so that they can be reconfigured quickly for discussion groups. Jamieson *et al.* (2005) also discuss the sizes of lecture theatres required and say that in the future there will be a need for fewer large lecture theatres and more rooms that accommodate, "…one-to-one, small group, and large group activities" (Lippman, 2004; Lippman, 2003). These small spaces may be designed with fixed elements that can be varied in size to support individual and group activities.

Shabha's (2004) belief is that university buildings should be flexible to accommodate various different learning activities and their locations and timetables. This means that spaces should be designed to accommodate the majority of activities performed by, "…over-sizing of spatial provisions and greater similarity and uniformity of areas to accommodate change in use and function" (Shabha, 2004:84).

Adaptable spaces can be designed for use by smaller, more interactive classes, by providing a level-floored area at the front of raked lecture theatres, where tables and chairs could be situated for use in the lecture, or rearranged for tutorials or project groups. These "new" lecture theatres should be available for students to occupy outside of class times to enable individual or collaborative work with other students

and increase the usefulness of the space. Lecturing spaces should accommodate students with laptops or other portable technologies (Jamieson *et al.*, 2005). A learning institution needs spaces which offer the possibility of both formal and informal interaction, these spaces should be located close to classrooms and faculty offices and should be attractive according to Jamieson *et al.* (2005).

Ways in which rooms can be made more flexible were explored by the JISC (2006), and found to be as simple as widening doorways and passages, using flexible furniture and open-plan spaces. Shabha (2004) described the optimisation of flexibility by ensuring flexibility of furniture, equipment, cables, and allowing the learners to adjust their learning spaces to meet their own needs.

2.5.2 SOCIAL LEARNING

Based on their study, Brett and Nagra (2005) determined that due to the expense of fitting-out computer environments, these spaces should be designed in a way that encourages productive learning, and spaces provided for PC-based self-study should have clustered arrangements to allow collaborative group work on individual PC's. They say that the layout of the room should encourage interaction, because students' perceptions of learning were found to be affected by the way the room is organised (Brett & Nagra, 2005).

Conversation is an important part of learning and in the traditional lecture classroom conversation is restricted or non-existent. "At the break, or end of the class, the sometimes painfully silent classroom will suddenly come alive with spontaneous conversation among students" (Kolb & Kolb, 2005:207). The *Whole Building Design Guide* (Norris, 2006) points to the need for, "social buildings" because of the importance of collaboration spaces such as break-away rooms, meeting rooms, atria and café spaces. The Design Guide postulates that every space built in an institution is a potential collaboration space (Norris, 2006).

2.5.3 ACCESS TO TECHNOLOGY

The introduction of new CITs to higher education has complicated the nature of the learning environment and the participants' relationships to it. These environments include both physical places and electronic spaces, where things like video

conferencing creates electronic classroom environments made up of multiple places and groups linked in real-time interaction (Jamieson, 1998 as cited by Jamieson *et al.*, 2000). So students may be sitting in a physical place with other students and a teacher, while working with physically separated participants (Jamieson *et al.*, 2000).

There is a movement towards allowing access to technology and encouraging students to use that technology in an integrated way within their day-to-day activities. This is achieved by making access to technology a priority, with more visible and open access. Providing workstations in entranceways and other high traffic areas is one way of encouraging the integration of technology into students' learning lives so that learning is seen as integral to daily life (JISC, 2006). Wireless connectivity everywhere on campus means that learning with access to the Internet can happen in any location that students choose, and is not confined to designated rooms (Brett & Nagra, 2005). In the future, the best way to get students to learn in a collaborative way will be to provide a wireless campus and laptops to all students (Brett & Nagra, 2005).

Brown and Long (2006) determined that, with the right approach, that is designing spaces based on learning principles and the use of personal devices, the entire campus can become a learning space. Schifter and Stewart (2010) say that in the past tutors did not encourage the use of technology in pedagogy, but now university lecturers are requesting workstation capacity in learning spaces and are employing virtual technology to expand learning outside the classroom. They also suggest that the advent of the World Wide Web in 1993 created the biggest transformation in availability of media in the classroom (Schifter & Stewart 2010).

Internet enabled learning spaces give access to information from many authoritative sources to all involved in education (Schifter & Stewart 2010) and therefore design of higher education spaces cannot feasibly be done without including available technology and making provision for future technologies.

2.5.4 INTEGRATED LEARNING SPACES

Brown and Long (2006) talk about a trend toward "human-centred design" with an increasing emphasis on the actual users and the range of services that students

require. Since there is such a proliferation of information technology, the focus of design has to shift from the provision of basic access to technology, to one of providing integrated services that assist and enhance the learning process. Their idea is that a learning commons of, "…integrated support services, including assistance for research, computing, writing, media preparation and production" should be explicitly designed with spaces for both individual and group work. Food and drink can be integrated as well, which serves to further humanise the space.

Specific locations could be created that encourage "metacognition" whereby the learner's own assessment of their learning can be done with the instructors help. Brown and Long (2006) go on to suggest that locating faculty offices near to the learning commons might facilitate the easy access of students to mentors (Brown and Long, 2006). This is the same principle as Jamieson *et al.*'s (2005:20) integration of functions.

Further ideas of Jamieson *et al.* (2005) are that today's students are adults and they expect to be allowed to make decisions about eating and drinking in study areas. To this end they should not be restricted unless there is a health and safety risk. Therefore in the opinion of Jamieson *et al.* (2005), outlets for purchasing food and beverages should be conveniently located to prevent loss of study time in their acquisition.

As far as integrated spaces are concerned, a good example is the "learning café" which is financially viable (the profits cover the maintenance costs) and an excellent environment for student learning (according to the students themselves). The learning cafe was created at Glasgow Caledonian University in 2002 with a pleasant setting, which allows for socialising, learning and eating to take place all in one space, simultaneously. There are many modern computer terminals and laptop stations, which allow for either individual or group study to take place, as well as coffee-table settings for more informal conversations, making the space the ultimate location in terms of flexibility. To this end students are actively encouraged to mix socialising with their studies, "…and links to mind-mapping software introduce an essential tool for learning support. Likewise, thin-client

technology keeps background noise and heat from computer drives to a minimum" (JISC, 2006:5).

In terms of the idea of an integrated campus, Jamieson *et al.* cite Peter Radloff (1998) and his advances of the idea of a "learning ecology" to encompass the multiple dimensions of a student's on-campus existence which directly affects their learning experience. They explain that Radloff's concept, "…takes us beyond the walls of the common teaching facilities into the greater campus environment." Their opinion is that the campus environment has not been a primary concern in literature which deals with the teaching and learning process in higher education. They cite Marton & Saljo, 1976; Entwistle & Ramsden, 1983 and Biggs, 1993 as authors who have noted that there is an absence of concern with the "place of teaching and learning" since the 1970's, but that in the 1990's the idea that teaching and learning was context dependent was put forward, but the concept of "context" was narrowly defined to be that of the classroom climate (Biggs, 1993).

Coulson *et al.* (2011) looked at the university environment and wrote about the design of spaces having to be made on "an institutional-wide basis", in order to promote the "greater aims and values of the university as a whole", and the fact that an "emotionally compelling campus" (Coulson *et al.,* 2011:235) would go a long way to ward off competition from other institutions and can have a real impact on the learning ethos of the student community (Coulson *et al*., 2011).

Quinn (2012), in his book *The Mobile Academy mLearning for higher education*, draws attention to the fact that the student experience can be improved through studying opportunities in the broadest possible sense using the Environmental Scan.

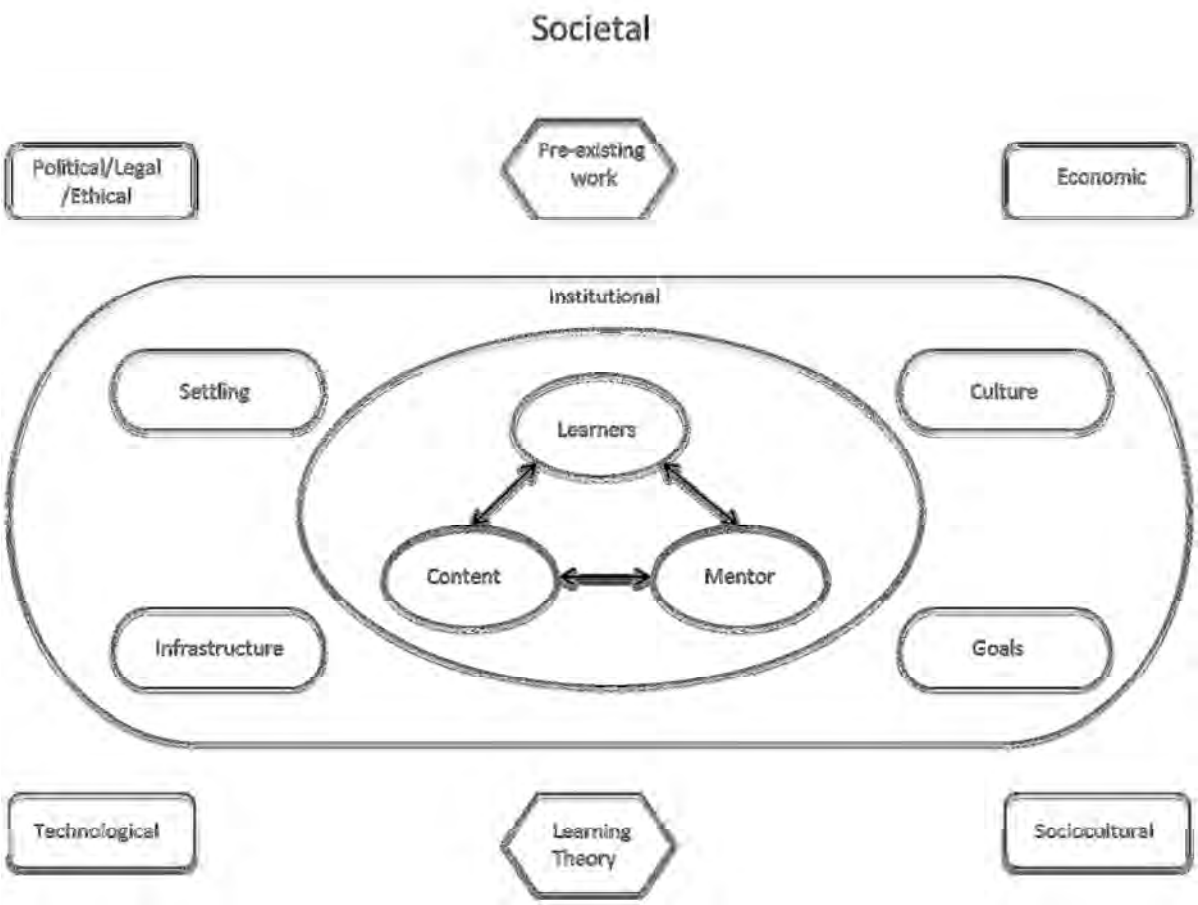

Figure 3. Environmental Scan (Source: Quinn, 2012, 40)

This diagram shows the impact of societal factors on the learning experience (Quinn, 2012). In the centre is the interaction of students with mentors and their course work which are housed in the institutions' wider strategy, entirely encompassed in societal constraints. Quinn is hypothesising that the opportunities to integrate technology into the design of university spaces must take into account all factors including economic constraints and students' access to mobile technology.

Kolb and Kolb (2005) talk of students taking control of and responsibility for their learning which can, "enhance their ability to learn from experience". They say that in order to implement the learning space principles that allow students to do this, "requires a holistic programme of institutional development" and that the vision of the institution must be taken into consideration (Kolb and Kolb, 2005:209).

2.5.5 FINANCIAL VIABILITY

"Organisations all face pressure to deliver higher standards of education, to greater numbers of students, with tight financial restrictions, but still need to provide facilities that will attract students in a competitive market" (JISC, 2005:6).

The JISC (2006) findings state that the provision of university buildings is a costly business, which is fairly obvious, but it tries to find ways to mitigate the costs by recommending that spaces are designed to accommodate both current and evolving pedagogies with the ability to re-assign uses to spaces in order to future-proof them.

2.6 CURRENTLY AVAILABLE SPACES

The examination of the literature encompassed an evaluation of spaces that are currently being provided by universities to assess whether indeed an 'ideal space' is being provided, given the changing nature and use of technology in the field of education. It appears from the standpoint of the available literature that at this point in time, the spaces provided by HEI's have been in use for a while, and probably due to economic constraints have not been redeveloped to effectively integrate the latest technology nor the current pedagogical epistemologies. Both Jamieson *et al.* (2000) and Shabha (2004:79) state that current facilities are under-utilised between scheduled classes, and that they lack flexibility for students who have total flexibility of location and time, thanks to the advent and use of IT. This means that these students have to work in libraries that are not generally designed for collaborative work within large groups (Jamieson *et al.*, 2000).

Learning is occurring more and more in virtual ways, according to Shabha (2004), with both collaborative and individual learning styles changing and becoming more iteratively spiralled instead of linear. This results in the need for fewer traditional classrooms, and the role of tutors to be that of facilitative leaders acting as counsellors. Existing spaces in buildings are not fulfilling these needs or the changes in technology. But as far as the design of new space is concerned, Brown & Long (2006) think that there is a movement towards active and social learning spaces with an interest in informal learning spaces which are recognised as being,"…particularly

conducive to working spontaneously and deliberately in small or medium-sized groups" (Brown & Long, 2006). These spaces incorporate wireless networks and plasma screens supported by IT (Brown & Long, 2006).

2.7 THE DESIGN PROCESS

In the experience of Jamieson *et al.* (2000), teachers and students rarely have meaningful input into the design of their facilities. Redesign of existing facilities is often led by an institution's facilities management staff, "…whose primary goal is to install new equipment while maintaining a room's established use". Where, in lecture theatres, whiteboards have been replaced by expensive projection facilities the result is the reproduction of the existing architectural-pedagogical paradigm (Jamieson *et al.*, 2000).

Jamieson *et al.* (2000) describe how architects who have worked without the input of teachers and students to create purpose-built cross-campus video conferencing classrooms have merely used the traditional theatre-style, teacher-centred model. They postulate that this "less than optimal" outcome is due to the builder/ project manager and facility manager controlling the process. They also cite lack of funds, strict building codes and regulations as reasons for the lack of a "participatory or social form of design process" (Jamieson *et al.*, 2000). Brown and Long (2006) believe that the emphasis in the design of spaces has shifted to "supporting learning activities" and so they believe that students and faculty who are the experts in this field should participate in the design process which should be driven by learning needs and not by the management of capital *i.e.* built assets. They believe that the clients who will use the space must be identified and an analysis of the pattern of use of the space is essential. Often a number of departments use the same classrooms for resource efficiency but the amenities and technologies are not inherently user-specific, so no one group's needs are optimally met (Brown & Long, 2006). Contrary to this, Norris (2011) feels that on many campuses, faculty, researchers, staff and architects are already collaborating to create new forms of learning spaces. These new spaces place the focus on flexibility and the ability to

accommodate multi-disciplinary learning, and enjoy the utilisation of support services.

The modern approach to education is to allow for more collaborative learning, but often the design of the learning spaces does not support this. It is important for discussion to take place with regard to the needs of the educational institution in regard to the preferred method of educating. It is also necessary to ensure there is acceptance by staff to the changes in methodology and thus in the design of spaces to support the new methodology. Most learning spaces will need to allow for both teacher-led and student-led education, which means they must allow for discussion, interaction, presentations and collaboration. In some versions different rooms are dedicated to different purposes and in others the open-plan space is utilised in various ways to support all methods of learning (JISC, 2006).

2.8 THE FUTURE OF HIGHER EDUCATION SPACES AND TECHNOLOGY

Peter Drucker famously made the comment that "the modern university is a relic that will disappear in a few decades" (Norris, 2011:33). Norris also cites others as saying that higher education is similar to a real estate bubble "waiting to burst" (Norris, 2011:34). To overcome this problem he suggests that some reinvention and re-imagining of institutions' "learning, research, and collaboration systems and processes" will be required to keep them relevant (Norris, 2011:34).

Goldstein (2006) makes reference to Drucker's viewpoint and agrees that there will be a diminishing need for certain types of students to use built campuses but the results of his studies showed that most Respondents were confident about the future survival of higher education institutions and the ability of technology to enable a variety of communication methods and access to information with resultant enhanced productivity. Higher education institutions need to enhance access to the Web in lecture theatres, and upgrade internet access. Teams of assistants must be created to support the faculty in using the technology in order to ensure its effective use (García-Valcárcel & Tejedor, 2009).

Brown & Long (2006) talk about the increased emphasis of design on the different ways that learning can take place, other than the traditional layout of auditoria and lecture halls which don't allow for student interaction and discussion, but merely serve to optimise instructor transmission. "Personal response systems, video-conferencing capabilities, floor plans that foster face-to-face contact among students, technology that supports the sharing of computer screens, and virtual whiteboards indicate a shift in learning spaces to support how people learn" (Brown & Long, 2006: 9.3).

The JISC states that although it is unknown how technology and education will develop in the future, plans can be made to accommodate change by designing learning spaces which are able to support a variety of learning styles. This design would concern an investment in mobile technology and configurable furniture to support video conferencing for large groups or dispersed groups (JISC, 2006).

It is expected that in future learning will involve multiple endeavours and actions and that a learning centre, which accommodates these will be designed with spaces for social activities, study, reading, IT use, collaboration and even "board room" style spaces for practicing presentations. This type of learning centre is shown in the 'integrated learning space" image of figure 4. Teaching may also take place within these environments. The focus would be on aspects which foster creative methods of learning and thinking (JISC, 2006).

Norris says that, "The future campus technology environment will likely include new embedded and mobile tools." With many changes being documented by Educause and various authors (Oblinger, 2006, Valenti and Mitchell, 2002) the proven formulas of optimal classroom/lecture hall mixes found in traditional institutions is changing. Technology is being embedded seamlessly into spaces (Norris, 2006). In his visionary book, *City of Bits: Space, Place, and the Infobahn*, William Mitchell describes how the function specific nature of buildings in institutions is changing due to technology's ability to provide flexibility in time and place and seamless movement between functions (Norris, 2006). Many new buildings are seen as "expeditionary," that is, their configuration is progressively being changed to address evolving needs

and preferences. At the same time, campuses are placing greater emphasis on retrofit, infill, and ways of enhancing existing spaces (Norris, 2006).

Figure 4. Integrated Learning Spaces (Source JISC:2006)

2.9 REFLECTIONS ON THE LITERATURE

The literature review looked at the types of technology used in teaching, how students learn, the impact of e-learning on space and how spaces are being designed today in higher education institutions to bring all these phenomena together.

In terms of technology, the literature pointed to the fact that most students have mobile devices, including smart phones that can be used for educational purposes and that these portable devices need Wi-Fi support to enable them to work anywhere on campus (Brett & Nagra, 2005). *M-learning* describes the use of

portable technologies such as handheld computers, MP3 players, notebooks and mobile phones and iPads which can be used as cameras, GPS devices, personal organisers, for Web searches and text messages in the learning environment (Norris, 2010; Quinn, 2012). There are many forms of software and applications that can provide real time connectivity such as Skype, Twitter, Whatsapp, podcasts and more. These platforms allow lectures to be broadcast to people off campus and also enable collaboration among the learning community. The advent of the World Wide Web made all of this possible.

There is evidence in the literature that universities abroad have become "technology-rich environments" into which students and faculty can connect anywhere on campus (Norris, 2010). Provision of technology by the universities themselves take the form of SMART boards, projectors, video conferencing, virtual reality, gaming and simulation with computer laboratories set up and networked for ease of use in instruction.

In terms of learning epistemology, today's students are known as the Net Gen, people who are problem solvers, who, according to Harasim (2012) view knowledge as, "…dynamic and evolving, not static and finite" (Harasim, 2012:83). What the literature is therefore telling us is that there is a different type of learner in modern higher education institutions who holds expectations of being able to be constantly in contact through the internet with other students, friends and various sources of information. The themes of social learning and collaboration flow through the literature. Educational writers refer to the changing pedagogy, a paradigm shift from didactic lecturing methods to a more collaborative style of teaching. Students are now involved in the creation of knowledge through collaboration and social interaction. They are technologically savvy and take part in interactive communication enabled by being connected to the world through the internet. The Net Gen learners are multi-taskers who study and socialise simultaneously.

The use of technology in education has led to the finding that spaces should be flexible (Jamieson *et al*., 2000) to accommodate the changes in technology and their potential impact on teaching and learning styles. Jameson *et al.* (2010) propose that spaces be designed to have multiple uses concurrently and consecutively, maximum

flexibility, integrated functions, and maximum user control. Many authors agreed with the need for flexibility of learning spaces (Brown and Long, 2006; Jamieson *et al.,*2005), (Lippman, 2004; Lippman, 2003), (Osmond, 1957), (Shabha, 2004) JISC (2006). This translates into the need for smaller adaptable spaces for interactive classwork with flat floors, that can be used in various ways by various different users even outside of formal class times. There appears to be a movement in design towards active and social learning spaces and informal learning spaces (Brown & Long, 2006). These spaces incorporate wireless networks to allow connectivity.

There appears from the literature to be a move towards the adoption of "collaboration spaces" (Norris, 2006), such as break-away rooms, meeting rooms, atria and café spaces. Today's students are seen as responsible people who can be trusted to make decisions about eating and drinking in study areas, so a "learning café" such as the one at Glasgow Caledonian University which allows for social interaction, learning and eating all in one space and all simultaneously, has become possible and even desirable. Computer terminals and laptop stations allow for either individual or group study to take place, and coffee-table settings allow for more informal conversations. According to JISC (2006) these learning cafés are found in many institutions in Europe and are very successful.

Coulson *et al.* (2011) looked at the university environment and wrote about the design of spaces having to be made on "an institutional-wide basis" to align the campus design with the overall strategy which they believe is necessary if a university wants to attract and keep the right kinds of students and staff to fulfil its objectives.

From the literature it appears that university spaces are generally out-dated, and probably due to financial constraints, do not get regularly redeveloped to accommodate the changing pedagogies and available technology for teaching. People believe that traditional higher education buildings are becoming white elephants, but as a result of an increase in student numbers, all of whom need to be accommodated, the larger lecture theatres are still useful for delivering a single lecture to a large audience in one sitting. Although there are various ways of providing education at tertiary level, there will probably always be a demand for

contact universities with face-to-face lectures, which will mean that the current venues can be used as they are, provided that they are given the technological backbone necessary to address the needs of the future educational environment.

These reflections lead to the research questions to be posed to South African HEI's, namely:-

1. What is the leading pedagogical epistemology of the day?
2. How is technology actually being used in teaching and learning?
3. What spaces are being provided for learning in today's HEI's?
4. Do these spaces allow for the use of the technology in teaching?
5. Does the provision of space by HEI's conform to the South African Department of Education space norms and do these norms keep up to date with changing pedagogies and teaching technology?

CHAPTER 3 : RESEARCH METHODOLOGY

3.0 INTRODUCTION

This chapter sets out the selected research design and methodology based on the research objectives. A justification of the research method is offered which will show a direct link between the design of the research method and the fulfilment of the research objectives.

The research objectives are:

1. To establish what technology, available today, is suitable for teaching.
2. To establish what the leading pedagogical epistemology of the day is.
3. To establish how technology is actually being used in teaching and learning.
4. To establish what the impact is of e-learning on learning spaces.
5. To find out what spaces are being provided for learning in today's HEIs.
6. To see if the spaces provided allow for the use of the technology in teaching.
7. To establish if the provision of space by HEI's conforms to the South African Department of Education space norms and do these norms keep up to date with changing pedagogies and teaching technology.

3.1 RESEARCH METHODOLOGY

Research methodology refers to the procedural framework within which the research is conducted (Michell, 2012). This framework is divided into the research paradigm, the research approaches and the research method.

3.1.1 RESEARCH PARADIGM

Bhattacherjee (2012) draws on Burrell and Morgan (1979) to explain that the "philosophical assumptions" of social science researchers can be described as being based on their ontology and their epistemology. Ontology describes the paradigm from which the world is viewed by researchers, whereas epistemology refers to the way they study the world (Bhattacherjee, 2012).

The ontology of this research paper is constructivist in that it is based on the assumption that human experiences shape social realities and contexts, which is a qualitative paradigm. This leads directly to a case study being a suitable method for gathering data in context. Punch (2005) gives the "general idea" of case studies as being that one or many cases are studied in detail using, "whatever methods seem appropriate," in order to develop a deep understanding of each case. As the case studies are qualitative in their approach, they allow the researcher to gain insights into particular phenomena and to develop theories about the phenomena (Leedy & Ormrod, 2001).

The epistemological view point of this research is interpretivist in its attempt to study the phenomenon of the provision of space at HEI's through "subjective interpretation" of the responses to questions of various participants involved in the process (Bhattacherjee, 2012). The YouTube video entitled *Writing a Methodology Chapter* describes interpretivism as being, "…usually more exploratory which contains observations, and approaches the data with questions" (Sheridan, YouTube). Using an interpretivist stance will produce a holistic and deep understanding of the social phenomenon being studied.

3.1.2 RESEARCH APPROACH

One approach to building a research theory is to follow a "bottom-up conceptual analysis" of a given phenomenon. This approach may be based on observation or prior knowledge, but either way it relies on the ability of the researcher to abstract an explanation for certain behaviours from evidence gathered (Bhattacherjee, 2012). This approach is known as inductive research which unlike deductive research does not begin with the formulation of a hypothesis (Michell, 2012).

The inductive approach is particularly relevant to the question of what spaces HEI's are producing and why they are doing so because the data may be easily manipulated to fit into a theory if one is pre-selected in a deterministic approach. Further to this is the fact that the literature is mainly produced in foreign countries and the data relates only to South Africa, and in fact Gauteng, and as a result any theoretical view point derived from the literature is most likely not directly applicable to the South African context.

This research report does not attempt to test a hypothesis because, as Punch (2005) pointed out in his book *Introduction to Social Research,* there is a case for not using hypotheses "for their own sake". He proposes that the researcher asks if answers to the research questions can be reliably predicted or not, and if not then one should "just proceed with the business of answering the questions" (Punch, 2005:38). This research poses questions derived from the literature and attempts to establish the current South African situation by looking for answers from three tertiary education institutions.

3.2 RESEARCH DESIGN

Punch (2005) describes research design as an "overall plan for a piece of research which has four main themes, being: "the strategy, the conceptual framework, the question of who or what will be studied, and the tools to be used" (Punch, 2005: 142). Bhattacherjee describes research design as the "blueprint" for research (Bhattacherjee, 2012).

The strategy (Punch, 2005) to be used is that of an interpretive case study. The conceptual framework is "usually best shown as a diagram" (Punch, 2005: 53) but can be described in narrative form according to Punch (2005) and its purpose is to show the relationship of the main concepts to each other. The main concepts explored in this study are set out in the form of questions. The conceptual framework of this case is as follows:

- Define technology;

- Explore all technology, hardware and software that could be used for educational purposes;
- Establish how students are being taught and how they learn;
- Decide what technology is suitable for these modalities and whether that technology is in fact being used;
- Look at how this technology impacts the design of space, if at all;
- Look at how the teaching methods impact the design of space;
- Find out what spaces are being built at HEI's; and
- Analyse the findings to see if the spaces provided are suitable for technology used in teaching and learning.

The question of whom or what will be studied is addressed through the consideration of three factors; they are geographic location; student/subject diversity and the relative importance of the institution. The research problem needs to be answered by looking at Higher Education Institutions and the decision of which institutions to study was made by the close proximity (to the researcher) of three of the largest, most important institutions in the country being in Gauteng. These institutions also have the maximum diversity of face-to-face teaching institutions in the country as far as areas of study, students and faculty are concerned. A more detailed explanation of the cases and the units of study is offered under the heading Case Study Design.

The last aspect of Bhattercherjee's "blueprint" is what tools will be used, of which interviews will be the primary one. Tools are discussed in more detail under the case study design heading.

3.3 RESEARCH METHOD

The research method is qualitative in line with the context specific nature of the study and the need to gather in-depth data on the subject matter. Punch (2005) describes the two main methods of qualitative research design being case study research and ethnography.

As this study is one of a contemporary nature, looking at what spaces are currently being produced by HEI's, the case study strategy is very useful because the "relevant behaviour cannot be manipulated" (Rowley, 2002). According to Rowley (2002) case studies, "…may offer insights that might not be achieved with other approaches" (Rowley, 2002: 16). Case studies are helpful in answering "How?" and "Why?" questions so they can be used for descriptive research (Rowley, 2002). The case studies will be comparative case studies across three South African universities with the objective of comparing what sort of spaces each HEI provides for teaching with technology, what technology is used in learning at each institution and how these institutions combine spaces and technology. The decision to use three universities as cases is based on Yin's (2009) statement that, "…evidence collected through multiple-case studies is more compelling and robust than that collected in single case-studies" (Yin, 2009).

Several case studies have been undertaken in the field of educational spaces and education and technology. Day (2012) in his MSc dissertation on the *Role of Facilities Management in HEI Space Provision* stated that, "…the case study is a method that has been employed elsewhere in research conducted on learning spaces" as part of his justification to use this method of research (Day, 2012). Girvan and Savage (2010) used case study strategy in their paper, entitled *Identifying an Appropriate Pedagogy for Virtual Worlds*, because they felt that case studies would give them an, "opportunity for in-depth exploration of a specific learning activity" (Girvan & Savage, 2012; 344). Bennet *et al.* (2012) used case studies to find out how Web 2.0 technologies were being implemented in higher education in Australia because in this way they could gather in-depth data in naturalistic settings and the cases could be understood independently, or cross-case comparisons could be made. In their study on technology and distance learning at Harvard, DeLacey & Leonard (2002) used case study as a strategy because cases are, "problem-based explorations of real-world experiences" (DeLacey & Leonard, 2002:2).

3.4 CASE STUDY DESIGN

In the collection of data for each case, various sources of information are interrogated such as documents, interviews are conducted, and observations made in an embedded design (Yin, 2009) which will afford the opportunity to find consistency of evidence from sources within the case. Three universities are studied because “replication logic” (Yin, 2009) will in all likelihood reveal similar for all three cases.

Contact universities have been chosen because, by their very nature, they are obliged to provide space for teaching and learning and the institutions chosen do so for large numbers of pupils in a range of subjects. Each institution is treated as a unit of analysis because the study is about higher education institutions holistically across faculties and the case of technology being applied to teaching is not unique to any one discipline.

The main tool used in the case studies is the interview. Within each case a wide range of participants is interviewed to gather information on each of the stated objectives. The choice of individuals to interview is determined by the research objectives. Lecturers and faculty answer questions posed on pedagogy. Facilities managers answer questions on the provision of spaces and the universities strategy. IT departments are consulted on the provision and use of technology on campuses. External consultants involved in design and development of spaces are interviewed where possible. Interviews are tailored to suit each individual’s role in the provision of space at the university. Further, the questions asked of participants are posed against a backdrop of the literature study which revealed the types of technology being used around the world in HEI’s.

Interviews are semi-structured in order to gather the information needed whilst not leading the respondents to a biased response and yet preserving the depth of knowledge of each participant. In order to ensure that the method has internal validity, questions are designed in such a way that respondents are not led to a conclusion, but freely state their opinions and describe their experiences.

The external validity or generalizability of the study is obtained by choosing interview subjects from different institutions and by allowing respondents to give detailed accounts of their experiences and these “thick descriptions” (Leedy & Ormrod, 2001:106) will give enough detail to allow conclusions to be drawn by the reader. Respondent validation takes place once conclusions have been drawn to ensure that interview responses are correctly interpreted.

Research participants are informed of the nature of the research report and their potential involvement in it before the interview takes place. There is no hidden observation, all participation will be voluntary and responses are kept anonymous to protect the respondents’ right to privacy.

The second level of investigation involves the perusal of several documents which are used to verify the information gathered in interviews to determine the internal validity of the responses. Documents are a source of evidence for case studies (Yin, 2009). These documents also provide another level of depth to the information provided by interviewees. Documents are chosen that give information on university policy to establish what each university’s strategy is regarding technology and pedagogy and the strategies for planning and development of learning spaces. These documents are sourced through systematically searching university websites and making specific enquiries about the existence of documentary evidence alluded to in each document that is found, or interview that is conducted. In other words, a trail is followed to find the relevant documentary evidence (Yin, 2009).

3.5 LIMITATIONS OF THE CASE STUDY METHOD

The choice of cases to study and the limitation or boundaries of the cases must be carefully made and well defined. In this situation each university represents a case and the boundaries to each case are limited to information gathered first hand and documentary evidence which is directly related to each case.

The matter of authenticity is one to be wary of, in that the researcher should allow the results to speak for themselves and not slant the data to validate any personal or political beliefs. Yin (1994) identified three reasons why case studies may be

challenged, one is a lack of rigour, two is a lack of scientific generalizability and three is the length of time case studies take to complete. These are valid concerns that are addressed here by limiting the number of cases studied, choosing mainstream universities for ease of generalizability and limiting the number of interviews undertaken to shorten the time spent gathering data. The question of rigour is addressed by the study of authentic university publications to corroborate interview findings.

3.6 ANALYSIS OF CASE STUDY FINDINGS

The general analytical strategy that this report follows is to rely on the objectives of the report to guide the analysis, in this way emphasis can be placed on the data that is relevant to answering the overall research question. A lot of extraneous information that is revealed by interviewees can be disregarded. A system of pattern matching (Yin, 2009) is used on the pertinent data to establish valid answers from a range of sources which reveal a pattern that describes the case accurately, “multiple observations must converge” (Soy, 1997).

In the first instance the interview transcripts are “mined” for information relevant to this report. The results of this exercise are captured under the headings of the research questions they are able to answer in a general way. A second interrogation of the data takes place in an attempt to maintain the richness of information gathered. The responses from each interview are compared with the other interviews to see if they correlate. Once this process is completed, this corroborated data is used as evidence. The information gathered in studying the available documentation from each university is distilled into the relevant research questions and presented under headings of the document from which they are obtained. The full case is then analysed for corroborative information from both interviews and documentary evidence. Each case is individually analysed in this way and presented in Chapter 3.

Chapter 4 contains a comparison of the findings of each case set against the findings of the literature. A conclusion is drawn for each case in a summary of the research questions.

Lastly the results of the three sets of findings are compared to test if there are commonalities that run through the cases and an assessment is made as to whether these results can be generalised to all HEI's in the country.

CHAPTER 4: CASE STUDY REVIEWS

4.0 INTRODUCTION

Three HEIs were used as case studies. The HEIs had to be contact institutions with large built asset bases, and internationally recognised courses in order to give credence to the findings. Time and travel limitations meant that only three case studies were undertaken.

The first contact that was made at each university was arranged through UCT and this led to interviews being set up with lecturers in the Built Environment departments of each university. The first respondent in each case recommended other respondents and made the necessary introductions. This led the interviewer to sources outside the universities who were directly involved in the creation of spaces at the HEIs. These interviewees had relevant insights into the process of space creation from a third-party perspective.

The majority of interviews were held at the institutions in a face-to-face manner which had the advantage of allowing the researcher to explore the campuses for first hand examination of the learning spaces. In one case, a key respondent had time constraints, so a telephone interview was held. There was one joint interview conducted with colleagues at a University which was then supplemented by a second interview with one of the respondents for the purpose of clarifying concepts and gathering further information about the particular institution.

Prior to each interview being held, the interviewee was asked to complete a consent form and assured of the anonymity of their responses, which led to open and honest answers being provided.

Secondary data was obtained in two ways. In some instances interviewees provided the documents and in others the documents were accessed on the internet. The relevance and validity of the documents was verified by various interviewees.

CASE STUDY ONE

4.1 CASE STUDY ONE INTRODUCTION

University one was chosen because of its prestige and location. It is included in the list of the top five universities in the country and is a contact institution with a large number of existing lecture halls. Strategically it aims to be highly attractive to good quality post graduate research students.

4.1.1 SECONDARY DATA – DOCUMENTATION

The following documents were reviewed in order to establish the strategic vision of the university in terms of technology and space:

1) Facts & Figures 2011/2012;
2) 2022 Strategic Plan;
3) Preliminary Development and Design Framework;
4) Academic Infrastructure Article;
5) Building a Better Campus;
6) Higher Education Infrastructure: The Case of University One.

FACTS & FIGURES:

The University, "…aspires to be a leading research intensive university firmly embedded in the top 100 world universities by 2022."

The University wishes to position itself as a springboard to open up Africa to intellectual achievement and claims that it is committed to,"…providing high-quality, internationally competitive education, founded on high academic standards, cutting-edge research, public engagement, and productive partnerships with leading institutions throughout the world."

This ethos was interpreted by Respondents as meaning that spaces provided will have to be designed in a manner that encourages post graduate students to complete their PhD studies at this university and that the overall environment of the university should be conducive to attracting world class students and faculty. Nothing was mentioned in the document about the technology that could be provided to achieve the University's goals.

VISION 2022

The Vision 2022 Strategic Framework explains the University's goals and strategy for the next ten years based on where it is now, what resources it has at its disposal and how it should review its approach to research, teaching and learning, as well as social engagement. It also explores various ways in which it may need to change in order to attain the stated goals.

The paper sets out the University's goal of becoming a leading internationally recognised research intensive institution, not explicitly explaining how this can be achieved, but merely setting indicators and benchmarks to track progress towards achieving this aim.

A pertinent goal of Vision 2022 is its aim to create a, "high-quality support environment and top-class infrastructure" for students and staff which will be conducive to raising the standard of research, the quality of teaching and the, "…rigour of intellectual and social engagement." Vision 2022 states that knowledge and innovation are drivers of change and that the speed of knowledge creation and the ease of access to knowledge through the internet means that there is an increased importance of research and development which translates into the university "selling" its innovations to generate revenue. It goes on to say that an institution is valued for its capital assets and more significantly for its human knowledge capital. It talks about a "knowledge based economy" which requires universities to keep up with the unprecedented rate of innovation and knowledge production.

In terms of support for students the paper states that this University will become a wireless campus and that all students will have laptops which will maximise their

access to information. Administrative systems will be available electronically and it will generally position itself as an “IT-savvy” university that uses technology to enhance its processes including student-staff engagement. The mobile technologies will make the university accessible from anywhere, at any time of the day, and although the university will remain a tutorial based contact university, learning and teaching will be reinforced through the, “…application of technology-enhanced pedagogy”. Researchers in particular will be supported by technology that enables them to carry out cutting-edge research which will enable work to be undertaken in, “virtual interdisciplinary teams”.

To achieve its strategic objective of enhanced access to information and research, University One will have a core IT department as well as an,“…e-learning team that is responsible for the application of cutting edge technology and pedagogy to teaching-and-learning”. Administrative support will also take advantage of the latest technology.

Further elements of the IT strategy are ensuring that every student has a computer that can be connected from any place at any time and that the students are able to use these devices to create knowledge in a connected manner. The University also aims to ensure that academics are adept at using IT for teaching, supervision and research. In terms of the infrastructure for the IT, the university wants to create a leading-edge system with an emphasis on electronic resource access and promoting greater connectivity with the global network of academic researchers.

Vision 2022 goes on to state that there is a shortage of financial resources at its disposal and in fact, as is the case around the world, supplementary government funding is dwindling, which naturally poses a significant problem for a research-intensive university. In order to mitigate this problem the university has to implement its “Financial Turnaround Strategy” and it’s “Strategic Resource Allocation Model”, both of which are designed to maximise any governmental subsidies it does receive. This maximisation process occurs through promoting efficiency in term of teaching and research outcomes, in order to maximise its generation of income by “selling” knowledge. The paper also refers to the Capital Development Project’s funding being supplied by government grants, philanthropy, alumni and private business donations.

BUILDING A BETTER CAMPUS

This paper states that Campus Development and Planning adheres to the strategic goals of the university which point to increasing the enrolment of quality undergraduate students, increasing the percentage of post-graduate/research students enrolled in degree programmes, becoming one of the top 100 universities in the world and attracting high quality academic and support staff. It then explains that the capital projects totalling R1, 5 billion that were recently completed would help achieve these goals. One of these capital projects is an undergraduate science centre which was built within a disused grandstand, in order to provide three laboratories with a total of 1,100 bench spaces, five lecture theatres (1,500 seats) and twenty tutorial rooms, with a total of 800 seats. The project received partial funding from the Department of Higher Education and Training (DHET). The lecture theatres used the grandstand tiers to create raked seating.

Other projects showcased in the paper are the completion of the forth quadrant of the Engineering building which was left unfinished since the 1980's, a new art museum, a renovation of a commerce building sponsored by First National Bank (FNB), known as the FNB building, and the Professional Development Hub. This paper's emphasis is placed on project and budget control, through the use on the NEC contract, which helps to manage the need for new infrastructure and the lack of funding.

HIGHER EDUCATION INFRASTRUCTURE EXPANSION PROGRAMME

This paper talks about the drivers of infrastructural development which includes a shortage of classrooms, laboratories, offices and residence accommodation due to the increased number of undergraduates enrolling each year, as well as the aging infrastructure and inadequately developed campuses. Capital has been invested in new buildings as well as in data connectivity and uninterrupted power supply systems; some of the funding for which has come from the National Research Foundation.

In 2008 universities were able to bid for infrastructure funding, provided the spending would allow increased enrolment and throughput rates, and the universities would

contribute up to 50 percent of the funding themselves. Because of a well-motivated bid, this University received 10% of the available funding from the DHET in 2009. At this point the University reconstituted its Capital Projects Programme, which serves to manage the delivery of projects and reports to the Deputy Vice-Chancellor: Finance and Operations. Its role is to co-ordinate project development by acting as a liaison between the design team and various university clients, as well as to provide project management expertise. A project steering team is set up for each project, in order to manage the needs of users and faculty stakeholders. From the academic side a project champion is chosen to act as the client, in order to develop a project brief, as well as to supervise the raising of funding.

A Capital Projects Steering Group, comprising of the Vice Chancellor (ex-officio) and various University Directors, serves to decide which projects get the go-ahead, based on the overall strategy and space needs of the university. This steering group is also informed by other working groups and committees, including a Space Allocation Committee.

Fundraising is addressed in the paper, which through experience, has revealed that the University has found a sustained effort has to be made by the academic champions of each project and the University top leaders in order to ensure sufficient sponsorship can be provided. However, even with this energy and commitment, some academic disciplines are not supported by wealthy sectors of the economy, and so no sponsorship may be forthcoming for those disciplines. To combat this, the University has developed finance models for projects that can generate income and repay loans. One method has been to use the University's capital to secure loan financing; while another is to use private sector turnkey solutions.

In order to aid decision making on which projects to pursue, a Spatial Development Framework was produced in 2009, which according to the paper, has been very valuable in terms of helping direct long-term decisions in keeping with the strategies of growth, reintegration into the city and linking the two separate campuses.

A PRELIMINARY DEVELOPMENT AND DESIGN FRAMEWORK

The Spatial Development Framework guides the spatial logic of the campus, makes the creation of good quality public space between buildings a priority, and looks at the quality of buildings and their "timelessness". These are all aspects that the paper identifies as lacking before the development of the framework. Importantly, the paper talks about the significance of the environmental quality in attracting internationally competitive staff and post-graduates in order to fulfil the goals set out in the strategy of remaining in the top 100 universities in the world.

The central ideas of the Framework are about how and where to create social spaces, and from here, how to enclosed public spaces with comfortable arrangements for meeting and socialising. Land and its asset value are highlighted in the need for efficiency of use, as well as the need for "pedestrian permeability" and the creation of a strong boundary for the campus. It also talks about expanding parking for student and lecturer vehicles and specifically the need for a parking garage on campus, or alternatively park-and-ride schemes that would make pedestrians dominant on campus instead of cars.

There is no mention of internet infrastructure or the need for Wi-Fi on campus in this Framework.

4.1.2 PRIMARY DATA – INTERVIEWS

Interviews were held with five individuals who were chosen for their involvement in the development of new facilities at the university.

The first Respondent, an architect who has completed significant amounts of work with higher education institutions, has studied the types of spaces that universities abroad build, and their reasons for providing these spaces. This Respondent is currently submitting architectural tenders for the design of university spaces and has an appreciation of the need for collaborative and comfortable spaces in which students can self-study. This architect is Respondent 1 in this case study.

The second Respondent is a Quantity Surveyor with many years' experience of involvement at this university in the redevelopment of spaces and the building of new spaces. He is currently involved in the construction of science laboratories and lecture theatres in a disused stadium on campus. He presented plans of these buildings and explained the stadium conversion process.

The third Respondent is a lecturer in the construction department. He is passionate about education and the new style of collaborative pedagogy that he finds far more effective than the old didactic style of teaching. He explained the pitfalls of trying to use technology in education from an educationalists point of view.

The fourth Respondent is the head of the Capital Development Projects (CDP) department which came into being in 2009, two years after the Department of Higher Education and Training (DHET) made money available to universities for large scale capital projects. At this time University One realised that the maintenance department could not adequately handle capital expansion projects and the work of day-to-day maintenance of existing infrastructure. Therefore the CDP was tasked with controlling infrastructure development, developing a spatial framework guideline and researching changes and faculty growth in response to the needs of the broader economy.

The head of the Construction Economics Department is Respondent 5 in this case study, due to his passion for redeveloping the courses in the faculty and for having been the project champion for the construction of the new Construction Department's building on campus. His experience of the campus development process was invaluable as was his passion for the creation of modern teaching spaces.

Information from interviews was distilled into five themes, listed below:

1. Technology useful for teaching and learning;
2. Pedagogical epistemology;
3. Technology in the classroom;
4. Types of learning spaces;

5. Learning spaces and the space norms.

4.1.2.1 TECHNOLOGY USEFUL FOR TEACHING AND LEARNING

Based on the responses from the interviewees in this case study, it is apparent that there is limited knowledge, among the case study one interview Respondents, in terms of the range of technology universally known to be useful for teaching.

Respondent 4 spoke about Wi-Fi and laptops being useful for teaching, but was weary about students in large venues using electronic devices because of the potential interference with teaching. He did however speak of a “magic spot” where technology enables teaching, but he said that the teachers are not ready for data views and SMART boards.

Respondent 1 described the podia that have been designed in lecture theatres for science students which house document cameras that can project images onto screens for ease of demonstration of formulas or objects. Network links are also being installed in venues to allow live broadcast of lectures over the internet and into various venues on campus simultaneously.

The students at this university have access to home computers and/or laptops, according to Respondents 3, 4 and 5, and are able to communicate with lecturers using a university specific web based application. There was however concern expressed by Respondent 4 that the use of laptops could create a security risk because students using public transport are vulnerable to theft.

4.1.2.2 PEDAGOGICAL EPISTEMOLOGY

Respondent 3 is involved in teaching at this University, designing curricula and training teachers. His aim, and what he says is the aim of the university, is to produce employable graduates who have been inculcated with the,“…key knowledge areas combined with personal, interpersonal and professional skills.” In order to do this he feels that teachers need to be trained to use, “…student-centred instructional approaches”. Respondent 3 feels that most students don’t remember much from their actual lectures, and that group work among students is a far more effective way

to foster actual learning. This means that the teacher's role, in his opinion, is to give clear instruction and to motivate students.

Respondent 5 said that there is no longer a need for students to prove they can retain information, it is commonly available, it is now more important to be able to,"…access information, filter it, synthesise it and combine it in creative ways." Respondent 5 feels that the current infrastructural architecture still encourages a, "conservative pedagogy." He also spoke about the interactions between students and staff, and how in this instance technology can break down barriers, but can also create a buffer between students and faculty. In the case of electronic messages, responses can be delayed, unlike the physical process of knocking on a door, which demands immediate attention. Online platforms hosted by this university provide mechanisms for students and staff to interact.

4.1.2.3 TECHNOLOGY IN THE CLASSROOM

The interviewees were asked to describe what technology is currently installed in the lecture halls and classrooms. The answers indicate that this university encourages the use of technology in teaching, but is also cognisant of its limitations. It was further noted that technology used in a venue for undergraduates needs to be robust.

According to Respondent 4, the use of clicker systems is prevalent at this University, which in turn helps to gauge the audience's level of understanding during lectures. Plug points for every student to charge a laptop in every classroom was found to be impractical by Respondent 4 who was concerned with the amount of electricity that this would consume and the need that this would create for more electrical transformers which would translate into higher fees.

Respondent 3 teaches undergraduate and postgraduate students, and uses Whatsapp and Skype transcripts to communicate with students. He did however state that they are busy experimenting with Facebook, as a medium through which to keep in touch with alumni. This university has a web portal which allows students

and lecturers to communicate and download information and upload assignments as well as hosting chats and email communication.

Respondent 2 described the maths and science building that is currently under construction as having computer laboratories with power points for everyone, as well as Wi-Fi access. The proportion of the budget being spent on technology is increasing over time, but a balance has to be struck between “cost and flexibility” according to this respondent. Respondent 1 pointed out that it is difficult to use technology in a venue and have flexibility, due to the fact that the wiring for computers in desks and podia means that these cannot be moved around the room and remain electrically connected at the same time. Computer laboratories are flat floor venues with the computers supplied by the university, according to Respondent 1, because of the, “…specialised nature of the software required for teaching.” Respondent 5 also spoke of the trade–off between flexibility and the provision of power points and suggested that longer battery life in laptops was a potential solution. This respondent said that students are increasingly bringing their own laptops into the classroom and accessing the internet during lectures. He felt that this was positive because a whole range of outside knowledge can be brought into a discussion if there is constant access to that information.

Flat floor venues which used to be drawing halls in the architecture building are now being used as learning spaces, however screens and sub-screens have had to be added so that students can see demonstrations from the all parts of the venue. These rooms are not used as much for lecturing as for tutoring and demonstrations according to Respondent 1.

The Construction Economics building has Wi-Fi throughout the building, which extends to the outside, in order that the spaces between buildings can be used for informal student interactions. Respondent 5 was interested in the idea of utilising the spaces between buildings to create collaborative spaces for students to use outside of lecture times.

The shortcomings of current spaces at the university were felt to be, too few power points, poor lighting and ventilation, a lack of heating and non-flexible furniture. Respondent 3 was aware of projects being undertaken to look at the adequacy of

learning spaces at this University but also expressed the fact that lack of finance was the main limitation to providing what might be deemed ‘ideal’ or ‘correct’ spaces.

4.1.2.4 TYPES OF LEARNING SPACES

Flat floor venues that were previously used as studios for architecture students were found to be “unfriendly”, according to Respondent 4, who said that one concern was that the spaces did not have lockers or places to store things safely and that they were generally cold.

Computer labs are still a necessity according to Respondent 4,due to the need to teach some classes this type of setting, and also because it is difficult for the IT department to support a variety of platforms. Therefore it was concluded that it is generally easier to have everyone on one network.

This University is investing heavily in Wi-Fi according to Respondent 4, in order to create nodes of connectivity and that the, “…knock-on is going to come in the nature of libraries going forward”, which will become more like “information hubs” where people socialise, drink coffee as well as work in small groups. As such, in his opinion, libraries are becoming a, “…mix of social spaces and quiet spaces”. A good example of this is the Engineering library.

Respondent 4 spoke of “in-between” spaces becoming more important on campus because there is a need to create decent social spaces where students can get coffee and meet on an informal basis for collaboration. These informal meeting spaces also create opportunities for students and staff to interact, in the opinion of Respondent 4.

Because of the large influx of undergraduates in the early 2000’s there was a serious lack of large lecture theatres, according to Respondent 4. However he did not think any more such venues would be created because of the technology shifts and the lack of personal interaction in such venues. Having said this, Respondent 4 went on to describe the current construction of the School of Public Health which is creating a 400 seater raked lecture theatre for symposiums and industry engagement, as well as for large classes that are common to the Health and Education departments, which will share the space. There will also be flat floor spaces for the post-graduate students, which will be equipped with flexible furniture for easy reconfiguration for group work assignments. Respondent 1 also spoke of large student numbers and the need for venues that can accommodate up to 500 students, leading to the need

for lecture theatres to be raked for lecturer visibility. Respondent 2 is involved in the Health Sciences building where a 520 seater raked theatre will be created with two flat floor seminar rooms below it.

Respondent 3 believes that learning spaces that support an “integrated learning experience” need to make good use of technology and use different types of flexible furniture such as tables with wheels and chairs that are light enough to move around. He mentioned that the two flat floor rooms used by his department, both have flexible furniture, overhead projectors and screens, and they are used for peer instruction. A staff boardroom in the school also doubles as a presentation room for students to present dissertations etc., a SMART board is used in this room. Respondent 5 concurred that the boardroom is also used as a teaching space which was deliberately designed to mimic a corporate environment as part of the,“…socialisation process of preparing students for work life”. This boardroom with multiple uses blurs the line between teaching spaces and faculty spaces.

Respondent 2 described the types of spaces that have recently been created as the raked floor type, as in the grandstand refurbishment, and the flat floor type, as in the computer science laboratories. The computer labs in the PhD Computer Science building, currently being built, will have bench seating with power points to take laptops. The only raked floor theatre will be a 102 seater facility for Actuarial Science. This respondent said that flat floor spaces allow for greater flexibility and are more economical to build in comparison to most alternatives.

Respondent 5 talked about the new Construction Economics building that was recently opened, and described his vision for creating this building. In 2011 when the building was first being designed, there was a desire for raked seating lecture theatres for large scale lectures. However this Respondent determined that these venues were the “last thing we needed” and so he motivated that flat floor “drawing studios” were required, which are cheaper to build, so they ended up with studio space to teach in. The result of this is that the building has a 70 seater flat floor venue on the ground floor with a 60 seater above it for post graduate and small class teaching.

Respondent 1 was involved in the design of a library which did not actually get constructed because of a lack of available funds, however it was modelled on overseas libraries and based on the learning commons approach, which involves creating a small holding library, a large archive for books, and then in the library itself there are computers and coffee vendors. Respondent 1 felt that by constructing archives to house the books in a separate venue, existing libraries could be converted to learning commons style venues without the need to build complete new libraries.

4.1.2.5 LEARNING SPACES AND THE SPACE NORMS

Respondent 4 revealed that this university has a space planning office which has to report on the space norms annually. He said that they are useful as a guideline for being on the "right track" with space provision, but he is of the opinion that it would be more useful to attend to the, "…manner in which the programme is taught". In his opinion the old public works guidelines which supplied formulae on how many square meters to provide per student are no longer applicable because of the fact that there is a "scarce skill commodity" in highly educated people (PhD students) and they have to be attracted away from other universities. This means that they tend to be given whatever they want in terms of offices and study rooms.

Respondent 3 was aware of the norms, but was more concerned with whether the spaces created suited the type of instructional activities currently being used.

Respondent 1 expressed awareness of the concept of space norms, but said that although the Department of Public Works used to give a brief it no longer happens, and the fact that a lot of paperwork is involved means that people don't bother with them, except in the creation of offices and tutorial rooms. This respondent has travelled to overseas universities and says that these institutions use venues of similar design and technology to what is currently being provided in South African HEIs.

Respondent 5 said that the space norms were used for office spaces and stated that there are ways to change the layouts of the office precinct and still meet the space

norm requirements by creating large open circulation spaces adjacent to small offices, this forces staff to interact around a coffee station, but still provides them with private spaces for quiet work.

4.1.3 SUMMARY

University One has a number of existing large lecture venues which the Respondents concurred were necessary for lecturing large numbers of undergraduates, but according to Respondent 4, were not conducive to students engaging and challenging lecturers, which is necessary in the collaborative style of learning referred to in the literature. In the words of Respondent 5, "…these spaces force academics to teach in a more traditional way than they would like". Respondent 5 is of the opinion that changing the way of teaching should be enabled to some extent by the infrastructure. This respondent also alluded to the debate about what constitutes a teaching space and the fact that we should talk about learning spaces because he and Respondent 1 are of the opinion that teachers facilitate learning and that this can be done in all sorts of spaces, including park-like environments between buildings.

In all instances Respondents said that spaces are configured the way they are because of financial constraints and the way in which lecturers teach, which is largely didactic. The didactic style of teaching is used by lecturers who were taught in this way and merely replicate the method.

The provision of WI-FI on campus and learning commons' in the libraries ensures that all students have access to the internet and can therefore have unrestricted access to information, lecture notes, lecturers and each other. In this way technology enables collaborative learning.

This University wants to be recognised as a global top 100 research institution and realises that this means that it has to provide the infrastructure to support this aim. In this regard it would like to provide each student with a laptop, but contrary to this stated aim, it does not want to provide the electrical charging points required to charge all the mobile devices of its students simultaneously.

This university sees the spaces between buildings as useful for socialising and collaborative learning and wants to provide WI-FI to all such spaces.

Flexibility of lecture spaces is not possible, to a large extent due to the raked theatre seating style of lecture halls that exist on campus, and that are being developed for future large classes of students. In flat floor venues, flexibility is limited by the provision of power points.

Respondents felt that the architecture that exists across the campus encourages a conservative pedagogy, and cited financial constraints as the reason that this type of space continues to be developed.

CASE STUDY TWO

4.2 INTRODUCTION

University Two was chosen because of its size and location. As was the case with University One, it is one of the top five universities in the country and is also a contact institution.

4.2.1 SECONDARY DATA – DOCUMENTATION

University Two Strategic Plan 2025

This University has a Strategic Plan, which gives guidance on how to achieve the, "…vision and strategic goals it has set itself for the next 15 years". The purpose of the Strategic Plan is to ensure that the vision of the university and its role are not overlooked in the changing context of the global community. Within this plan are five-year cycles of plans to be implemented in the short term which will help to keep the university on course to reach its long-term goals.

The University opened in 1908 and started off with four professors, three lecturers and 32 enrolled students. By 2011, the University had enrolled approximately 45,000 contact students and 14,000 distance education students. The University expects this number to increase to approximately 75,000 by 2025.

This University is a broad based teaching institution with nine faculties and a business school. These faculties are: Humanities; Law; Education; Theology; Economics and Management Sciences; Natural and Agricultural Sciences; Engineering, the Built Environment and Information Technology; Health Sciences; Veterinary Sciences; and a Business School spread over six campuses.

The Strategic Plan cites its diversity of staff, students and programmes offered as its "overarching strength" and its aim is to become a leading research university.

University Two in a Nutshell

This document describes in detail each of the faculties of the university. In line with the vision of the university to become a leading research institution, this document outlines the number of postgraduates and the amount of funding spent on research.

In its desire to be a leading institution, University Two provides lecturers with opportunities to keep their knowledge up to date on all aspects of teaching, learning and the assessment of students. According to this document, this university also regularly updates its teaching facilities and,"…provides blended learning opportunities through multimedia and an e-learning management system."

This University was arguably the first HEI in South Africa to use technology-enhanced learning on a large scale though what it calls, "e-education, e-assessment and e-information". In order to facilitate the transformation of education, the university has a department for Education Innovation which provides consultants to each faculty for training in education principles and "innovative practices" and also trains faculty on its learning management system and computer-based testing environments. The Education innovation team also conducts research into teaching, learning and educational technology.

On the "H" campus there is a learning centre with online assignment support, as well as a research commons for postgraduates. Wireless hotspots are described as being available in "some areas" at the library and there are electronic catalogues of books and journals as well as training in the use of various IT programmes.

4.2.2 PRIMARY DATA – INTERVIEWS

Six employees of the university were interviewed in order to establish what the university currently provides in terms of space and technology for teaching.

Respondent 1 is a lecturer in the Construction Department with an in-depth knowledge of the recently built engineering faculty building, complete with parking garage and study centre, and the new lecturing centre which houses several raked lecture theatres for general use.

Respondent 2 is a Projects Planner in the Department of Facilities Management and is intimately involved in the development of new space at the university.

The third Respondent is a Quantity Surveyor in the Department of Facilities Management who focuses on small alteration work and produces estimates for budget purposes on large projects.

The architect in the Planning Division of the Department of Facilities Management is the fourth Respondent.

The current Head of the Department of Construction Economics is Respondent 5, while a member of the IT Department is the sixth Respondent.

4.2.2.1 TECHNOLOGY USEFUL FOR TEACHING AND LEARNING

Of the two respondents who are lecturers at this university, one considered technology for teaching to be limited to the web-based student portal (LMS) and the other was mostly concerned that the use of technology should not interrupt lectures (Respondent 5) and therefore prohibits students from using tablets and phones during lectures.

4.2.2.2 PEDAGOGICAL EPISTEMOLOGY

Respondent 1 referred to group work as something to be done in libraries and the Engineering study centre, not the classroom.

Respondent 5 was adamant that his knowledge and experience were imparted to students in lectures and that in order to do so he would only need his laptop with a

projector, to project slides onto a screen at the front of the classroom, and to lecture in a didactic manner. He does not support the notion that lecturers should load all their material onto the LMS, but that students should do their own research on the relevant subject matter. He also said that group work was too time consuming for the lecturers and should be limited to work done in tutorials.

From these responses it can be deduced that members of the construction department (and possibly other departments) of this university do not subscribe to the collaborative, knowledge building learning epistemology described in the literature as being currently accepted as educational best practise.

4.2.2.3 TECHNOLOGY IN THE CLASSROOM

Respondent 1 spoke about the LMS which is intended for lecturers to upload their notes to give students access to teaching material. He also spoke of doing away with "talk and chalk" and using laptops to project slides onto a screen. Computer laboratories on campus allow students to work anytime on the network with pre-loaded software packages. Wi-Fi hotspots around campus allow students to work on their own devices (Respondent 1).

Respondent 2 described the new lecturing centre as having "quite a bit" of technology, which he detailed as audio, loudspeakers, overhead projectors and screens, as well as document cameras mounted on the ceiling which allow lecturers to write on or place objects on a specially designed lectern, making it possible to project images of these things onto the screens for good visibility. There is also a system in place where the lecturer can project his laptop screen onto one large screen and project images of an object or a live experiment onto another screen simultaneously. This new building does not have plug points for students to charge their devices during lectures; however provision was made for retrofitting these.

Wi-Fi is already present in all faculty offices according to Respondent 2. While Respondent 6 spoke of a campus-wide Wi-Fi project which is underway and aimed

at extending the availability of wireless access on all campuses, with the focus on providing wireless access in open areas, study centres, cafeterias, and other student hubs. All registered students have access to the wireless network through their student accounts free of charge.

Respondent 6 concurred that lecture halls have a combination of Audio Visual equipment installed, which includes data projectors and screens. Some lecturers still make use of overhead projectors and screens, as well as black boards to write on, so these are also still available. Many lecture halls are fitted with a so-called "smart podium" which consists of a computer connected to the data projector and sound system for lecturing purposes. These podia also have Internet connectivity, a document camera and a light display to project transparencies. Large LCD display panels are also used where appropriate. Some lecture halls are equipped with network connections in the form of network ports at the desks.

4.2.2.4 TYPES OF LEARNING SPACES

Respondent 1 showed a preference for flat floor lecture theatres with fixed benches or loose tables that can be configured for discussion groups. In response to questions about in-between spaces, this Respondent said that because there is no space between buildings for students to use for recreation and group work, learning commons have been created in new buildings for students to use in their free time.

From observation, and discussions with Respondent 1, the vast majority of new spaces being created are raked lecture halls to accommodate large volumes of undergraduates. Group work spaces and individual spaces with computer access are being provided in study centres and libraries. The study centres incorporate areas for relaxing, socialising and drinking coffee. Respondent 6 described the study centres as having connectivity to the Intranet and Internet, as well as printing facilities; with some facilities also having Wi-Fi connectivity. According to Respondent 6, group work rooms in the study centres have large tables that seat 4-7 people and are equipped with display screens and network connectivity, in order to enable laptops to be connected.

Respondent 2 explained that the types of spaces created depend on the needs of the "client", this being the staff member that requests the space. He said that the new lecturing centre has lecture halls which were built to accommodate six hundred first year students in a single class, but that they are able to be subdivided by the addition of drywall partitions to create smaller 200 seat lecture halls, without the need for major alterations to the building. Space for first year students needs to be big and robust, as the building is expected to receive a lot of wear and tear from the 2,400 students who will use it every hour (Respondent 4).

The new engineering building, which was requested by the Engineering Department, houses a study centre which was seen as a necessity, due to the fact that students get to campus early in the mornings and leave late in the evenings, and as a result need space to study before and between lectures. There are three things the students need space for, according to Respondent 2. They are, study, eating and socialising. All three of these are provided in this weather-proof environment.

Respondent 4 spoke of spaces being created on a request basis, in which requests get incorporated into the long-term plans. He also said that the government harbours a desire to increase the capacity of certain facilities and these particular developments have had to be expedited. He was of the opinion that the "nature of our education" is changing so much that the need for large lecture halls has decreased, except in the case of first year students. He spoke of a move towards a more research oriented university with an emphasis on post graduate courses, and so the requests for new spaces are generally for smaller spaces which are flat floor venues. These spaces allow post graduates to have individual work stations with computers or room to plug in their own laptops and have large open areas for collaboration. This space requirement is suitable for research-based courses commonly provided in post-graduate studies, according to Respondent 4. In terms of undergraduate space, Respondent 4 described the numerous requests for tutor study space where small groups receive help from tutors, as a supplement to lectures. There is also a large requirement for one-on-one tutor facilities, which take the form of small cubicles where a tutor can sit with a student.

4.2.2.5 LEARNING SPACES AND THE SPACE NORMS

All requests for space go through the architectural department and as a result it is this department's responsibility to ensure that the requests are in line with the existing space norms. Therefore, according to Respondent 2, all space provision and alteration of existing spaces is controlled by the architectural department, in line with the space norms.

Respondent 3 uses the established space norms to calculate allowances for future development of spaces at the university, however Respondent 1 was only aware of the space norms relating to the submission of requests for finance from government.

Respondent 4 was very clear about the fact that this university adheres strictly to the space norms as they are required to report on them. He also opined that the norms need to change, in order to suit the types of requests for space that he is getting from the academic staff, in terms of a greater desire for group spaces rather than large lecture halls.

4.2.3 SUMMARY

This university has mostly raked seating lecture halls for its large undergraduate groups, with the use of document cameras and screens being prevalent throughout the various campuses. Lecturers use laptops and projectors to make their lecture notes visible to the class. WI-FI is being rolled out everywhere on campus, but the lecturers do not want students to access the internet during class times.

There is a new learning commons which applies all the principles that the literature talks about in terms of areas for students to work on laptops, areas for group work and fixed PCs for students who do not have their own hardware to use. There are also opportunities to rest and purchase refreshments in these places. These learning commons are used by students before, between and after lectures, and are as such deemed necessary because the students spend the whole day at the university and therefore require places to socialise, work and eat.

Undergraduate and postgraduate students need different types of spaces, as do various faculties, so there is a range of different types of lecture space provided by this university. It appears that undergraduates are taught in the traditional didactic style because of their vast numbers, and as such separate tutorial rooms are provided for collaborative sessions. Postgraduates have smaller spaces to work in and they tend to favour working in collaborative groups. The reason given for the discrepancy in approaches is that it is all about the contrast in the volume of students with which the university has to contend at the various levels of study.

The lectures appear to be didactic in nature with a technology being used to provide visual and audio assistance. This university positions itself as a pioneer of e-learning, but the ability to connect to the internet is not encouraged during lectures and as such technology appears to be used as an instrument to replace 19th century tools rather than a catalyst to change pedagogy.

CASE STUDY THREE

4.3 INTRODUCTION

This third and final case was built around one of the largest universities in Gauteng which has nine faculties across four campuses and in excess of 662,000m^2 of space in 302 buildings.

4.3.1 SECONDARY DATA – DOCUMENTATION

UNIVERSITY THREE STRATEGIC THRUSTS – 2011 TO 2020

This University is a comprehensive institution which wishes to place itself in the realm of science and technology in terms of stature, research and innovation.

The scientific and technology courses offered at this university are designed to attract top students, use high-level technologies, be intellectually challenging and to, "…empower students to design solutions to problems through innovative thinking".

According to this document, academic employees must possess appropriate expertise, be highly qualified and innovative and the top performing undergraduates should be innovative in terms of utilising technology.

The University should create strategic partnerships with policy-makers and the private sector to enable innovation, whilst also involving international partners in creating cutting edge, "teaching and learning collaboration". A Technology Innovation Centre should be established to enable technology transfer.

An important thrust of this University is to have suitable Information and Communication Technology resources to support open learning and fulfil the "demands of "supercomputing" required for advanced scientific and technological research", and enhance the administration capabilities of the university.

BUILDING SPACE MANAGEMENT POLICY

The purpose of this policy is to create guidelines for providing space of a high standard and quality for staff and students which supports teaching and learning. These spaces must be provided in a framework,"…wherein the HEMIS norms and standards can be applied equitably". The policy states that the spaces provided must meet the requirements of all accreditation boards of various academic programmes and be utilised in a cost effective manner. This policy also provides a framework for managing space effectively to meet the University's needs.

The scope of this policy is university-wide, including off-campus space owned or rented by the university. The authority to allocate building space resides with the DVC: Strategic Services, and is delegated to the registrars and directors of various facilities (health, study, management, etc.) of the university. This is to ensure that decision making is balanced between decentralised and centralised stakeholders.

According to the "General Building Space Considerations"**,** lecture spaces are allocated centrally by the registrars and computer laboratories are managed by the Executive Director ICS. All equipment needed by the occupants of the space must be provided through a process facilitated by the Executive Director: Operations and all stakeholders.

Anyone requiring new space or alterations to an existing space, must send a request to their Campus Directors who will facilitate consultation with CTS and other bodies as necessary. Space data is kept by CTS in a suitable format for HEMIS reporting and is used for space management purposes, which is why CTS must be kept informed of changes to built spaces. This database is also used for maintenance purposes, building space allocation and in the assessment of building space utilisation.

ACADEMIC DEVELOPMENT AND SUPPORT (ADS) ANNUAL REPORT 2010

In this university, ADS occupies the role of managing the directives of Higher Education policy, developing and implementing academic policy and managing student enrolment, success rates and throughput. It contributes to the development and improvement of curricula and programmes and runs the following specific projects: the SANTED project, the First Year Experience project, Orientation and the

National Benchmark Tests, the Staff Qualifications Programme, and the roll-out of the Teaching and Learning Strategy and University Teaching Philosophy. It also delivers academic development and support to staff and students. Under the ADS division sits; the Centre for Technology Assisted Learning (CenTAL); the Academic Development Centre; the Centre for Professional Academic Staff Development; and the Centre for Psychological Services and Career Development.

Of interest here is CenTAL, which has the job of integrating educational technology into teaching, learning and assessment practices in innovative ways. CenTAL helps the university to respond to the, "world of the information and communication revolution", which sees ICTs as essential to a quality student experience. This is managed in the context of the University's commitment to teaching and learning,"…within an environment of rapidly proliferating technological advances".

CenTAL gives professional development and support to the teaching staff that are,"…increasingly using ICT to administer their modules, communicate with students and to transform their pedagogy" and it assists lecturers to redesign their modules as well as providing digital literacy help to students. CenTAL technical staff is available twenty four hours a day through their Learning Management System. During 2010, over 43,000 students utilised the LMS according to this report.

Video and teleconferencing and the development of,"…learning material with audio, video and animations for the web," are also managed by CenTAL.

This report opines that "digital inclusion" should be provided by universities in this, the 21st century, which means that the students should be educated in IT literacies and provided with an environment to practice those skills to enable them to better understand their future work places.

4.3.2 PRIMARY DATA – INTERVIEWS

Five interviews were held with four different Respondents. The first Respondent is a lecturer in the construction department, the second is an architect in the department of Central Technical Services, the third is a project director in the Central Technical

Services (CTS) department, while the fourth is the director of the Centre for Academic technologies (CAT). Both the members of CTS were interviewed together and then the architect was interviewed a second time, as a result of his interest in, and ability to add value to, the subject.

4.3.2.1 TECHNOLOGY USEFUL FOR TEACHING AND LEARNING

Respondent 1 has a vision of every class being configured with flat floors and the ability to project images onto screens from a SMART board/tablet device. Respondent 4 believes that any technology in existence can be used for teaching and says that this University supports many different software packages, and therefore students are encouraged to use the ones that suit them. He also spoke about the web-based portal or LMS which is designed to be used with mobile technologies.

4.3.2.2 PEDAGOGICAL EPISTEMOLOGY

In the construction department group work is confined to the fourth year students, and according to the information supplied by Respondent 1, the teaching remains didactic. Contrary to this is the work being done by Respondent 4 to promote authentic learning based on Vygotsky's social constructivism and activity theory. This Respondent has written several research papers on the “politics” (author’s description) of learning with technology. He speaks about social environments for collaborative teaching, and when interviewed, he expressed his opinion that these can be created with large groups if desired, and that the change form didactic to collaborative learning is more to do with the teacher transforming his teaching than the influence of the space on the type of teaching practised. He did say however, that the use of tutorials at the University as an aid to learning provided the interactive part of learning that may enhance learning in large group didactic lectures. The tutorial is an integral part of this University’s teaching philosophy.

4.3.2.3 TECHNOLOGY IN THE CLASSROOM

Respondent 1 described air-conditioning as a technological improvement to classrooms, which is what described in the literature in terms of students' comfort and their ability to study. This Respondent also spoke about data projectors and laptops being used in classrooms.

As far as portable technology is concerned, Respondent 1 stated that only 15% of students have laptops because of the low LSM of the majority of students, and therefore the University provides computer laboratories for the students. Respondent 1, 3 and 4 said that the university would like to supply every first year student with an iPad or tablet of some description to technologically enable them.

The students and lecturers communicate though the LMS that allows notes to be distributed by lecturers and assignments to be uploaded by students and tests to be taken online. According to Respondent 1, the engineering department has developed some interesting methods of carrying out class tests online and this system has been offered to other faculties who may implement it in the future.

Respondent 4 said that there is Wi-Fi throughout the University and the residences. He believes that access is the main objective, in that if the students are connected, they will use the technology they need.

4.3.2.4 TYPES OF LEARNING SPACES

Currently the lecture spaces in the construction department, as well as some health and engineering related departments have flat floors that hold up to fifty students. This is because of the fact that small tutorial rooms have been combined in an attempt to get maximum use out of them, according to Respondent 1, as opposed to having been carefully planned to be flat and flexible.

Respondent 2 described in detail why large raked lecture theatres are being produced at this University. He put this down to the need to provide large spaces for large numbers of first years'. This Respondent opined that the best characteristic of flat floor venues is their flexibility and adaptability for many uses, but noted that there are logistical problems from the point of view of having to move large amounts of

furniture around in short time frames. He has therefore personally come to the conclusion that raked venues are preferable. Raked lecture halls can house large numbers of pupils and also be used for external lectures and presentations, as well as exams. These venues are also used by pupils between classes. Respondent 4 said that, in his opinion, large groups can be taught in a collaborative manner even in large raked seating venues.

This university's process of creating space allows lecturers some say in what types of spaces get built, but the final decision is made by the strategic planners. The types of learning spaces provided have more to do with throughput of students than anything else, according to Respondent 2. Respondent 3 re-iterated the fact that an advantage of large raked venues is that they can be used for presentations to outsiders;"…you must think beyond the boundaries of the university" said Respondent 3.

Respondent 2 and 3 described the simulation centre in the health sciences department that allows students to practice real-life scenarios on dummies linked to computers. This department also has a simulation lab and a video lab where learners sit in a raked lecture theatre and watch through glass screens whatever teaching module as it is demonstrated.

Respondent 2 described the way that libraries are changing to create social, learning and research commons. They are becoming dynamic spaces which the head of this University's libraries describes as a "shopping mall" experience with opportunities to plug in laptops, find books, and watch TV as well as to purchase books and refreshments. Respondent 3 concurred with Respondent 1 about the fact that many students do not have laptops and said that this makes the library an even more important space due to the amount of time students spend in it and the functions that they require it to perform.

Respondent 2 spoke of the role of CTS being one of creating spaces to support academic programmes. He described a flat floor venue that was built on a low budget to accommodate five hundred first year students. The venue has large screens at the front, TV monitors along the sides and audio feeds throughout the space in order to enable everyone to hear. The seating is fixed and there are power

points at every second seat. Although the main thrust is to create raked seating venues for large groups, this Respondent said that in this case, it was expedient to use existing space and add technology to allow good visibility, and similarly to use audio for large groups (Respondent 3).

In terms of computer laboratories, Respondent 1 described the laboratory in the Construction Department as having space for sixteen post graduate students to use the fixed computers at any time of the day, with links to printers and the internet. Respondent 2 described the general computer laboratories on campus as being predominantly useful for printing, as far as students with their own devices were concerned. The learning commons in the library are equipped with computer stations, coupled to Wi-Fi for learners with their own laptops to be able to access the internet. He also said that there is a programme on campus to roll out Wi-Fi throughout which will enable students to sit almost anywhere and access both the internet and the universities own intranet.

Limitations to the use of new technology were described by Respondent 2 and 3 as being attributable to lack of finances, and teachers" knowledge of and ability to use the latest technology.

4.3.2.5 LEARNING SPACES AND THE SPACE NORMS

Respondents 2 and 3 talked about the university having to prepare annual reports for the DHET in terms of the space norms. This is conducted with the help of a data base that they maintain with all relevant space information included in detail, right down to room level. Respondent 2 explained that the administrative department of the university converts the space information into a factor relating to the numbers of pupils using a space in terms of the timetable and submits this to the DHET for on-going funding purposes.

According to Respondent 2 who presented a paper at the HEFMA Conference, there is value in accurately maintaining space data because, "Ineffective Space Data results in a reduced ability to deliver quality information regarding activity within all spheres of the University" (HEFMA 2011 Conference).

4.3.3 SUMMARY

University three currently has a drive underway to make information accessible to students, and therefore sees infrastructure as a catalyst for change through technology. This university has several research facilities equipped with specialised technology to synthesise real life situations. The use of specific technology in each department at the university is motivated by the need to have the same technology as the corresponding industries, and as such space is consequently configured to suit any technology which needs to be used. Simulation laboratories and video laboratories can be found in the health and education facilities as well.

All students have access to a variety of work spaces which are provided in the learning commons that are housed in existing campus libraries. The head of libraries has a clear vision, according to Respondents 2 and 3, of how the library should be changed to attract students to suit their learning and socialising requirements.

This university has a large number of diverse programmes on offer and which translates into a requirement for many different types of lecture spaces. Undergraduates needing large raked seating venues for lectures, as well as flat floor venues with visual and audio aids where necessary. Computer laboratories and science laboratories are flat floor venues with fixed benches. These spaces are designed partly because of shifts in academic programmes and partly because of throughput rates.

A limiting factor to change is the,"…uptake of new technology and the transition phase between old methods [of teaching] and new," according to Respondent 2 who went on to say that staff do get training in new technologies which takes place in specially allocated training rooms on the libraries.

From both the interviews and the documents studied for this case, it is apparent that large lecture venues are being developed with raked seating which is indicative of a

didactic teaching model. There is a strong emphasis on technology in learning at this HEI and computer laboratories and work stations in libraries are provided to cater for students who have laptops, and those that do not. The roll-out of the tablets to first year students is a primary need for this University, in order to reach their goal of giving students access to technology and the internet.

This University places a strong emphasis on adhering to the HEMIS space norms, and reports annually to the DHET on their progress in terms of implementing these norms.

CHAPTER 5: RESEARCH ANALYSIS

5.0 INTRODUCTION

The questions posed in this research report were derived from an extensive review of the literature surrounding modern learning pedagogy, the use of technology in education and how these two factors influence each other in terms of the provision of space at HEI's. In order to establish these factors intersect in reality at universities today, case studies were undertaken on three prestigious institutions in South Africa and the findings were presented in Chapter 3.

The questions posed of the case studies were:

1. What technology, available today, is suitable for teaching?
2. What is the leading pedagogical epistemology of the day?
3. How is technology actually being used in teaching and learning?
4. What is e-learning's impact on learning spaces?
5. What spaces are being provided for learning in today's HEI's?
6. Do these spaces allow for the use of the technology in teaching?
7. Does the provision of space by HEI's conform to the South African Department of Education space norms and do these norms keep up to date with changing pedagogies and teaching technology?

Due to the nature of the answers obtained, these questions had to be slightly altered and rearranged, and are therefore presented here as headings under each case study analysis. The questions regarding technology have been combined into an explanation of the technology currently used on campus. The questions about the impact of pedagogy and technology on physical spaces have been distilled into an overall description of the spaces provided for teaching at each university. The universities all comply with the requirements of the DoHET to submit information on

their space allocations and as such they submit requests for funding together with space norms calculations. In this regard the discussion on the space norms has been placed under a separate heading after the case study analysis.

5.1 ANALYSIS OF CASE STUDY ONE

Leading pedagogical epistemology

Most of the Respondents (1, 3, 4 and 5) in this case study expressed awareness of the constructivist learning epistemology (Harasim, 2012) and wanted learning to be conducted in a collaborative manner. They did however state that this was not really possible in terms of the types of spaces that are currently provided, which are large and raked and therefore not conducive to group, interactive learning. They all thought that money was the most salient limiting factor in terms of providing the right types of spaces, because, although flat venues are cheaper to provide, the reality remains that there is a lot of existing teaching space which is raked and that this space would be expensive to convert. Another aspect is the fact that large numbers of students attend this university and they need to be accommodated in large classes to avoid the need for lecturers to repeat their classes many times to smaller groups.

The documents describing the underlying strategy of this university espouse the values of quality teaching and the, “rigour of intellectual and social engagement” (Vision 2022) which is in principle a collaborative learning strategy.

What technology is actually being used in teaching?

The Respondents in this case were aware of technology aimed at enhancing the teaching process being available, but that the applications of these technologies in a sense simply remains as a modern version of a blackboard; and ink and paper. This is a missed opportunity according to Harasim (2012) who says that technology can provide more, “advanced ways of learning” (Harasim, 2012:90). An enhancement to a basic blackboard scenario is the fact that for instance the cameras that are present

can be used to record classes and broadcast them to other venues simultaneously. Likewise these can then be viewed on the internet at any time of the day or night, depending on the preference of the learner. This is cited in the literature as being a huge benefit of mobile learning (Quinn, 2012).

The students communicate with each other using Whatsapp and Skype for learning, with lecturers using the University's web based portal. WI-FI access is available in various hubs. Therefore as a core component of this University's strategy, is the fact that it must become increasingly IT-savvy, with cutting-edge technology being used to enhance teacher-student interactions in terms of technology-enhanced pedagogical applications. This rhetoric is aligned with the literature, however in reality this university is merely using new tools (technology) to accomplish tasks already easily undertaken using traditional methods (blackboard and chalk).

What spaces are being provided for learning in today's HEI's and do these spaces allow for the use of the technology in teaching?

As stated under the previous headings, most lecture venues are raked and have technology embedded in them. There are also flat floor venues for postgraduate students to use, with flexible furniture for collaboration. There is a lot of conversation in the literature about flexible furniture, which is said to change teaching and learning styles (Jamieson *et al.*, 2000). The Respondents to interviews at this University showed concern for the trade-off between flexibility and the ability to provide technology, e.g. plug points. "Nodes of connectivity" have been created by the installation of WI-FI enabled areas which allow students and staff to interact in informal spaces, "in-between spaces", which are important for collaborative work. The literature talks about using entrances, and "less effectively employed spaces" (JISC, 2006) for informal collaboration. This university sees these spaces as outdoor spaces between buildings.

This university has created "information hubs" or learning commons where social and intellectual pursuits take place. These are typically situated in libraries. These spaces are central ideas to the Development and Design Framework of the

University. Providing research and learning commons is a theme that runs through the literature with an emphasis on the fact that today's students are mature enough to decide when and where to eat, study and socialise (Jamieson *et al.* 2000). This idea changes the old fashioned library model of working in silence with no food/drink allowed.

Another principle from the Development and Design Framework which is aligned with the literature is the notion that the quality of the environment will attract staff and post-graduates of a desirable standard. Design of the campus should be done with the strategy of the university in mind and "emotionally compelling" campuses will ward off competition (Coulson *et al*., 2011).

5.2 ANALYSIS OF CASE STUDY TWO

Leading pedagogical epistemology

The literature talks about the "Knowledge-creating Age" (Harasim, 2012) and by this they mean that students are part of the process of constructivist learning in an online, collaborative fashion. This university appears not to have this epistemological perspective to learning because the lecturers interviewed in the case study were of the opinion that they have the knowledge and they impart it to the students in a didactic fashion.

Group-work is a method of encouraging deep-learning according to Biggs (1999, 67) but in this case study there was clear evidence to show that group work is too time consuming for the lecturers and is therefore not used as a teaching tool for undergraduates in large classes.

The university has a Department of Education Innovation which according to the documentary evidence available is largely involved in the web-based portal and computer-based testing systems. These are merely teaching tools for lecturers using any pedagogical perspective in their teaching style, and do not necessarily promote collaboration and constructivism in learning.

What technology is actually being used in teaching and learning?

This university uses a web-based portal to link students to lecturers, and from here the students communicate with each other using free VOIP apps. WI-FI is being provided campus-wide to enable these technologies.

Lecture theatres have speakers, overhead projectors and data projectors with LCD screens. There are "smart podia" connecting these devices. Some lecture venues also have network connections and power points at the seats. Blackboards are still used by some lecturers in smaller venues. These technology-rich environments are described in the literature, and both the blackboard and technology that is effectively a modern version of the blackboard, was noted by Mazur to be the classroom of the 19th Century (Harasim, 2012).

What spaces are being provided for learning in today's HEI's and do these spaces allow for the use of the technology in teaching?

The majority of new spaces built at this University are raked lecture theatres with embedded technology. Flat floor venues are prevalent but the benches are fixed and they are devoid of technology other than lighting and overhead projectors.

A large amount of effort has gone into the provision of learning commons for the students to complete their work in, either individually or in groups, and to promote social interaction coupled with the ability to purchase refreshments. These spaces are provided in existing libraries, which have been redeveloped, and also included in the development of new buildings. They all offer connectivity to the internet for users. Postgraduates have their own workstations in these spaces and undergraduates have access to one-on-one tutorial spaces or group workspaces. "Open-plan social" areas encourage "engagement in learning" and learning activities outside of formal lectures according to the literature (JISC, 2006).

5.3 ANALYSIS OF CASE STUDY THREE

Leading pedagogical epistemology

Brett and Nagra (2005) wrote about the way collaboration between students fosters deep learning in terms of the social constructivist principles of education and the director of the Centre for Assisted Learning (CAT) at this university, who is directly involved in developing curricula and programmes at the university, believes that social environments for large groups can be created in line with these principles. Tutorial work at this university is a key part of their teaching philosophy and is a very valuable tool, in his opinion, in providing interactive learning.

The CAT at this University has the role of supporting academic staff in the use of ICT and transforming their pedagogy, presumably in line with technological developments, but not specifically in line with any particular epistemological perspective.

What is technology actually being used in teaching and learning?

Data projectors and laptops are used in lecture theatres at this university which provides WI-FI connectivity throughout. Further, TV monitors and speakers enable learners in large venues to easily see and hear the proceedings.

This University has simulation laboratories and video laboratories, which the literature refers to as, “augmented reality facilities” (Norris, 2010). These and other technological devices used on campus are in line with the strategy of the University to provide suitable ICT resources that fulfil the demands of “supercomputing” for research endeavours of an advanced scientific nature.

This University sees ICT as essential to the quality of the learner experience and as far as laptops are concerned, only 15% of students can afford them, so there is a programme in place to supply tablets to these students to ensure that everyone has access to the internet. This lines up with their strategy of “digital inclusion”.

What spaces are being provided for learning in today's HEI's and do these spaces allow for the use of the technology in teaching?

Raked lecture halls are provided for first year students which are generally large groups of students. The new venues all have embedded technology. One of the Respondents did say that students use these spaces between lectures, which is consistent with the ideas explored in the literature that point out that these venues should be available outside of class times for individual or collaborative work in order to maximise the use of space and promote collaboration between students.

This university has created learning commons in the libraries and they view these spaces as important for students, due to the number of hours they spend on campus and the consequential need for social and study workspaces. These areas are aligned with the definition of the learning commons described in the literature. The University's Strategic Thrusts include the requirement to provide a high standard of space to support teaching and learning.

5.4 ANALYSIS OF THE SPACE NORMS

The question posed in this thesis was "Does the provision of space by HEI's conform to the South African Department of Education space norms and do these norms keep up to date with changing pedagogies and teaching technology?

The answer from the universities was that they do conform to the norms and that they have to report on them to the DoHET annually. However, some universities adhere more stringently to this process than others.

The Department of Education explained that the space norms are designed to, "...ensure consistency across institutions when applying for funding" (DHET, 2013), however these norms are not building norms and are put in place in order to provide a basis for calculating the amount of funding that should be applied to any request from an HEI. The basis of these requests is that for each CESM, an amount of space

is allocated to each full time student and the overall quantum of space translates into an amount of money that the government can contribute to development projects at HEIs.

The Building and Space Inventory and Classification Manual assigns codes for the classification of rooms in a university e.g. laboratory, and it does not cater for mixed use spaces e.g. learning commons. According to the DHET there have been limited applications for funding of mixed use premises. From the research it can be deduced that where there have been funding applications for learning commons, the universities may have used an existing code as a substitute, due to the fact that there are learning commons in existence and they have been built through the partial use of government funding.

Since the norms are based on room classification, any changes in pedagogy and technology, and as such the corresponding variance in spaces created for teaching, would not have an impact on the space norms in the opinion of the DHET. For this answer to be valid they have assumed that the sizes of space assigned to each full time student would not be affected by the use of technology.

5.5 CROSS CASE ANALYSIS

Leading pedagogical epistemology

All three institutions practice a hybrid of didactic objectivist pedagogy and constructivist collaborative pedagogy. University's One and Three were closely aligned with their teaching ideals, but direct evidence was found that some departments at University Two considered group work too time consuming for lecturers. Through careful observation of the types of spaces being built at this university, it is clear that various faculties do however still encourage group work. The reasons for continuing to adopt didactic teaching practices which were given in all three cases, are partly due to the fact that the intake of first year students is

enormous; partly as a result of the fact that existing spaces are not conducive to collaboration (furniture is fixed and not flexible); partly because of the scarcity of funds; and finally, due to teachers teaching in the manner in which they themselves were taught. It is also apparent that unless instructed how to teach, in terms of adhering to more modern pedagogical theory, the lecturers will continue to teach in the manner in which they have become accustomed.

As far as pedagogical epistemology is concerned, there is sufficient evidence to suggest that South African HEI's are indeed aligned.

What technology is actually being used in teaching and learning?

The three cases showed that the HEI's all have strategies that are more or less aligned with the literature on the subject of technology useful for teaching. They all use technology in their lecture spaces in the form of projectors, cameras and audio aides. In terms of the type of mobile technology they provide, all three cases rely on the students having access in some way to laptops or tablets, printers and the internet. Where students cannot afford the technology it is provided in the form of desktops in learning commons. University Three stands out as an institution whose general student body is primarily composed of less affluent students, and in this regard the university plans to provide tablets to all who cannot afford them, in order that connectivity to university content and systems can be achieved remotely. University Three is also the most progressive in its use of technology, through its provision and use of simulation laboratories and video laboratories. The provision of Wi-Fi by all three institutions is seen as necessary and the responsibility of the university, although not all campuses are completely covered by Wi-Fi at the time of writing.

The three cases revealed that web-based communication between lecturers and students is now the norm at HEIs, with each institution having its own LMS, equipped with password protected access. The manner in which this technology is used for teaching cannot be generalised, due to individual lecturers expressing different

opinions about the quantum and type of content that they feel should be shared between a lecturer and their students, in this type of forum.

What spaces are being provided for learning in today's HEI's and do these spaces allow for the use of the technology in teaching?

Raked style seating venues with a lecture podium are currently being built or have recently been completed at all three HEI's. These spaces are deemed necessary because of the large numbers of first year students enrolling to study every year. The venues are designed to incorporate various types of technology but not in a uniform manner. For instance, there are variances between the number of power points that each institution is able, or willing, to provide for the charging of mobile devices. Undergraduates have access to a combination of learning commons, in the form of library and tutorial rooms, which in all three cases are provided for group-work and collaboration. Spaces between buildings are only used to create learning spaces at University One.

Flat floor venues are provided for post-graduate lectures as the groups are small. Technology built into these rooms is primarily audio/visual. All postgraduates in the three HEI's have access to group work rooms and research commons, in line with the literature. These spaces are designed to accommodate mobile technology and have desktop computers at various points. The Learning Commons built in the style described in the literature is present in all three universities and all of them support the idea that students use the space for socialising, eating and working simultaneously.

Based on these results it can be said that there is enough evidence to support cross case generalizability in terms of the learning epistemologies, types of technology implemented and the types of spaces provided.

CHAPTER 6: CONCLUSION AND FURTHER RESEARCH

6.0 INTRODUCTION

In this chapter the findings of the research are detailed and the main objectives of this thesis are examined to establish if the conclusions reach the objectives.

The first objective, as delineated in chapter one, was to establish what types of available technology could be used in education. An extensive study of the literature was undertaken to discover what technology is currently available to students and is able to be utilised in learning.

In order to reach the second objective of comparing South African HEIs to universities abroad in terms of the use of technology in education, it was necessary to first establish the pedagogical epistemology of the local HEIs and then discover the ways that they use technology to promote that epistemology. This was done through literature review in the case of foreign institutions and interviews in the case of local institutions.

The third objective was to establish if the types of space provided by HEIs impact learning in order to bring together the themes of technology, education and space to answer the question: Are universities supplying spaces that suit the technology available for teaching?

6.1 RESEARCH FINDINGS

6.1.1 TYPES OF TECHNOLOGY AVAILABLE

There is a vast array of technology available today that can be used in education from electrical power to virtual reality hardware and software. The literature revealed that computer and internet technology is used at HEIs abroad in various ways to aid learning. The literature points to the fact that students members of the Net Gen are constantly in contact with each other through the use of mobile technology and most students have laptops, tablets and cellular telephones which can, through the installation of relevant applications, be used for learning.

Technology used at HEIs in can be divided into that which is provided by the university and that which is supplied by the students. In terms of what is provided by the universities it was found that all three South African institutions have LMSs for student-faculty communication. In lecture venues all three HEIs have audio and video communication in the form of screens, document cameras, projectors and speakers. These types of technology enable various configurations of lecture venues, both large raked lecture halls and flat floor rooms, to be used effectively for the dissemination of information to large groups of students. Computer laboratories are found in each institution and these are used for lecturing certain subjects and are also available for student use outside of formal lectures. By providing fixed computers and installing software for student use, it was found that universities are able to easily manage ICT through networks. The alternative, where students have their own programmes, is that management of the software is virtually impossible. Therefore, even with the loss of flexibility to the venue, computer laboratories are used extensively throughout South African HEIs. Another advantage of the university providing computers for student use is that many South African students are indigent and cannot afford their own hardware devices.

From the point of view of student supplied technology, laptops and tablets with user purchased applications and programmes are prevalent worldwide and because the South African HEIs studied use web-portals to communicate with students, there is a need for students to own these devices. Where they cannot afford to do so, the HEI endeavours to provide them in order to facilitate communication at all times of the day in any location.

All three institutions studied supply Wi-Fi to some degree. This is to enable students to access the internet from any location on campus.

6.1.2 EPISTEMOLOGY AND TECHNOLOGY

The literature study established that the leading worldwide teaching epistemology is constructivist and collaborative. This type of learning is ideally suited to the Net Generation, who currently form the basis of student populations, and are accustomed to being constantly in contact with each other and the wider world. The

Net Gen uses technology extensively to communicate and have come to expect its use in education.

The case studies revealed that the three institutions studied have a number of staff members who are familiar with and promote collaborative learning and some staff members who find group work too time consuming. On the whole these institutions use didactic methods of teaching combined with tutorial sessions where more collaborative learning can take place. The main reasons cited for this were the lack of funds for creating collaborative spaces out of the existing spaces and the fact that their intake of students at first year level is too large to allow constructivist collaborative work at undergraduate level. In all three cases post graduate learning largely involves collaborative group work.

The literature lists the advantages of using technology in collaborative learning as being the fact that students can be in contact with faculty and fellow students at all times and they can access information remotely and use their devices to capture data, manage the data and create knowledge through interaction and collaboration.

The case studies found that the use of mobile devices in the HEIs studied is limited to uploading and downloading lecture notes and research papers and is useful for enabling communication between students and staff. This is all done through the institutions' LMSs. The idea of collaborating during lectures and with other students in a collaborative way are limited to post graduate students. The reason for this appears to be that the lecturers continue to lecture in the way that they were taught, which is mostly didactic, and also that probably they are not familiar enough with available technology to use it in any way other than as a replacement for pen and paper.

6.1.3 SPACE AND IT'S IMPACT ON LEARNING

The literature points to the fact that the impact of space on learning is not well understood or studied. In the cases studied there was found to be little emphasis placed on how space impacts learning for a number of reasons: firstly there is a lack of funds to alter the existing spaces and to create new ones, secondly the teachers do not have a desire to change their teaching methods so the old spaces suit the

lecturing style and thirdly students are not consulted on what they would like. In terms of adhering to principles that have been developed overseas, the space that is most aligned is the learning commons, which aims to create collaborative spaces for individuals to work with tutors, and groups to work together.

In cases where faculty value collaborative learning, it was found that the creation of new spaces that are flexible and can be used collaboratively, is possible if the insight and drive of a few parties involved in the process leads the design team to the desired outcome. In light of this, the general view that funding is the biggest constraint in producing the types of spaces needed for collaboration is probably an excuse not to change the entrenched teaching styles.

The case studies revealed that the Space Norms are adhered to, but that by carefully manipulating the uses of rooms, the lines between teaching and faculty spaces can be blurred thereby creating collaborative spaces with multiple uses. An example of this is the staff boardroom at one HEI that emulates a work environment and is used for student presentations. The socialisation enabled by this room helps to prepare students for work life.

Using technology in teaching has an impact on the need for learning spaces and the types of spaces required. Through virtual reality, VoIP or video conferencing it is possible for students to interact remotely with peers and lecturers which means that many students can be taught simultaneously. The HEIs study use virtual reality in a limited manner to create real-life scenarios for teaching. These institutions are contact universities and therefore do not stream their lectures to remote students. The development of learning commons at the HEIs in the case studies are based on the overseas model of providing space that is capable of being used for learning by individuals and groups while simultaneously having access to food as well as the internet for learning and socialising. These spaces have been introduced to cater for students who have limited means of commuting and spend all day on campus and need space to work and relax between classes. These spaces, together with the provision of campus-wide Wi-Fi, enables learning to take place in a collaborative and connected way.

In the final analysis of the cases it was established that HEI's are providing technology enriched spaces similar to those described in the literature, but that the technology is not being utilised to its full potential in order to change the way students are taught from a didactic model to a collaborative model. This means that the spaces provided by the HEIs studied are suitable for the technology used in teaching today, but that the pedagogy is possibly not adapting to fully utilise the educational potential of the technology available.

6.1 FURTHER RESEARCH

In this study the interrogation of the reasons for the manner in which spaces are designed and developed was not a focus. These reasons therefore need to be further investigated from an educational epistemological viewpoint. A starting point could be, "...the design, development, integration and use of technology in the classroom is driven by individual and institutional ideologies that support current hegemonic constructions maintained through observation and control systems" (Amory, 2010).

The impact that space has on students" performance was not part of this study and further case study work could be carried out to determine the impact that the current spaces have on learning outcomes. Bennet (2007) believes that learning spaces could be better designed for their purpose if there was a greater understanding of the impact that they have on students" ability to learn.

The assumption was made that students in South Africa today are part of the Net Generation and that they want to learn in a collaborative way. This is a topic for further research in line with the findings of Oblinger & Oblinger (2005) that the Net Generation of students are capable of learning in an active manner and exhibit a high degree autonomy in their learning process.

The interviewees in the case study cited financial constraints as a determining factor in terms of the provision of spaces in HEI's, and that studies could be conducted in

order to determine the differences in costs associated with the various types of spaces currently being provided.

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APPENDICES

APPENDIX 1: SAMPLE CONSENT FORM

INFORMATION SHEET & CONSENT FORM

Are Universities Supplying Learning Spaces that Suit the Technology Available for Teaching?

Hello, my name is Janet Glendinning and I am conducting research towards a master's degree at UCT. I am researching the incorporation of technology into higher education and would like to invite you to participate in the project.

The research report aims to find out how technology is being integrated into university teaching and if the design of the campus is changing to reflect the use of technology.

A) I would like to interview people who currently have (or do not have but are striving for) a successfully integrated solution to teaching that can show me examples of the types of spaces designed for teaching with technology, that I can use in my case studies.

Also B) I would like to interview people about the space norms as designed by the department of education and their current use in universities and higher education institutions.

Please understand that you do not have to participate, i.e. your participation is voluntary. The choice to participate is yours alone. If you choose not to participate, there will be no negative consequence. If you choose to participate, but wish to withdraw at any time, you will be free to do so without negative consequence. However, I would be grateful if you would assist me by allowing me to interview you.

An explanation will follow on the time requirements and whether there will be follow up interviews or questionnaires.

Complete privacy and anonymity will be maintained, institutions will be described but not named and participants will be referred to by their position in the institution/organisation but not by name.

The final outcome of the research will be available in the form of a copy the final thesis if so desired or feedback can be provided in the form of email correspondence if the participant is interested in any aspect of the research results.

The interview will then begin.

APPENDIX 2: INTERVIEW QUESTIONS

Interview Faculty

1) Please explain your role at the university
2) Are you currently creating new lecture rooms/ interactive spaces?
3) Are these spaces in line with the Education Department's space norms?
4) Do you implement these space norms when designing new spaces for teaching?
5) If not, why not?
6) What technology do you use in teaching?
7) Who supplies the technology?
8) Does the design of the campus cater for the type of technology that you use in teaching?
9) In your opinion, are the students happy with the spaces and technology provided?
10) How do the students/lecturers benefit or are they disadvantaged by the universities design?
11) Is the design process consultative? Who is involved?
12) What are the failings of the system in terms of space provision and technology?
13) How do you think universities can better use their current spaces?
14) What types of spaces do you think would be ideal in today's teaching environment?
15) What are the limiting factors to providing the ideal space?
16) General comments and discussion

Interview with Architect

1) Are you currently involved in creating new lecture rooms/ interactive spaces?
2) How does the university engage you / who from the university approaches you to start a new project?
3) Is the design process consultative? Who is involved?
4) Does the university insist that you implement government space norms when designing new spaces for teaching?
5) If not, why not?
6) What technology do you have to cater for in the design of learning spaces?
7) Who supplies the technology?
8) How do you think universities can better use their current spaces?
9) What are the limiting factors to providing the ideal space?
10) General comments and discussion

APPENDIX 3: ETHICS COMMITTEE APPROVAL FORM

EBE Faculty: Assessment of Ethics in Research Projects

Any person planning to undertake research in the Faculty of Engineering and the Built Environment at the University of Cape Town is required to complete this form before collecting or analysing data. For more info regarding the procedure of completing the form please log onto http://www.ebe.uct.ac.za/research/ethics/.
When completed it should be submitted to the supervisor (where applicable) and from there to the Head of Department. If any of the questions below have been answered YES, and the applicant is NOT a fourth year student, the Head should forward this form for approval by the Faculty EIR committee: submit to Ms Zulpha Geyer (Zulpha.Geyer@uct.ac.za; Chem Eng Building, Ph 021 650 4791).
Students must include a copy of the completed form with the thesis when it is submitted for examination.

Name of Principal Researcher/Student: Janet Glendinning Department: Built Environment

If a Student: GLNJAN002 Degree: MSc Property Studies Supervisor: Prof K Cattell

If a Research Contract indicate source of funding/sponsorship: N/A

Research Project Title: **How could universities better prepare students for work life?**

Overview of ethics issues in your research project:

Question 1: Is there a possibility that your research could cause harm to a third party (i.e. a person not involved in your project)?	YES	NO
Question 2: Is your research making use of human subjects as sources of data? If your answer is YES, please complete Addendum 2.	YES	NO
Question 3: Does your research involve the participation of or provision of services to communities? If your answer is YES, please complete Addendum 3.	YES	NO
Question 4: If your research is sponsored, is there any potential for conflicts of interest? If your answer is YES, please complete Addendum 4.	YES	NO

If you have answered YES to any of the above questions, please append a copy of your research proposal, as well as any interview schedules or questionnaires (Addendum 1) and please complete further addenda as appropriate.

I hereby undertake to carry out my research in such a way that

- there is no apparent legal objection to the nature or the method of research; and
- the research will not compromise staff or students or the other responsibilities of the University;
- the stated objective will be achieved, and the findings will have a high degree of validity;
- limitations and alternative interpretations will be considered;
- the findings could be subject to peer review and publicly available; and
- I will comply with the conventions of copyright and avoid any practice that would constitute plagiarism.

Signed by:

	Full name and signature	Date
Principal Researcher/Student:	Janet Glendinning Signed by candidate	21 October 2012

This application is approved by:

Supervisor (if applicable):	Signed by candidate	30/10/2012
HOD (or delegated nominee): Final authority for all assessments with NO to all questions and for all undergraduate research.	Signed by candidate	30 Oct 2012
Chair : Faculty EIR Committee For applicants other than undergraduate students who have answered YES to any of the above questions.	Signed by candidate	12/NOV/2012

APPENDIX 4: TURNITIN SUMMARY PAGE