The role of ICT in the shift towards student-centred learning in higher education

Eduardo Mondlane University, Mozambique: A case study

Xavier Muianga
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Abstract
Over recent decades, there has been a significant rise in the use of information and communication technology (ICT) and a greater emphasis on student-centred learning (SCL) in higher education all over the world. The introduction of ICT- and SCL-based approaches is intended to improve the quality of teaching and learning to better prepare students for the 21st century workplace. Despite the curricular reform initiated in the early 2000s which involved the introduction of ICT and SCL, teachers continued to use traditional teaching methods, and ICT played a secondary role in teaching and learning. The current research study uses four different theoretical frameworks and models to explore and analyse the use of ICT in combination with SCL to improve teaching and learning practices at Eduardo Mondlane University (UEM), Mozambique.

An interpretative research approach was used to examine the introduction of a new pedagogical model with support for ICT for teaching and learning. Action research to introduce pedagogical innovation and the use of a case study to analyse the process of curricular reform were the overall research strategies, and the aim of this was to gain a better understanding of the impact of SCL and ICT on the lecturers and on changes to teaching and learning methodologies across the University. Data were collected using a combination of interviews (37 students and 24 lecturers from UEM, and managers, ICT and distance education experts from six different universities), questionnaires (66 students and 104 lecturers from UEM, and managers, ICT and distance education experts from 13 different universities including UEM), observations, and workshops with students and lecturers.

The findings showed that the adapted flexibility-activity framework can combine any teaching and learning methods and strategies, with a focus on a student-centred approach, depending on the learning competency and learning objectives that students are expected to develop. This research study contributed to the design of new curricula within an integrated ICT and SCL, as well as a desirable instructional design of the courses that is appropriate to the UEM context. The research study also analysed several factors drawn from different frameworks of pedagogical innovation using ICT, and identified further factors that have been implemented and have contributed to improving teaching and learning at UEM. Key factors include institutional policies, ICT infrastructure, access, pedagogical approaches, and partnerships with the public and private sector, and these have contributed to the effectiveness of SCL and ICT education. It is shown that the particular interests of the teacher and students are the primary factor in the successful implementation of SCL and ICT. Moreover, the findings contribute to the design and implementation of new training and professional development, based on technological pedagogical and content knowledge (TPACK) principles and on contributions from lecturers and pedagogical coordinators from several higher education institutions in Mozambique. Despite the changes that are taking place at UEM, the allocation of incentives by the institution at faculty and school level and the engagement of the teachers remain factors constituting a barrier to effective implementation.

Keywords: ICT, student-centred learning, pedagogical innovation, educational models, factors in ICT implementation, professional development, higher education, developing countries.

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Xavier Muianga
To my wife, Lurdes, my partner in marriage for 21 years, for her love, patience, and dedication to me, and to our children and grandchildren, who were a constant source of inspiration for me when I was far from home.
Abstract

Over recent decades, there has been a significant rise in the use of information and communication technology (ICT) and a greater emphasis on student-centred learning (SCL) in higher education all over the world. The introduction of ICT- and SCL-based approaches is intended to improve the quality of teaching and learning to better prepare students for the 21st century workplace. Despite the curricular reform initiated in the early 2000s which involved the introduction of ICT and SCL, teachers continued to use traditional teaching methods, and ICT played a secondary role in teaching and learning. The current research study uses four different theoretical frameworks and models to explore and analyse the use of ICT in combination with SCL to improve teaching and learning practices at Eduardo Mondlane University (UEM), Mozambique.

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Sammanfattning


En tolkande ansats användes för att utvärdera införandet av en ny pedagogisk modell som innefattade stöd av informationsteknologi för utbildning och inlärning. Som forskningsstrategier användes aktionsforskning för att introducera ”pedagogisk innovation”, och fallstudie för att analysera processen kring utbildningsreformen. Syftet med studien var att öka kunskapen om effekter som informationsteknologi och student-centrerat lärande har på universitetslärare och på förändringar av metoder för utbildning och inlärning på hela universiteten. Insamlingen av data gjordes genom en kombination av intervjuer (37 studenter och 24 universitetslärare från UEM, samt chefer och experter på informationsteknologi och distansstudier från sex olika universitet), enkäter (66 studenter och 104 föreläsare från UEM, samt chefer och experter på informationsteknologi och distansstudier från 13 olika universitet), observationer och workshops med studenter och universitetslärare.

Resultaten visar att användningen av det för Moçambique anpassade flexibilitets-aktivitetsramverket, som möjliggör att flera metoder och strategier för utbildning och student-centrerat lärande, kan kombineras beroende på vilka kompetenser och lärande mål som studenterna förväntas utveckla. Denna studie bidrog till utformningen av nya kursplaner som inbegriper informationsteknologi och student-centrerat lärande, samt till utveckling av

**Nyckelord:** IKT, student-centrerat lärande, pedagogisk innovation, pedagogiska modeller, faktorer i IKT-implementering, professionsutveckling, högre utbildning, utvecklingsländer
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### Abbreviations

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<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>BL</td>
<td>Blended learning</td>
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<tr>
<td>CABLS</td>
<td>Complex adaptive blended learning system</td>
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<tr>
<td>CAD</td>
<td>Centre for Academic Development</td>
</tr>
<tr>
<td>CIUEM</td>
<td>Centre for Informatics of Eduardo Mondlane University</td>
</tr>
<tr>
<td>CK</td>
<td>Content knowledge</td>
</tr>
<tr>
<td>CMS</td>
<td>Course management system</td>
</tr>
<tr>
<td>CNAQ</td>
<td>National Council of Quality Assurance</td>
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<td>HEIs</td>
<td>Higher education institutions</td>
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<tr>
<td>ICT</td>
<td>Information and communication technology</td>
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<tr>
<td>ICT4E</td>
<td>Information and communication technology for education</td>
</tr>
<tr>
<td>ISP</td>
<td>Internet service provider</td>
</tr>
<tr>
<td>LMS</td>
<td>Learning management systems</td>
</tr>
<tr>
<td>MEC</td>
<td>Ministry of Education and Culture of Mozambique</td>
</tr>
<tr>
<td>MESCT</td>
<td>Ministry of Higher Education, Science, and Technology</td>
</tr>
<tr>
<td>MINED</td>
<td>Ministry of Education of Mozambique</td>
</tr>
<tr>
<td>MOODLE</td>
<td>Modular object-oriented dynamic learning environment</td>
</tr>
<tr>
<td>MoReNet</td>
<td>Mozambique Research and Education Network</td>
</tr>
<tr>
<td>NGOs</td>
<td>Non-governmental organisations</td>
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<tr>
<td>PBL</td>
<td>Problem-based learning</td>
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<tr>
<td>PCK</td>
<td>Pedagogical content knowledge</td>
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<tr>
<td>PK</td>
<td>Pedagogical knowledge</td>
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<tr>
<td>POL</td>
<td>Project-oriented learning</td>
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<td>QIF</td>
<td>Quality improvement and innovation</td>
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<td>SAL</td>
<td>Students’ approaches to learning</td>
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<td>SCL</td>
<td>Student-centred learning</td>
</tr>
<tr>
<td>SINAQES</td>
<td>National System of Evaluation, Accreditation and Quality Assurance of Higher Education in Mozambique</td>
</tr>
<tr>
<td>SRL</td>
<td>Self-regulated learning</td>
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<tr>
<td>STADEP</td>
<td>Staff development project</td>
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<tr>
<td>TCK</td>
<td>Technological content knowledge</td>
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<td>TK</td>
<td>Technology knowledge</td>
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<td>Abbreviation</td>
<td>Description</td>
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<tr>
<td>TPACK</td>
<td>Technological pedagogical content knowledge</td>
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<td>TPK</td>
<td>Technological pedagogical knowledge</td>
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<tr>
<td>UEM</td>
<td>Eduardo Mondlane University</td>
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<tr>
<td>UNESCO</td>
<td>United Nations Educational, Scientific and Cultural Organisation</td>
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<tr>
<td>USAID</td>
<td>United States Agency for International Development</td>
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1. INTRODUCTION

The use of information and communication technology (ICT) as a tool to support modern teaching and learning methods, and especially student-centred learning (SCL) pedagogy, is a widespread practice. Many research studies have addressed this topic, identifying the supportive role of ICT in the implementation of student-centred approaches in higher education (Clark, 2001; Kozma, 2001; Eng, 2005; Balasubramanian et al., 2009). Student-centred learning approaches encourage lecturers to use various methods that allow active learning, such as cooperative learning, open-ended assignments, critical-thinking exercises, simulation, and problem-solving activities (Felder & Brent, 1996; Casner-Lotto & Barrington, 2006; Muianga et al., 2013). This modern pedagogical approach has proven to be an effective learning tool in today’s society, where the labour market demands that employees possess both job-related competencies and more generic skills. It is therefore essential that higher educational institutions (HEIs) adopt SCL to provide a foundation for the continued growth of graduates in terms of competence, skills, and knowledge (Janor et al., 2013; Muganga, 2015).

Although Eduardo Mondlane University (UEM) had introduced computer engineering to the Faculty of Engineering in the 1980s, the development of the Internet and the launch of courses on basic computer skills for teachers, students and civil servants in general in 1993 was seen as the start of a new phase in the introduction of ICT. Furthermore, in this phase, the university also began serving as an Internet provider for public institutions, and provided the use of email for the academic community and non-academic staff. In the 2000s, with curricular reform, the university also began installing of computer rooms in some faculties and promoted their use in teaching and learning.

The transition from an industrial society to an information and knowledge society was seen as a global development, and many countries in the word were preparing their economies and societies for this new era (Hadad, 2017). Mozambique also took this opportunity by developing new policies in various key areas of the economy, the most important of which
included Mozambique's ICT policy in 2000 and its action plan in 2002. The former provided principles and objectives that allowed ICT to be a driving force for various aspects of national development, contributing to the country's participation in the global economy based on information and knowledge, and to better governance (Government of Mozambique, 2000). Other objectives of this policy included giving citizens wider access to the information society, the eradication of absolute poverty, improvements to the living conditions of Mozambicans, and the conversion of the country from a mere consumer to a producer of ICTs (Government of Mozambique, 2000).

After nearly 20 years, the Information Society Policy released in 2018 continued to focus on education and human development as key areas for development. The implementation and dissemination of ICT in the educational system offers added value and opportunities for the development of the sector in terms of access and the quality of teaching and learning (Government of Mozambique, 2018). Current global conditions require the population to be educated for new challenges, and specifically those related to the economy, labour market, culture and social relations, and require people with strong and well-developed competencies. SCL and ICT play major roles in these changes and in the development of this society.

In recognition of the value of ICTs and the role of student-centred education in implementing these changes, UEM initiated curricular reform in 2000. According to the Strategic Plan for Higher Education 2011–2020, one of the main objectives of this curriculum reform was to promote the use of student-centred learning in all pedagogical activities, in order to raise the quality of education and the relevance of the programs offered (MINED, 2011a). Moreover, the focus of higher education was increasingly changing during this period to prepare students with the necessary skills to successfully meet the demands of the modern labour market (MINED, 2011b). The curriculum reform process introduced SCL and ICT as tools for teaching and learning, and there was also a need to provide teachers with the skills and abilities to introduce the changes and pedagogical practices necessary for this new reality.

This study aims to examine the process of introduction of SCL for teaching and learning, with support from ICT, that began in 2000, taking the implementation by UEM as the main object of research. It should therefore be stressed that the purposes of this research study are firstly to discuss the pedagogical model to adopt and the different teaching and learning strategies to use in this model, and secondly to examine the different ICT tools required, the factors involved in their implementation, and the pedagogical
training needed, from the perspectives of the teachers, students, IT technicians and managers of the HEIs involved.

There are many theoretical frameworks and pedagogical models that can be used for the effective implementation and innovation of SCL and ICT for teaching and learning. ICT infrastructure and equipment have advanced a great deal since developing countries began its implementation in the 2000s. Furthermore, equipping the university with the latest generation of computers will not make education effective if other factors are not considered such as implementation within the institution, support from outside of the institution, the organisational climate, staff training and development, resources and ICT policy, and teacher and student support for a more holistic experience. However, for a more effective implementation of SCL and ICT in teaching and learning, it is still necessary to develop a culture of innovation at various levels within universities. It is important that a top-down approach is accompanied by a bottom-up approach to speed up implementation.

1.1. Background

According to Newhouse (2002), computers in higher education are both a subject of study per se (technology education) and as support for learning and teaching (educational technology). Two important aspects were mentioned: firstly, there is a need to develop further technologies as a way to meet the demands of humanity itself, and secondly, there is a need to study how to use these technologies effectively, both within education and in other sectors of society. Hayes et al. (2001) identified the potential of ICT to transform pedagogy in terms of: (a) educational philosophy, where it facilitates the shift from students reproducing the knowledge of others to constructing knowledge themselves; (b) teaching and learning approaches, where it enables the move from teacher-centred to student-centred learning activities; (c) new materials, where it allows access to both local and global resources; and (d) the type of learning activities, where it allows for more complex tasks to be performed and multi-modal information to be used, as opposed to simple and single-mode activities. It is important to mention that these pedagogical changes do not occur separately, but are intertwined; many modern learning technologies assume certain types of pedagogy and approaches to learning, while many modern pedagogical approaches benefit greatly from certain types of technology (Mikre, 2011).
The advantages of the use of ICT in education have been widely debated. Although some institutions have invested a great deal of resources into ICT infrastructure, some of those efforts have shown few or no results in terms of inducing institutional change and sustainably improving the quality of education. It is possible that these investments did not take into consideration the potential of ICT to transform pedagogy in the four areas identified by Hayes et al. (2001). The extent to which ICT can improve education also depends somewhat on the lecturer’s beliefs and attitudes towards ICT. Scrimshaw (2004) argues that the personal characteristics of teachers may influence the extent to which they are willing to take up innovation, while Fullan (2000) emphasises that alterations in mindsets, such as pedagogical assumptions, values and beliefs, are key factors in any effort towards educational change. This means that people’s mindsets and their subconscious values play an important role in the success of implementing new tools and approaches. Teachers who advocate for the use of ICT usually have a positive attitude towards change and are willing to experiment (Hatlevik & Arnseth, 2012; Teeroovengadum, Heeraman & Jugurnath, 2017). These teachers are most likely to succeed in implementing ICT in the classroom. Logically, the chance of success in implementing new tools and approaches is lower for teachers who do not advocate the use of ICT and SCL (Fullan, 2000).

1.1.1. ICT in education

Many scholars have discussed the difficulty in reaching a consensus on the definition of ICT (Elisha, 2006; Jamieson-Proctor & Finger, 2008; Hamid & Zaman, 2010; Hesterman, 2011; Kahiigi et al., 2009), due to the rapid changes and development in this area. Although various definitions of ICT have been reported in the literature, the two presented below are the most widely shared.

Tinio (2003) defines ICT as a “diverse set of technological tools and resources used to communicate, and to create, disseminate, store, and manage information” (p. 4). This is similar to the definition used by Cohen, Salomon and Nijkamp (2002): “ICT is a collection of technologies and applications which enable electronic processing, storing and transferring of information to a wide variety of users or clients” (p. 34). These definitions highlight two important aspects. The first is related to the variety or collection of technologies and applications, which may include hardware (e.g. computers and other peripheral devices) or software and connectivity (e.g. access to the
Internet, local networking infrastructure, video conferencing and other applications). The second aspect of ICT is related to those technologies that are used for processing, storing and transferring/communicating information. Here, the term ICT covers any product that creates, stores, retrieves, manipulates, transmits or receives information electronically in a digital form (Elisha, 2006; Wee & Zaitun, 2006).

A more elaborate definition of ICT is given by Elisha (2006), who describes ICT as follows:

“...[A]n umbrella term that includes any communication device or application, encompassing: radio, television, cellular phones, computer and network hardware and software, satellite systems and so on, as well as the various services and applications associated with them, such as videoconferencing and distance learning” (Elisha, 2006, p. 35).

This definition specifies ICT in terms of the kinds of technology that are considered. Furthermore, it includes distance education as an ICT application.

It is clear from the above definitions that in the educational field, ICT and its applications can be used for many different purposes. Firstly, ICT can be seen as a subject in its own right that involves the development of technology and the analysis of its impact on society. Secondly, ICT can be used to support pedagogical activities and deep learning by making education more personalised, emotive, creative, flexible and dynamic. For example, in the pedagogical activity of e-learning, ICT is used to support all educational activities (Kahiigi et al., 2009). This includes hardware such as computers and mobile phones, and also software such as email, chat and learning management systems (LMS). There is also a more restricted form of e-learning called ‘blended learning’ that can be briefly described as a mix of e-learning and traditional classroom learning (De Boer, 2004). In the last decade, a new variation of e-learning has emerged called ‘m-learning’ (mobile learning), which makes use of portable wireless technologies such as digital media players, smartphones, and personal digital assistants; this differentiates it from e-learning (Evans, 2008). The rapid evolution of this technology and its application in different forms in education has meant that it is difficult to identify a common definition for e-learning (Arkorful & Abaidoo, 2015).

Thirdly, ICT can be used to support educational management, which involves a variety of technological applications such as financial and administrative management, or any other activities related to the organisational
aspects of the institution (Kipsoi, Chang’ach, & Sang, 2012; Zain et al., 2004; Kozma, 2008). Fourthly, ICT can be used to enhance the creation of research networks (Howells, 1995; Kommers et al., 2014), and it has contributed to the modernisation of academic library services (Ani et al., 2005; Parvez, 2011). Although there are differences in the types of role that ICT plays within education, the common denominator is that ICT functions as a catalyst for a diversity of changes in education at all levels (Mooij and Smeets, 2001; Sangra, & González-Sanmamed, 2011). It is also important to mention that the implementation of ICT does not immediately bring forward concrete and desirable transformations; for example, a common barrier at classroom level is that teachers tend to rely on traditional teaching methods, and resist the integration of ICT into teaching activities (Howard, 2013; Perrotta, 2013; Ponticell, 2003). It is clear that the integration of ICT into education is not an easy matter, as it is still difficult for some educational institutions to allocate enough resources to support its implementation (Barron et al., 2001; Muianga et al., 2013).

The debate over the use of ICT in education has never been the subject of consensus worldwide; there have always been both supporters and opponents, particularly in relation to developing countries. Over the last ten years, several studies of the use of ICT in education reported by specialists and international organisations have highlighted the failure and the inconclusiveness of the evidence of the impact of ICT on educational quality (Lubbin, 2018). Conversely, other experts have found that the use of ICT has undergone developments within this period, and have defended these great changes.

The advances in ICT over the last decade mean that human beings must be willing to adapt to new challenges in various sectors of society, including in the educational sector. In the previous decade, the primary concern of educational institutions has been the ratio of computers to students; however, students and teachers now generally have access to more than one device connected to the Internet. It is also believed that if the Internet, tablets, computers, applications and other platforms are used with clear goals to stimulate students’ imaginations and support the work of teachers, they can have positive impacts outside of student engagement (Thilakarathna et al., 2010; Turcano, 2016).

The emergence of the Internet of Things (i.e. devices used to offer connectivity for everyday objects) has made a difference in the field of education, since this can offer students access to educational tools at any time and anywhere (Asseo et al., 2016). People are already living in a time that
smartphones allow to be used for everyday objects that offer connectivity. Smartphones, tablets, e-book readers and computers can be used to access virtual environments such as libraries and laboratories, among others (Dresselhaus & Shrode, 2012).

Another important development over the last decade is related to cloud computing, which allows virtual files to be stored and shared without the need to install applications on the teacher's or student's machine (Romero-Zaldivar et al., 2012). This evolution allows users to work with a great deal of content even without the aid of devices such as CDs and pen drives, simply by storing everything in the cloud. Thus, cloud computing offers a true revolution in the educational field; it can even replace heavy books with virtual files and, in particular, facilitate access to such material (Gosavi, Shinde & Dhakulkar, 2012). Another feature of cloud computing is related to the speed with which access to information is provided. Access can also be offered through iPads, notebooks and desktop computers, among other devices.

Recently, following the significant expansion of social networks, some educational institutions have begun to pay attention to this new way of disseminating information among students (Alwagait, Shahzad & Alim, 2015). Social networks can generate new synergies among members of an educational community, such as by facilitating the sharing of information on topics studied in the classroom or in group study, and can disseminate diverse information content by sharing resources (documents, presentations, links, videos). The involvement of students and teachers creates a channel of communication with other people outside of the institution.

Nowadays, the production of audiovisual material is becoming increasingly easy, as confirmed by the number of such programs that are available for free or via streaming services on the Internet. This also involves changes in education, as it allows teachers and students to work with educational materials that are capable of offering a better understanding of various subjects. Ten years ago, the primary concern of education in this area was the development of basic ICT literacy for teachers and students; today, this concern has been replaced by the importance of coding and computational thinking.

Thinking about the future of education involves knowing how to apply the range of new resources that are emerging. When teachers do not take advantage of new technologies for educational purposes, it gives space for these technologies to end up acting contrary to the ideal. The use of ICT in
education is inevitable, and it is important to understand trends that can ensure a better teaching and learning process in the future.

In conclusion, ICT in education can be defined as the use of all tele-communication devices and applications (hardware and software) to support activities related to an educational institution. This includes pedagogical, organisational, administrative and management activities. In this research, ICT in education is defined as the use of telecommunication devices and applications (hardware and software) to support pedagogical activities.

1.1.2. Student-centered learning and constructivist learning theory

The societies of the twenty-first century are dynamic, and are in a constant state of change (Michalski, Miller & Stevens, 2000). Changes are taking place in various spheres of life, including economic, scientific, cultural and social (Ogunsola, 2005), and these are caused both directly and indirectly by many factors, including ICT. The effects of ICT in our modern society have required people to adapt to changes and respond to the challenges that these technologies have caused. Some scholars refer to this skill as ‘professional autonomy’ when discussing the new competencies that are required of today’s employees (Mathew, Mathew, & Peechattu, 2017). To gain professional autonomy, education must encourage students to independently learn, evaluate, synthesise and create information, and the mode of learning must shift from one in which teachers transmit knowledge to students, to one where students construct knowledge themselves. This learning philosophy constitutes the fundamental ideas of constructivism and SCL (Froyd and Simpson, 2008; Motschnig-Pitrik & Holzinger, 2002; Muganga, 2015).

Different terms are used to describe SCL depending on the principles and practices emphasised. Some common phrases used include “inquiry-based learning” and “collaborative learning”, which focus on the active role of the students in the learning process (Froyd and Simpson, 2008). SCL is grounded in the constructivist learning theories. In this approach, learning is seen as a process through which individuals construct meaning for the world through experiencing things, and by reflecting on these experiences (Muganga, 2015; Tinio 2003). By working in groups, students construct knowledge with their peers in a way that is holistic, authentic and challenging. The role of the teacher is to act as a guide and facilitator, and to engage students in a learning process where they can develop deep understanding and, in the long run, competencies and attitudes that are crucial to succeeding in a modern-day workplace (Barr and Tagg, 1995; Tinio, 2003). Some of
the most critical abilities required of today’s graduates are critical thinking, creativity, initiative taking, problem-solving skills, teamwork skills, and communication skills, which are all promoted in SCL (Aviram & Yonah, 2004; Billing, 2007; Bridges, 2000; Kember & Leung, 2005; Muganga, 2015).

Students’ approaches to learning (SAL) and self-regulated learning (SRL) are referred as the main two dominant research traditions in SCL (Apiola & Tedre, 2013; Biggs, 1987; Lonka, Olkinuora & Mäkinen, 2004). Researchers focusing on SRL have highlighted, for instance, deep learning, as it emphasises the autonomy of learners. Students are encouraged to control and direct their actions to achieve learning goals such as information acquisition and self-guidance of professional growth (Marton & Säljö, 1976a; Zimmerman, 2000). Researchers have pointed out that the main pillars of self-regulated learning are the involvement by students in learning activities, the responsibility for motivating themselves and the attainment of personal goals (Zimmerman, 2000; Greene & Azevedo, 2007).

The term “self-regulated learning” is often used to refer SCL. SRL is used in a variety of learning theories to describe the promotion of higher-level learning abilities such as collaborative learning, intrinsic motivation, and metacognitive skills. The term is also used to describe surface learning strategies and intrinsic goals, together with deeper learning strategies (e.g. Biggs, 1993; Laurillard, 2005; Marton & Säljö, 1976b).

According to Felder and Brent (1996, p. 43), SCL is a broad approach that includes active learning experiences, a self-paced and cooperative style, responsiveness to individual needs and the nurturing of learning potential. In this definition, students have a fundamental responsibility for and engagement in their learning activities. It is important that learning activities such as peer discussions, student collaboration and contribution, project-oriented learning and problem-based learning allow students to explore each others’ attitudes and values. “Active” and “collaborative” learning are further terms used to characterise students’ involvement in the learning process in SCL approaches (Froyd & Simpson, 2008, p. 2).

SCL has several advantages compared to traditional methods of teaching and learning; these include higher rates of retention of knowledge and skills, self-regulated learning and increased student motivation. Students also develop greater self-confidence, as they are involved in learning activities and are responsible for their own learning (Baeten et al., 2013; Thanh, 2010).
1.1.3. The shift to student-centred learning

The transition from an industrial society to an information society has forced higher educational institutions to rethink their position and function. According to Bates (2000, p.8) there are three particular reasons for why HEIs need to change and innovate: (i) the need to do more with less; (ii) the changing learning needs of society; and (iii) the impact of new technologies on teaching and learning. In a knowledge society, one of the most important roles of HEIs is to prepare students to use technology, so that they can in due course advance the economy of the country (Bloom et al., 2006). To do this, HEIs must consider the increasingly diverse student body, and put into place new systems for academic support and apply suitable pedagogical approaches (Altbach, Reisberg, & Rumbley, 2010). This constitutes a transformation, referred to by Le Grew (1995) as a “a paradigm shift” in postsecondary education, as characterised in Table 1 below.

Table 1: Paradigm shift in postsecondary education (Le Grew, 1995)

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial society</td>
<td>Information society</td>
</tr>
<tr>
<td>Technology is peripheral</td>
<td>Multimedia is central</td>
</tr>
<tr>
<td>Once-only education</td>
<td>Lifelong learning</td>
</tr>
<tr>
<td>Fixed curriculum</td>
<td>Flexible, open curriculum</td>
</tr>
<tr>
<td>Institutional focus</td>
<td>Learner focus</td>
</tr>
<tr>
<td>Self-contained organisation</td>
<td>Partnerships</td>
</tr>
<tr>
<td>Local focus</td>
<td>Global networking</td>
</tr>
</tbody>
</table>

It is therefore critical that education undergoes a general rethinking and changes to methods of teaching and learning, since modern society is in a constant state of transformation.

1.1.4. The role of ICT in SCL approaches

The use of ICT can amplify student-centred learning pedagogy in many ways. The effective integration of ICT into education can yield an invaluable learning experience that can motivate students to become lifelong learners. For example, teachers can use ICT to produce authentic and challenging tasks, and this can stimulate inquiry and curiosity among students (Moeller
& Reitzes, 2011), helping them to relate their knowledge to issues in the real world.

Since SCL requires a great deal of interaction between students and facilitators, depending on the selection of the ICT tool used. ICT can facilitate communication and collaboration between individuals, independently of time and location. ICT can facilitate documentation and the storing and sharing of information (Moeller & Reitzes, 2011), and this can make learning more effective. ICT allows teachers to diagnose and address individual needs (Moeller & Reitzes, 2011), making it easier for them to act as guides and advisors. Moreover, ICT facilitates the repetition of tasks; for example, weaker students can repeat tasks if necessary, while stronger students can proceed to higher-level tasks. With ICT, students can freely explore different forms of learning material and solve problems independently, which enhances their creativity, self-management and higher-order thinking skills (Motschnig-Pitrik & Holzinger, 2002; Tinio, 2003). ICT can also support students in articulating thoughts, knowledge construction and theory building (Li et al., 2010).

Although ICT has the potential to improve the quality of education by promoting SCL, integrating it into educational practices has proven to be a slow and complex process (Moeller & Reitzes, 2011; Tondeur et al., 2007). For the successful implementation of ICT, a project must overcome common challenges such as a lack of organisational support, a lack of pedagogical support, a school culture that conflicts with specific uses of ICT, and a lack of confidence by teachers in the use of technology (Moeller & Reitzes, 2011; Muganga, 2015; Tinio, 2003). Despite limitations on resources, it is still possible to implement SCL approaches (Muganga, 2015), and it is therefore critical that education undergoes a rethinking of the methods of training new employees for the demands of modern society.

The use of the Internet in education offers new opportunities, and allows easy, universal access to many digital resources. This access has been cited as one of the reasons for the increase in plagiarism in the academic field, and as a consequence, the decline in the quality of student academic work (Kang, Gelbukh & Han, 2006; Park, 2003; Scanlon & Neumann, 2002). Brown and Howell (2001) argue that the rates of plagiarism have increased, and that the Internet both facilitates this practice and reduces the probability of detection. This has posed a significant challenge in the education sector (Ali, Abdulla & Snasel, 2011; Park, 2003). Despite certain limitations, researchers have been developing a range of different software and applications for plagiarism detection (Ali, Abdulla & Snasel, 2011), tools
that are increasingly important for academic quality assurance due to their ease of use.

Mozambican universities have also been facing the problem of plagiarism. In 2015, a study that evaluated 150 undergraduate and Master's theses from the five largest universities in the country, including UEM, revealed that 75% contained significant plagiarism (Coughlin, 2015). This is because the students have access to content on the Internet and do not use this properly when writing up projects at the conclusion of their studies. This evaluation raised concerns for higher education in general, and some universities adopted tools such as Turnitin and Urkund (which have a Portuguese version) for plagiarism control.

1.1.5. Professional development in higher education

Another important issue that is related to improvements in the quality of teaching and learning in HEIs is professional development. Although this may be obvious, the sphere of professional development is changing. Effective training for academics could in the past be achieved by taking into consideration the specific domain of knowledge related to a profession, the competences demanded for the development of research projects, and the skills needed to effectively redesign learning opportunities (Ebert-May et al., 2011; Rienties, Brouwer & Lygo-Baker, 2013).

The complexity of the globalised world is notable for its contradictions and challenges. It has therefore become increasingly evident that teaching in HEIs not only requires knowledge derived from science and technology but also pedagogical, socio-cultural and ethical knowledge. Nowadays, specific knowledge and competences in the development of research projects are no longer sufficient for teaching in higher education; due to these new demands, it is necessary to provide adequate training and staff support for academics in order to increase their awareness of the complex interplay between technology, pedagogy and the cognitive content in their disciplines (Rienties, Brouwer & Lygo-Baker, 2013). Furthermore, the profession of teaching requires the (self)-coaching of human and social aspects, or in other words, a cultural attitude.

Professional development must provide autonomous, critical-reflective thinking (Mathew, Mathew & Pechattu, 2017; Šarić & Šteh, 2017). This training should enable personal growth, and develop elements that add value to the life of the teacher. Growth in self-confidence and more independent thinking allow participants/teachers to see this training as a
personal investment, and this kind of professional development therefore contributes to the construction of both a personal and a professional identity.

1.2. Research context

Lourenço Marques University, which later became UEM, was the first higher education institution in Mozambique, and it was established in 1962 by the Portuguese colonial government. At the time, higher education was only accessible to people of Portuguese descent (Beverwijk, 2005), since access to university required social and economic capital that was not available to the large majority of the Mozambican population. It was the only higher education institution in Mozambique until 1975, when the country became independent. On the eve of National Independence Day of this year, it was estimated that more than 90% of the Mozambican population was illiterate (Macabi, 1991). This was one of the many challenges that faced the new government: the shift from a colonial education system to a new system where education was accessible to all. UEM now has 1,741 teachers and researchers (396 PhDs, 816 masters, and 529 graduates), 2,934 non-academic staff, and 34,910 students (77 PhDs, 3,219 masters, and 35,809 graduates) (UEM, 2018). It has 17 academic sites located within a radius of 7 km in Maputo, and 11 faculties: a main campus with six faculties and five faculties on their own small campuses. It also has six higher schools, two of which are located in the main campus, and four across three different provinces.

The national education system introduced to Mozambique included primary and secondary education, higher education, vocational education and adult education (Dhorsan & Chachuiaio, 2008). However, it was not until 1985 that the Ministry of Education created additional HEIs, including the Higher Pedagogical Institute (now the Pedagogical University) and the Higher Institute for International Relations (ISRI). In 1995, the Mozambican government developed the Education Sector Strategic Plan to expand access to high quality education and to strengthen institutional capacity and decentralisation (Errante, 2009). It was within this framework that the private sector was permitted for the first time in Mozambique to enter the field of higher education, which had until then been dominated by the government and the ruling political party. A new law regulated the founding of public and private institutes for higher education, and facilitated the establishment of the first private universities, namely the Catholic University of Mozambique,
the Polytechnic University, and the Institute of Science and Technology. Since then, the number of HEIs has increased to 41 (18 public and 23 private universities), and these are spread across all of the provinces in the country (MCTESTP, 2016). Following this growth in the number of HEIs, the government began to have concerns about the low quality and ineffectiveness of education at some of these universities (Beverwijk, 2005; Bloom et al., 2006). As a response to these concerns and as a reaction to the shift towards globalisation, the government formed the Ministry of Higher Education, Science and Technology in 2000. In the same year, the Ministry approved the Strategic Plan for Higher Education in Mozambique for the period 2000–2010 (MESCT, 2000). This plan aimed to improve the quality of education to meet social and labour market demands, and to enhance the use of available resources, the development of research activities, and the diversification of institutions and training opportunities.

Over the last few years, Mozambican higher education has experienced an increased use of ICT applications by both students and lecturers. This is due to a nationwide initiative that invites HEIs, banks and IT companies to offer loans allowing students and lecturers to purchase ICT equipment (Muianga et al., 2013). As the cost of ICT equipment and Internet services decreases, and as the mobile network continuously expands, access to ICT and its services have become more affordable and available (Muianga et al., 2013). Better access to these technologies facilitates their use in education, and hence the possibility of combining traditional classroom teaching with ICT-enhanced learning.

In 2018, the country developed and launched a new Information Society policy, and education continues to be a priority area. One of the issues mentioned in the new policy is related to the development of distance learning, which promotes learning and addresses challenges related to access to education, especially in the most remote regions and among the most disadvantaged social groups. Another issue is the improvement of the teaching-learning process through access to digital and interactive content, making it more stimulating and enhancing the development of critical competencies for a modern and competitive society.

The commitment of the government to the massification of the use of ICT in the strategic sectors of the country has had positive effects. ICT access has been growing, in terms of both quality and the number of service providers, although it still benefits only a small percentage of the population. For example, access to the Internet, one of the main tools in higher education, is limited since the average Internet speed in Mozambique is 13.91
Mb/s for download and 7.49 Mb/s for upload. Table 2 gives a list of internet service providers (ISPs) offering Internet access in Mozambique, in order of download speed; this shows that UEM is one of the best in the country.

Table 2: List of ISPs offering Internet access in Mozambique (source: Broadband, n.d.)

<table>
<thead>
<tr>
<th>Provider Name</th>
<th>Download Speed (Mb/s)</th>
<th>Number of Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eduardo Mondlane University</td>
<td>100.36</td>
<td>4</td>
</tr>
<tr>
<td>Intra Data communication</td>
<td>92.23</td>
<td>2</td>
</tr>
<tr>
<td>Intra Ltd</td>
<td>1.94</td>
<td>2</td>
</tr>
<tr>
<td>Mozambique Celular, SARL</td>
<td>2.17</td>
<td>2</td>
</tr>
<tr>
<td>Movitel SA</td>
<td>4.77</td>
<td>66</td>
</tr>
<tr>
<td>Moztel Lda</td>
<td>1.96</td>
<td>2</td>
</tr>
<tr>
<td>Telecomunicações de Moçambique (TDM)</td>
<td>5.81</td>
<td>17</td>
</tr>
<tr>
<td>Teledata Mozambique</td>
<td>9.31</td>
<td>3</td>
</tr>
<tr>
<td>TVcabo Mozambique</td>
<td>2.39</td>
<td>42</td>
</tr>
<tr>
<td>Vodacom Mozambique</td>
<td>16.07</td>
<td>33</td>
</tr>
</tbody>
</table>

The issues that are considered crucial in the educational sector include the massification of access to knowledge through linkage to a globalised information network, the creation of digital libraries and the promotion of information sharing among the various educational institutions, and the implementation of school management systems that can maximise the efficiency of administrative processes, such as enrolment, management of teachers, student follow-up and other issues (Government of de Mozambique, 2018).

1.2.1. ICT in Mozambican higher education

UEM was the first HEI to introduce ICT as a tool for teaching and learning in Mozambique in the 1990s, as a response to the universal technological revolution. In 1993, all faculties were connected to the Internet, and this was facilitated by the Centre for Informatics at UEM (Domingos, 2012; Smail, 2001). In 1998, Mozambique established the Commission for Information Technology Policy, and in 2000, the National ICT Policy was developed and approved. In 2002, the National ICT policy action plan and strategy was developed, and this was immediately implemented (Gaster, Cumbana, Macueve, Domingos, & Mabila, 2009).
The UEM Strategic Plan 2000–2004 supported both the use of ICT in the curriculum and related research to improve teaching and learning processes (UEM, 1999). This plan included a number of recommendations for turning UEM into a more effective institution. ICT was mentioned in several places, and some of the recommendations underlined the use of ICT as a way to offer access to a broader student population across the country. It was argued the university could increase its market through the use of ICT, and that offering distance education programs could enhance the expansion of the university and the educational quality. The use of ICT was seen as an opportunity to introduce new teaching and learning methods and up-to-date lesson materials; it could provide a basis for the development of focused, profitable and lifelong learning programs, and for the professional development of teachers. It was also seen as a powerful instrument to address new strategic priorities, including the promotion of postgraduate programs, a supportive tool for administration and management, a route to becoming a centre of excellence and consequently a justification for increases in admission rates (UEM, 1999).

HEIs in Mozambique started to use ICT for educational purposes in the early 2000s when the first steps to create an ICT infrastructure were taken (Mário et al., 2003). The Strategic Plan of the Eduardo Mondlane University for the period 2010–2014 emphasised the need to ensure high-quality education by improving teaching methods, increasing research activities and expanding ICT infrastructure and the use of ICT in classrooms (UEM, 2010). Almost all of the faculties of UEM are now engaged in program innovation to meet the goals of the strategic plan.

Although the Strategic Plan highlighted changes in the traditional way of teaching, little was done to accommodate these changes in reality. The use of ICT at UEM also played a secondary role. It became clear that there was an urgent need to implement new teaching and learning methods that were geared towards active learning by students. This was not only seen as an important goal for UEM to achieve but also as one of the most important challenges for the country (MEC, 2006). Future students will be expected to change from being passive receivers to creators and constructors of knowledge. As competent learners, students will need to understand how to evaluate information critically, act accordingly and otherwise deal with information in a proficient and applicable way. In order to guide learners successfully in the right direction, it was argued that ICT should become a basic resource for teaching and learning at all levels of education (MEC, 2006). ICT can be used to promote formal and instructional learning as well as self-
directed learning, for example through non-formal and informal education (Odero & Chinapah, 2016; Olcott, 2013).

1.2.2. The quality of higher education

Over the last 20 years, since the liberalisation and its massification provided by the Higher Education Strategic Plan (2000–2010), Mozambique has seen a significant increase in the number of HEIs. The Strategic Plan was preceded by the Law of Higher Education in 1993, which opened the higher education sector to private providers as a response to challenges in terms of the development of the country (Muianga et al., 2013). However, this massive growth, both of higher education institutions and the number of students that were attracted to register, has posed enormous challenges in maintaining the effectiveness and the quality of the programs required of higher education institutions (Sousa & Oliveira, 2010). The Mozambican government has established a set of policy and normative mechanisms to promote the quality of educational programs, and these are considered to be the main legal instruments regulating the operation of public or private higher education institutions (Langa & Zavale, 2015).

Based on the legal instruments mentioned above, the National System of Evaluation, Accreditation and Quality Assurance of Higher Education in Mozambique (SINAQES) was created to control the expansion and the quality of HEIs in Mozambique. The need for harmonisation and good governance of HEIs and the urgency of meeting the international quality standards were further factors contributing to the development of criteria for monitoring the performance of HEIs (Premugy, 2012). SINAQES relates to the quality assurance of HEIs in four main areas: firstly, ensuring that procedures are in place to measure the degree of excellence and these are operationalised by various stakeholders; secondly, ensuring that norms and procedures are created within which institutions must operate, and which they can use to assess their performance through self-evaluation; thirdly, to certify that norms and mechanisms are there to guide external entities to assess the performance of higher education institutions; and lastly, to verify that norms and procedures are present for internal evaluation in order to allow for accreditation (Uetela, 2015). In this quality assurance system, the use of ICT in teaching and learning is not seen as an essential indicator yet. According to National Council of Quality Assurance (CNAQ) (2016), the indicators used in this system include:
• The vision, the mission, and the objectives, including management and governance (organisation and management of quality assurance mechanisms);

• The curriculum, i.e. alignment with the mission, quality management and teaching-learning methods that include the adaptation of the qualifications of the faculty to the study cycle;

• Research and extension services (consultancies and community outreach activities), including the implementation of policies and research lines, allocation of financial resources, and provision of relevant services to the community;

• Infrastructure in the form of laboratories, classrooms, libraries and equipment, including the existence of a structure for operation, the presence of adequate equipment for the operation of the courses and programs, equipped and organised classrooms, and the availability of adequate bathrooms separated by gender and adapted to the physically disabled;

• Technical and administrative staff i.e. their presence and qualifications, recruitment and selection procedures, training, performance evaluation and career plans, valorisation, and respect for their rights; and,

• University internationalisation, including the implementation of policies to promote the mobility of teachers, students, and researchers.

1.3. Research focus and motivation

The main motivation for this research study was the dissatisfaction expressed by employers in Mozambique with the poor quality of graduates in terms of competencies and capacities (Chilundo and Beverwijk, 2001; Mário, et al., 2003). Under pressure from the demands of the labour market, the Strategic Plan for Higher Education 2000–2010 (MEC, 2005) required universities to strengthen their educational quality, so that graduates were better qualified for work in a global society. The active participation of graduates in the national labour market is crucial for the stable socio-economic development of the country. As a response to the call for improved educational services, HEIs in Mozambique restructured their curricula and course content; however, they omitted one crucial aspect: a reconsideration of the traditional pedagogical approach used at the universities (Noa, 2011). As a countermeasure, UEM carried out a number of assessments, including...
analyses of strengths and weaknesses and of the pedagogical strategies used. These analyses showed that in order to improve the quality of education, curricular and pedagogical reform was needed that integrated ICT and SCL approaches into teaching and learning practices.

UEM introduced curricular reform in the early 2000s, with the aim of introducing ICT and SCL approaches to improve the quality of education. The university built a central library and purchased books in all areas of knowledge; where there was a lack of literature in the faculties, teachers produced and collected scientific articles and chapters of books with relevant information for the modules/subjects and provided these to students (Muinga & Mutimucuio, 2011). Until as late as 2010, it was found that ICT had not been used efficiently as a tool for teaching and learning, and that traditional teaching methods were still dominant at the university, influencing the students to become mere consumers and reproducers of knowledge transmitted by lecturers (Chilundo and Beverwijk, 2001; UEM, 2012; Mandlate, 2003; Mário et al., 2003). In 2010, an additional four-year Strategic Plan for UEM (UEM, 2010) provided more detailed and updated guidance on how to integrate SCL and ICT in education. These recommendations formed the motivation for this research.

1.4. Research problem

Over the last two decades, Mozambique has experienced sustained economic growth (Cho & Feda, 2015; Jones & Tarp, 2015), and a society characterised by globalisation, the job market and the professions have gained new directions and perspectives. There is a need for HEIs to produce more technically skilled workers, which are required by employers, and to design curricula that incorporate the needs of employers in order to meet the demands of the local labour market and today’s society (Cho & Feda, 2015).

Evaluations of curricular reform in the faculties showed that traditional teaching methods dominated the university pedagogy. The majority of courses were designed to transmit content, emphasising rote learning and transferring an encyclopaedic view of knowledge (UEM, 1999; Mandlate, 2003; UEM, 2007). These problems were also highlighted in the report issued in 2012 by UEM, which examined the psycho-pedagogical training of teachers (UEM, 2012). Further problems highlighted in both reports included the sole use of traditional teaching methods, a lack of modern pedagogical knowledge by teachers, and the secondary role played by ICT in teaching.
and learning (UEM, 2012; Mandlate, 2003; UEM, 2007). It was found that computers were used only for basic tasks, such as word processing, PowerPoint presentations, accounting and academic records. The Internet was mainly used for sending and receiving emails or for visiting websites that were not always related to the subject matter taught in the classroom.

Despite the attempt to shift to SCL and to increase the use of ICT for teaching and learning purposes, lecturers continued to teach using traditional and obsolete pedagogical strategies, and there was no observable difference in the way ICT was used.

This research provides insight into the question of the impact of SCL and ICT on students, in terms of motivation and achievement. The study is unique in the sense that it investigates the use of ICT in relation to SCL within the real setting of an HEI and for the purpose of improving the process of teaching and learning in the context of Mozambique.

1.5. Overall aim and research questions

1.5.1. Research aim and objectives

Based on the problem outlined in the previous subsection, the main aim of this study is to investigate the use of ICT to support the shift from teacher-centred learning to SCL in the context of UEM, Mozambique.

The primary objectives are as follows:

- To identify which SCL approaches are suitable for improving teaching and learning processes within UEM, based on literature studies;
- To implement and test the SCL approach, with ICT support adapted for the UEM via pilot courses;
- To analyse factors related to ICT implementation that can support SCL approaches at UEM and other HEIs in Mozambique;
- To evaluate the effectiveness of the integration of SCL and ICT-based programs at the UEM that addresses the requirements of continuously changing teaching and learning.

1.5.2. Research questions

In regard to the aim and objectives clarified above, the main research questions is as follows:

How can the use of ICT support a shift from teacher-centred learning to SCL in the context of UEM, Mozambique?
The sub–questions related to this question are as follows:

R.Q. 1: What types of SCL approaches are suitable for the UEM in order to improve teaching and learning, according to the literature?

R.Q. 2: How can ICT support SCL approaches with the aim of improving teaching and learning at UEM?

R.Q. 3: What factors/aspects are most significant for the integration of SCL approaches and ICT to improve teaching and learning processes at UEM?

R.Q. 4: What is the effect of the professional development of teachers on the use of ICT in teaching and the use of SCL pedagogy in the classroom at UEM?

1.7. Relationship between research questions, publications and action research cycles

Figure 1 shows the research process, the study presented in this thesis is a compilation of papers that focus on different parts of the main steps of the action research cycle.

The results of studies 1, 2 and 3 address common issues such as the resistance of teachers to the use of SCL and ICT for teaching and learning, the need to improve professional development and the need to combine SCL and ICT in training. The university decided to redesign the professional development programs and used Technological Pedagogical and Content Knowledge (TPACK) as a theoretical framework for combining SCL and ICT, thus building a comprehensive knowledge basis for the teachers.

Based on the conclusions of studies 1 and 2, there was a need to look at other institutions outside Mozambique that had similarities to UEM, with the objective of verifying how the implementation of SCL and ICT for teaching and learning was carried out elsewhere. The chosen institution was the University of Rwanda. It was also necessary to find a theoretical framework that could be used as a basis for comparison of the two institutions and that could function as an implementation reference framework for UEM. This resulted in study 1, 2 and 3, which involved reflection, part of step 3 of the action research cycle. As a result, the flexibility activity framework, the factors involved in pedagogical innovations using ICT and the Complex Adaptive Blended Learning Systems (CABLS) framework, which contained the key factors for the implementation of SCL and ICT in teaching and learning, was used as the basis for a comparison of the two institutions. In
other words, these frameworks were used to guide the implementation process at UEM.

This study highlighted the need to reflect on what the CABLS framework uses as subsystems of blended learning as a way of systemic thinking. An analysis of the interaction between the subsystems can build up a comprehensive understanding. The results show that at UEM, the technology subsystem is mature enough to feed other subsystems. However, a weakness is seen in the teacher subsystem, and the lack of an implementation action plan for SCL and ICT was a further weakness. Study 3 addressed R.Q. 2 and R.Q. 3. The first three studies represented the first cycle of action research, and study 4 and 5 began the second cycle.

Study 4 concerned the design and implementation of a course entitled ‘ICT in Environmental Education’. Improvements to the design model used in study 1 were necessary, and Web 2.0 tools were used to facilitate SCL and to develop competencies such as planning, acting and observation, which are included in the second cycle of action research. An acquisition and contribution model was combined with the flexibility-activity framework, and these were used as teaching and learning models. The results again confirmed that the identified teaching and learning model was appropriate for the conditions at UEM. The course deliverables showed that students developed the competencies that the course aimed to deliver, including problem solving, collaboration, e-learning skills, production of Web 2.0 information, generic ICT skills, and information searches on the Internet. Study 4 also partially addressed R.Q.1 and R.Q.3.

Study 5 carried out an evaluation of the new training in professional development after four years of implementation. This study was a reflection, corresponding to the second cycle of action research, and the results showed that the training activities had a considerable impact. Almost all respondents who participated in the training activities with a focus on the area of content knowledge confirmed that all of the courses had at least a moderate impact, and that more than half of the courses had a significant impact. The study also showed that teachers who participated in professional development activities were more likely to use ICT, and positive influence was also seen in the fact that more participants than non-participants thought that the use of ICT supported the implementation of SCL. A combination of all of the areas of knowledge of the TPACK model in the design of the professional development training was crucial, as it allowed the teachers to understand the pedagogical implications and the potential of using ICT and SCL. Study 5 partially addressed R.Q. 4.
Figure 1 Relationship between research questions, publications and Action Research Cycles
1.8. Research contribution

This research study explores how ICT can support the shift from teacher-centred learning to SCL in the context of a developing country, and specifically at UEM which is a higher education institution in Mozambique. The significance of this thesis lies in an attempt to provide a set of practical problem-solving methods, using existing knowledge that should be considered when introducing SCL and ICT to support teaching and learning. In Study 1, an adapted flexibility-activity framework is used as educational model, and this defines the relationship between ICT and pedagogy in order to describe the changes associated with the intervention at UEM. The educational model provides guidelines for dealing with issues related to the acceptance of ICT in the daily practice of lecturers and students. This educational model was used for instructional design in some courses, resulting in Studies 1 and 4. The model also helped teachers, students, managers and staff to understand the implementation of the new curriculum.

This research study highlights and gives an in-depth analysis of several critical factors/components, such as technology, pedagogy, implementation strategies and institutions, that can have a positive or negative influence on the implementation of SCL and ICT approaches in the context of Mozambican higher education. These components, and factors such as roles within institution, partnership with other organizations, the organisation of learning, the organisational climate, staff training and development, infrastructure and resources, ICT policy, the learner, the teacher, the content, the technology, and learning support at the institution, are very important for the successful adoption of ICT for teaching and learning in the present context. Identifying the factors that contribute to successful implementation at UEM is crucial for a successful implementation and these have to be considered in holistic approach.

In addition, this research study also contributed to the design and implementation of the new professional development training using the TPACK framework, which arose from a study, and comprised by several modules distributed in the different areas of TPACK knowledge. Study 5 arose from an evaluation of the impact of the new professional development program from the teacher’s perspective. This new program is the result of a study by the UEM of the effectiveness of the old professional development program. The opinions of teachers influenced the design of this program.

In terms of contribution to practice, and in line with the goal of the research study, the main research contributions are as follows:
• An adapted flexibility-activity framework in the context of UEM/Mozambique/developing countries that can combine teaching and learning methods and strategies with a focus on a student-centred approach, depending on the learning competences and learning objectives that students need to develop;
• A new system of professional development training, designed based on the concerns of the lecturers and pedagogical coordinators of all HEIs;
• The development of a new curriculum that integrates both ICT and SCL approaches.

This thesis contributes to the body of empirical and theoretical knowledge within ICT in education and the implementation of pedagogical approaches in higher education.

In terms of a contribution to knowledge, in line with the goal of the research study, the main research contributions are as follows:
• Proposed approaches for teaching and learning that are adapted for the context of UEM/Mozambique;
• Identification of the factors involved in pedagogical innovations in the implementation of ICT and SCL in the context of UEM/Mozambique;
• Identification of the particular interests of the teacher and students as unexpected key factors in the successful implementation of SCL and ICT;
• A professional development program designed based on TPACK principles and the contributions from lecturers and pedagogical coordinators of the institutions.

1.9. Structure of the thesis
The thesis is divided into five chapters.

Chapter 1: Introduction. This chapter gives the background to this work, and is divided into five subsections. The first presents a definition of ICT and related concepts in education. The second describes the different definitions and concepts of SCL and the related learning theories, followed by a discussion of the importance of shifting from traditional teaching and learning approaches to SCL and the role that ICT plays in this shift to improve educational effectiveness. A description of the research context and
the research focus and motivation is given in the third section, which is composed of two subsections that summarise ICT and quality in Mozambican HEIs, respectively. The research problem is presented in the fourth section. The fifth section concerns the overall aim and research questions. The relation between the research questions follows and study publications with action plan circles as the sixth section. The research contribution of this thesis is presented in the seventh section, and the chapter ends by giving the structure of the thesis and a list of publications in the eighth and ninth sections, respectively.

Chapter 2: Theoretical Background. This chapter is divided into two main sections: the first discusses educational models involving the use of ICT and is subdivided into six subsections. The first discusses and conceptualises terms used in educational models, and the second conceptualises the pedagogical model and pedagogical innovation, which is essential for the implementation of ICT in teaching and learning. The third subsection presents the flexibility-activity framework as the key educational model for implementing SCL approaches and ICT for teaching and learning. The factors involved in pedagogical innovations using ICT are discussed in the fourth subsection, followed by a description of complex adaptive blended learning systems as frameworks for evaluating the effectiveness of ICT implementation and innovative pedagogy at UEM. As a key factor for successful application of SCL and ICT for teaching and learning, TPACK is presented in the sixth subsection. Finally, the second section of this chapter discusses the implementation of SCL and ICT in education in developing countries.

Chapter 3: Methodology and research methods. This chapter describes the research approach and research strategies applied in this study, and is divided into nine sections. The first section describes the philosophical assumptions driving this research study. Action research and a case study are presented in the second and third sections, respectively, as research strategies used to examine the changes taking place through intervention at UEM. The collection and analysis of data are described in the fourth section, which is divided into six subsections: the interviews are discussed in the first subsection, the workshops in the second, the observations in the third, qualitative data analysis in the fourth, and questionnaires and quantitative data analysis in the fifth and sixth. The fifth section explains the data triangulation used in this research study, and this is followed by a description of the selection of the participants. The latter is divided into three subsections: a description of the students in the first, the lecturers in the second, and the
managers and IT technical staff in the third, as the main respondents in this research. This is followed by a description of the timeline of the study, and the chapter ends with a discussion of research ethics, validity, and reliability, and the limitations of this research.

Chapter 4: Findings and discussion. This chapter provides a brief summary and discussion of the main findings derived from the five studies undertaken in the research study. This is followed by a description of the proposed educational model and its impact on curricular reform, the proposed scheme for professional development, and the factors involved in effective implementation of SCL and ICT.

Chapter 5: Conclusions. This chapter concludes the dissertation by summarising the most interesting findings, the research limitations, and recommendations for further research.

1.10. Research papers

This research study is based on five papers that explore the research phenomena outlined above. Each paper contributes to identifying, analysing and implementing SCL and ICT approaches that are suitable for the given context, i.e. for improvements to the teaching and learning environment at UEM. The following papers have Muianga, X. as the principal author (with more than 80% contribution to all papers) and are published in international journals or conference proceedings, as shown below:


2. THEORETICAL BACKGROUND

The introduction of SCL and ICT into teaching and learning to contribute to educational effectiveness in higher education is a complex and time-consuming process that involves the selection of educational and pedagogical models, and must be well planned, taking into account the economic, social and cultural context. The main theories, related concepts and research findings by which this research study is informed are outlined in this chapter, and a rationale is given for the relevance of these theories to this study. This chapter also presents the conceptual frameworks that will guide the discussion of the various aspects of implementation, and related key factors that are crucial for the implementation of SCL and ICT for teaching and learning. A description is also given of some additional literature that will help the reader to understand the extent to which these educational and pedagogical models and selected ICT tools impact on teaching and learning.

2.1. Educational models and ICT in education

This section presents a discussion of several issues that warrant further explanation, based on the key aspects that frame the setting for this research. Aspects such as the pedagogical framework used, teacher training, technical support, content, context, administrative and political support, sustainability, and other aspects have been highlighted by researchers as being crucial for ICT implementation in teaching and learning across all levels of education (Alsadoon, 2018; Forkosh-Baruch, Nachmias, & Mioduser, 2008; Nachmias, Mioduser, Cohen, Tubin, & Forkosh-Baruch, 2004; Pedró, 2018; Tedre, Hansson, Mozelius & Lind, 2011; Wang, Han & Yang, 2015). In this section, some of these aspects are discussed in the light of the theoretical frameworks used in this research study.

The introduction of SCL and ICT for teaching and learning is a slow and complex process that is influenced by many factors (Inan & Lowther, 2010). It requires changes to different aspects across the institution as well as changes to be made by all stakeholders such as managers, teachers, students...
and IT support. In order to achieve improvements in teaching and learning and a better understanding of the process of introducing SCL and ICT to teaching and learning, four different theoretical frameworks were used for different proposes. The first of these is the flexibility-activity framework (Collis & Moonen, 2001, p. 24). This is a general approach, and covers the components and factors that are crucial to the implementation of ICT in higher education. Moreover, this framework covers in detail the combination of the component technologies versus pedagogy, and how this combination can create flexibility in the various aspects of teaching and learning. The flexibility-activity framework is related to the educational model that was integrated into the new curriculum. The second theoretical framework is a configuration of the factors involved in pedagogical innovations using ICT (Nachmias et al., 2004), and is a comprehensive framework that is related to the internal and external factors that must be considered when introducing changes in pedagogy and ICT for teaching and learning. The third theoretical framework is CABLS (Wang et al. 2015), and this is closely related to the interaction of the blended learning subsystems, which are similar to the internal factors in the Nachmias framework. The fourth and last theoretical framework used in this study is TPACK; this is a framework that considers the necessary knowledge that a teacher must have or acquire to use ICT effectively in teaching and learning.

2.1.1 Educational model
This section provides a background to this dissertation in terms of the introduction of new teaching and learning models. The discussion about educational model versus pedagogical models/frameworks is not a new topic, since the school was introduced in society, and the different models have been used at the different stages of the development of society over time. In education, the concept of a model is considered in several viewpoints like a paradigm, and is also considered to be synonymous with learning theories such as those developed by well-known psychologists or learning theorists like Piaget, Vygotsky, Roger and Bruner, among others. Another important concept related to educational models is proposed by Conole et al. (2004), who use the term “model for the design of learning” to refer to the different pedagogical approaches and learning activities that help with effective learning designs and the appropriate use of different mediating tools and artefacts. These authors argue that a model for learning articulates the key components
of existing learning theories and can make explicit which components are grounded in different learning activities (Conole et al., 2004).

2.1.2. Pedagogical model

Another important concept used in this research study is the pedagogical model. Like an educational model, this concept can be used in various ways in education. Haerens et al. (2011) use the term ‘pedagogical model’ to refer to model-based practice through their description of a curriculum model. These authors use the term ‘curriculum model’ to define this concept, and go further by comparing it with a general pattern that serves to create or shape program designs using a conceptual framework in which it is necessary to identify learning objectives and the structure of the contents of the program. It is also necessary to indicate how the teaching and learning processes should take place, and how the learning environment should be set up. Another term used to refer to a pedagogical model is an instructional model; this provides a kind of scaffolding that be used by pedagogues to enable students to extend their learning beyond what could be learned independently, based on the postulates of the theory (Kavunja, 2014). The similarity in meaning between these two concepts has also been confirmed by other researchers (Andrews & Goodson, 1980; Collis and Moonen, 2002; Reigeluth, 1983). However, it can be argued that pedagogical models are views of pedagogical theories or approaches that are used to guide the specialists and teachers in the elaboration and analysis of studies programs, in the systematisation of the teaching-learning process, or rather in the comprehension of some part of a studies program. In this study, the terms ‘educational model’ and ‘pedagogical model’ are both used: the former refers a combination of the pedagogical model that is used in the teaching and learning process, the technology used for communication in this process, and its implementation in practice, while the second refers to abstract conceptions about the teaching and learning processes implicit in these approaches.

Collis and Moonen (2001) introduce a clear distinction for two important concepts. The first is a ‘pedagogical approach’, which refers to the components used in the course and the pedagogical activities involved, such as the general course organisation, lectures, self-study, assignments, and communication. The second is a ‘pedagogical model’, which is used to refer to the theoretical foundation, concepts and principles upon which the approach is built (Collis & Moonen, 2001). In this study, the term ‘educational model’ is defined as a combination of a pedagogical model, the pedagogical
approaches that are used in the teaching and learning process, the technology used for communication in the process, and their implementation in practice.

2.1.3. The flexibility-activity framework

The first framework of reference for this study is the flexibility-activity framework described by Collis and Moonen (2001). This is a general, visual and/or written product that explains the key factors, concepts or variables, and the presumed relationships among them, in the use of ICT in higher education. This framework offers a range of options from which the student can choose with respect to key dimensions that are specified in advance by the teacher or institution for a certain teaching and learning situation, in which innovative pedagogy is coupled with new learning technologies. This framework is characterised by four key components of flexibility in the implementation of ICT-supported learning in higher education: these are technology, pedagogy, implementation strategy, and institution, as summarised below.

Technology

Technology is used to refer all forms of ICT, such as CD-ROMs, video, audio, social media, and the Internet in general. The use of communication tools between teacher and students is multidirectional and is extended for outside to face-to-face contact in the classroom.

Pedagogy

According to Collis and Moonen (2001), pedagogy is related to “the methodologies and strategies that the teaching and learning processes and settings in a course are organized and implemented by the teacher” (p. 224). These authors describe two important pedagogical models: the acquisition model and the contribution model. An acquisition model focuses on learning activities that are established in advance and are based on the acquisition of pre-specified knowledge, whereas a contribution model focuses on learning activities in which students interact and communicate with others and learn together by exchanging and discussing ideas, creating a product, solving problems, and contributing some additional materials.

Collis and Moonen (2001) highlight the relation between flexibility and pedagogy by gradually introducing participation- and contribution-oriented forms of learning, with activity goals that are focused on acquisition or contribution with a flexibility dimension with categories related to less
and more flexibility. This combination defines the key dimensions of the flexibility-activity framework (Collis and Moonen, 2001), as shown in Figure 2.

Figure 2: Flexibility-activity framework (Collis and Moonen, 2001, p. 24)

The use of technology is indispensable, and the design of learning activities requires multi-skilled teamwork. In addition, this model places emphasis on the work of the students outside of face-to-face classes, either individually or in groups, and requires flexible environments where students can choose when, where, what and how to study and learn (Chen, 2013; Collis & Moonen, 2002; Wanner & Palmer, 2015).

An acquisition model is a more individualised model, and is used to obtain knowledge, while a contribution model is a more group- or community-based model that is used to create the membership of a student in a community. When participation is insufficient, it is necessary to use a contribution-oriented model. Collis and Moonen (2001) suggest that both models should be reflected in pedagogy, with a greater emphasis on contribution-oriented activities. The framework underpinning flexible learning requires a range of teaching methodologies and relationships between teachers and students, and is characterised by the use of various kinds of teaching and learning resources.
Implementation strategies

In the flexibility-activity framework, mediation is required between technology and pedagogy. A further important aspect is the institutional environment, which should describe the strategies and actions used to guarantee the effective integration of ICT. A model is used that predicts the acceptance of ICT for teaching and learning purposes, called the 4-E Model, and this argues that “the individual’s likelihood of making use of technological innovation” (Collis and Moonen, 2001, p. 25) is a function of four groups of factors:

- Environment (related to the institutional context);
- Educational effectiveness (the perceived or expected effectiveness);
- Ease of use (how difficult or easy it is for teachers and students to use a particular program or system);
- Personal engagement (the way that individuals respond to technology and changes).

Institutional Framework

This component is related to ways of planning and delivering flexible learning course units or the curriculum, and explicit attention is paid to pedagogic issues. The chosen pedagogy should be appropriate for the material, the students, the teacher, and the ICT tools for teaching and learning. It is vital to establish which learning resources and learning activities are appropriate for different contexts. Unit design must be informed by learning aims and outcomes, student characteristics and institutional constraints such as staff, resources and infrastructure capacity.

One of the significant advantages of this framework is its flexibility. The range of options and key dimensions mean this model can be adapted to any conditions and context of ICT implementation and pedagogy innovation. Depending on the technological infrastructure and the pedagogical model to be introduced, the institution may stay or move to any of the four quadrants defined by less or more flexibility, and by acquisition or participation and contribution. Collis and Moonen (2001) suggest other institutional factors that are more difficult to measure, and these can affect the implementation of flexible learning. These factors include the social and professional climate of the institution, the leadership management style, the previous experiences of
the institution in terms of technology-related change, and the vision of the leader and key persons with influence within the institution (p. 26). Due to this difficulty in measurement, other theoretical frameworks were also used in this research study to determine the importance of these factors.

2.1.4. Factors involved in pedagogical innovations using ICT

The second framework of reference used in this study is the configuration of the factors involved in pedagogical innovations using ICT, as described by Nachmias et al. (2004). In contrast to the framework presented above, this framework defines the most critical and detailed factors; individuals who have never studied ICT can easily understand which are the most important factors, and which can contribute to the shift from teacher-centred learning to SCL.

The authors of this framework analyse factors including the individuals involved, the infrastructure, the organisation of the school, and the internal and external factors involved in the introduction of pedagogical innovations using ICT. The framework is also used to measure the intensity of involvement of each factor and to explain the connections between these factors and the levels of innovation in different school domains, such as teaching and learning processes, curricula and learning configurations (Forkosh-Baruch, et al., 2008; Nachmias et al., 2004).

Another useful approach with regard to the framework of Nachmias et al. (2004) is to consider four major domains of innovation within pedagogical practices using technology: organisational issues (mainly concerning time and space configurations), student roles, teacher roles, and curriculum issues. The identified factors can also be grouped into seven different categories:

- Role within the school (principal, computer coordinator, leading teachers, and teaching staff);
- Role outside the school (parents and the wider community, the external institutes involved, subject matter experts, policymakers in the Ministry of Education, and municipal position holders);
- Organisation of learning (learning units in terms of time, place or content, and allocation of students into learning groups);
- Organisational climate (diffusion of innovation within the school, and innovation history of the school);
- Staff training (content of training, and source of staff development);
- Infrastructure and resources (amount of computers and peripherals,
technical support, and budgeting of the innovation); and

- ICT policy (national and local/regional).

(after Nachmias et al., 2004).

The framework presented here is related to the implementation of innovative pedagogical practices using ICT in undergraduate education. However, it can be observed that most of these factors can also be used to study the implementation of innovative pedagogical practices using ICT in higher education, and particularly to study some of the issues that are not clearly covered in the first framework. Another crucial aspect that can be observed in the framework of Nachmias are presented critical factors that should be considered in the implementation of innovative pedagogy using ICT particularly in developing countries HEIs (Buabeng-Andoh, 2012; Schweisfurth, 2011; Tedre, Hansson, Mozelius & Lind, 2011; Tedre, Apiola, & Cronjé, 2011).

2.1.5. Complex adaptive blended learning systems

Many researchers have recognised the complexity of integrating ICT for teaching and learning. Akbaba-Altun (2006) showed that the introduction of ICT in education is a complex innovation and that many obstacles need to be overcome before it can be considered effective. Educational changes are complex, dynamic processes involving changes in an institution identity and environment, the teachers’ role and behavioural patterns, the student’s role and performance, and other factors (Nachmias et al, 2014; Tondeur, Van Braak, Ertmer & Ottenbreit-Leftwich, 2017; O’Callaghan, Neumann, Jones & Creed, 2017). Moreover, one of the most crucial changes arises in pedagogy that must accommodate the use of ICT in teaching and learning, and particularly if this technology is used with campus-based students, for example in blended learning.

The third theoretical framework used for this research study is CABLS. This framework identifies and discusses factors that influence the students’ experience of blended learning. Compared with the previous two frameworks, it is unique, as it recommends the use of complex adaptive systems as a theory for re-conceptualising blended learning. The CABLS framework is also used to understand the implementation of pedagogical innovation using ICT from a holistic perspective and to help to develop a more effective and efficient teaching and learning environment.
Wang et al. (2015) argue that the integration of ICT in teaching and learning, and particularly in campus-based learning, has made teaching and learning more complex than ever before. Due to this, and in order to understand blended learning as a system, these authors used complex adaptive systems theory, which consists of five fundamental attributes: complexity, self-organisation, adaptability, dynamism, and the ability to co-evolve. As a result, they suggested the CABLS framework, which according to Derbel (2017) integrates layers consisting of “six elements of learning with its own subsystems that interact with others in a dynamic and non-linear relationship, and each subsystem has its own characteristics and internal driving forces, depending on surrounding subsystems to maintain its vitality” (p. 147).

Figure 3: The framework of complex adaptive blended learning systems (Wang et al., 2015)

Figure 3 shows the six subsystems suggested by the CABLS framework. The first is the learner: students become active agents in the learning process by taking on new roles, such as researchers, practitioners, and collaborators. The second is the teacher, who gains multi-disciplined profes-
sional skills through taking on new roles such as a facilitator, moderator, coach and advisor. The third is the content: a rich variety of content is drawn from different categories, for example by blending offline and online learning, self-paced and live, collaborative learning, and structured and deeper learning. The fourth is technology: multiple interactions take place within technology and between technology and the environment, for example in online, offline, synchronous and asynchronous ways. The fifth is learning support; this refers to academic support that focuses on helping students to develop effective learning strategies, such as time management and collaborative skills, and technical support through helping students to improve their knowledge of the technological tools. The last is the institution: support mechanisms should be provided at an institutional level, such as strategies, policies, support, service and infrastructure.

Unlike the previous two frameworks, CABLS was designed to understand blended learning (Wang et al., 2015). The others were designed to evaluate the implementation of ICT in teaching and learning and the related principles and theories of pedagogical innovation in general (Collis & Moonen, 2001; Nachmias et al., 2004; Pratt, & Kovatcheva, 2018).

2.1.6. Technological pedagogical content knowledge
The fourth and last framework used in this research study is TPACK. This is a conceptual model used by educators and educational researchers to design and implement technology-enhanced learning (Kihoza et al., 2016; Koehler et al., 2014; Moroney & Haigh, 2011; Rienties et al., 2012). The TPACK framework offers an additional perspective on the role of professional development in the context of pedagogical innovation using ICT. To understand this framework, we must consider the complex interplay between technology, pedagogy and content. As recognised by many scholars, the use of ICT alone does not improve the quality of education (Jaffer, Ng'ambi & Czerniewicz, 2007; Kihoza et al., 2016; Mikre, 2011; Nachmias et al., 2004). The transformational aspect is the knowledge of how ICT can be used to enhance the teaching and learning processes (Kihoza et al., 2016; Koehler & Mishra, 2005; Majumdar, 2009; Tinio 2003). Effective teaching therefore requires that teachers have subject matter knowledge, pedagogical knowledge and knowledge related to technology. The TPACK model consists of seven areas of knowledge, three of which are the core knowledge areas of content, pedagogy and technology (Koehler & Mishra, 2005). Figure 4 shows these seven areas.
TPACK was developed by Mishra & Koehler (2006) and is based on Shulman’s (1986) model of pedagogical content knowledge (PCK). Content and pedagogical knowledge should not be separated into different types of knowledge, as they are complementary, and this combination makes teaching and learning more meaningful. Content knowledge refers to subject matter knowledge, while pedagogical knowledge refers to strategies through which knowledge can be made comprehensible; only when these two aspects are combined can teaching become effective. Today, however, the educational context has changed a great deal due to the introduction of modern ICT, defined as technology that enables people to receive, store, interpret, capture, communicate, exchange and transmit information (Anderson, 2010).

The first aspect of core knowledge is content knowledge (CK), which refers to the subject matter knowledge that is to be taught/learned (Koehler & Mishra, 2005). Pedagogical knowledge (PK) is the second aspect, and refers to processes, procedures and methods of teaching and learning (Koehler & Mishra, 2005; Shulman, 1986). The third aspect is technology knowledge (TK), and this refers to an understanding of how to use modern technologies, and traditional technologies for teaching and learning. The
interactions between these three core knowledge areas generate four combinations of knowledge areas, and these are described below.

Pedagogical content knowledge (PCK) was coined by Schulman (1986) and reflects the interplay between content and pedagogy that makes subject content comprehensible to learners. It includes an understanding of what makes the subject content difficult or easy to understand, and refers to the ability to select a pedagogy that corresponds to the requirements of effective teaching (Moroney & Haigh, 2011).

Technological content knowledge (TCK) is knowledge about how technology can enhance subject matter content (Koehler & Mishra, 2005) (e.g. the use of simulations to show the movements of the earth’s tectonic plates).

Technological pedagogical knowledge (TPK) refers to a knowledge of the affordances and constraints of technologies and how these can be used to enable different teaching approaches (Koehler et al., 2014; Moroney & Haigh, 2011). For example, a user-friendly, accessible learning management system involving instructional videos and a discussion forum can be used to promote flexible, collaborative and individualised learning.

Technological pedagogical content knowledge (TPACK) refers to knowledge about the complex interplay between technology, pedagogy and content (Koehler et al., 2014). High-quality teaching requires an in-depth understanding of TPACK knowledge, as this enables educators to develop teaching strategies that are flexible, appropriate and context-specific (Mishra & Koehler, 2006).

The theoretical frameworks described above served as basic knowledge to support the data production strategies that were considered when answering the research questions, and at the same time served to show why and how these theoretical references were pertinent and suitable for this study. The application of the conceptual framework in this study also places more emphasis on the proposed implementation models to the effectiveness of a pedagogical innovation perspective and the use of ICT in the current context of a developing country. Finally, the design of this research study was chosen as an example as it refers to the implementation of innovative pedagogy using ICT in an institution given changes in pedagogical practices that help to sharpen the focus of learning environments that in many ways are more complex than imagined.
2.2. Implementation of SCL and ICT in education in developing countries

In developing countries, and particularly in Africa, the implementation of ICT in education began in the 1990s; it was marked by connection to the Internet in some government institutions, and was followed by the design of national ICT policies in several countries (Africa Tracking Internet Progress, 2011; IST Africa, 2012). In most developing countries, “the national ICT policies are fundamental to the global education agenda and depend heavily on the use of ICT” (Lubin, 2018). The use of ICT can contribute to improving learning outcomes while also promoting access to education, equity in education, a high quality of teaching and learning, more significant social and political equality and stability as well as improved management and governance in a given society (Kozma, 2005; Lubin, 2018; Noor-Ul-Amin, 2013; Samarakoon, Christiansen & Munro, 2017; World Bank Group, 2012).

The use of ICT in education is seen as a strategy for bridging the knowledge gap in developing countries, and also for increasing access and improving the quality of teaching and learning (Kahiigi, 2012; Rogers & Shukla, 2001). Despite barriers like pedagogical framework, ICT teacher training and professional development, limited technology infrastructure and maintenance, ICT in education policy and plans, teacher and student support, content development, institutional support. The types of ICT currently being neglected and/or emphasised in relation to concerns of usability and affordability and sustainability (Hennessy, Harrison & Wamakote, 2010; Tedre, Apiola, & Cronjé, 2011; Tedre, Apiola, & Oroma, 2011; Teeroovengadum et al., 2017; Schweisfurth, 2011; Wallet, 2015). Countries such as Namibia, Botswana, South Africa, Mauritius and the Seychelles have successfully implemented ICT in education (Chisholm, Dhunpath, & Paterson, 2004; Wallet, 2015). Many countries across sub-Saharan Africa have national policies and plans for implementing ICT into the education system, although some of these are still at an embryonic stage (Samarakoon, Christiansen, & Munro, 2017; Wallet, 2015). However, these countries are relatively advanced in terms of the implementation of ICT in education compared with the remaining sub-Saharan countries (Isaacs, 2007a; Isaacs, 2007b; Isaacs, 2007c;).

The governments of these countries have elaborated ICT policies for education and have prioritised distinct areas of development, such as the investigation and development of appropriate ICT solutions, deployment of ICT, maintenance and support, ICT literacy and ICT integration. Some of
these sub-Saharan countries have developed ICT policies for education, and implementation plan prioritises educational institutions by their proximity of socioeconomic situation. Governments of these countries, in partnership with international agencies, have been active in supporting ICT capacity-building (Lubin, 2018). The integration of ICT into education in countries like Malawi, Mozambique, Tanzania, Uganda and Zimbabwe, particularly in primary and secondary schools, “is a low priority when compared to other objectives such as increasing enrolment rates, decreasing the proportion of out-of-school children and ensuring an adequate number of trained teachers” (Wallet, 2015, p.8).

Furthermore, the integration of ICT into education is seen as the highest priority due to its impact on the entire education system (Beukes-Amisse, 2006; Simon & Ngololo, 2015; Wambui & Black, 2009). Organisations such as SAIDE, via the Partnership for Higher Education in Africa (PHEA) project, and the German capacity-building institution InWEnt have organised training courses in instructional design, content development, e-learning management and support for virtual learning communities to allow lecturers to support the implementation of learning management systems (SAIDE, 2013; Wambui & Black, 2009).

Although advancements have been made in the implementation of some key factors of ICT policy in education, other factors remain that constitute barriers to effective implementation. In developing countries, the use of ICT and pedagogical innovation is low, and those teachers who use ICT in their classrooms do so with minimal technical support (Ngololo, Howie & Plomp, 2012; Tedre, Apiola, & Cronjé, 2011; Schweisfurth, 2011). A study conducted by Isaacs, Kazembe and Kazondovi (2018) concluded that the majority of teachers were at only a beginning level of using ICT in teaching; most of them used only word processors and presentation tools for this purpose. The same study highlighted a lack of training in ICT pedagogy, time to learn and incorporate ICT skills and tools into lessons, as well as the exposed insufficient budget allocation for ICT tools such as hardware and software (Isaacs, Kazembe & Kazondovi, 2018).

According to Wallet (2015, p.8), “the integration of ICT into education is taking place relatively slowly in many countries, due to factors such as a lack of formal policies, financial resources, basic infrastructure and teachers with appropriate skills”. Several aspects must be considered in the implementation of pedagogical innovation within ICT. A governmental ICT policy is an important document that provides a variety of strategies or guidelines related to the integration of ICT into the economy, society and
education of a country (Brown & Thompson, 2011; Kozma, 2005; IST-Africa Consortium, 2012). Almost every country in the world has established a national policy on ICT and education, and sub-Saharan countries have used these government documents to define priority areas in which ICT can make a significant difference to economic, social and educational development. However, an ICT policy stresses education as the most important area for the development of a country, and underlines the need for the development of ICT infrastructure, access and use of ICT for education, as well as the creation of partnerships and support as key factors in the implementation of ICT in the country (Kozma, 2008).
3. METHODOLOGY AND RESEARCH METHODS

This chapter begins by explaining the underlying philosophical assumptions of this work. It describes the choice of research methodology and how it was applied in the five studies, and the data collection methods and data analysis used. The data collection methods included interviews, workshops, observation, and questionnaires. The sampling technique used in the studies is also described, and the ethical and limitations of the research methods are clarified. Finally, the chapter presents a time line for the research study.

3.1. Philosophical assumptions

This research study aims to address the real-world problem of identifying and implementing effective SCL approaches with ICT support in order to improve the teaching and learning processes, taking into account the conditions at UEM. According to Creswell (2003), the design of a research study is a difficult and time-consuming process. In the social sciences, it is necessary to consider various aspects, such as the concept of social reality, which should be examined carefully, both explicitly and implicitly (Cohen et al., 2007). The way we look at this concept is related to a particular philosophical assumption. This means that knowledge must be used for reflection about the nature of the world and how this can be obtained (Myers, 2009). Thus, we can conclude that knowledge links the real world with the world of science.

In view of the aspects mentioned above, it is crucial to define the object of the research study and the philosophical assumptions on which the study will be based. It is also important to acquire related knowledge and identify methodologies that are suitable for the object of the research study.

The central objects of this research study are people (lecturers, students, managers, IT staff, and distance learning experts), and their characteristics, attitudes, behaviours and perceptions of the processes of understand-
ing the effectiveness of SCL approaches derived from using ICT, and their experiences drawn from different social and cultural environments. Given all of the issues involved in this study, the conclusion can be drawn that an interpretive approach to social research is the most suitable philosophical position to underpin this study. Another aspect that motivates the choice of this philosophy is the area in which the object of study is inserted teaching and learning approach and the use of ICT for educational improvement.

As a philosophical stance, interpretivism means that reality can only be described through interpretations of the social world (Gray, 2014; Ritchie et al., 2013; Yilmaz, 2013). In interpretivism, assumptions about how knowledge can be obtained are usually based on the use of naturalistic methods (Cohen & Crabtree, 2006) such as those entailing dialogue (e.g. interviews) between the researcher and the participants. This enables the researcher to conceptualise a meaningful interpretation of reality, which can be interpreted in multiple ways. However, this assumption can make fixed reality more difficult (Bernard & Bernard, 2012).

According to Myers (2009), “interpretive researchers assume that access to reality (given or socially constructed) is only through social constructions, shared meanings, and instruments” (p. 38). In other words, “interpretivism is closely linked to constructivism” (Gray, 2014, p. 23). An interpretivist approach allows the researcher as a social actor to appreciate differences between people (Krauss, 2005). Consequently, reality is an emerging social construction that cannot be understood in isolation (Krauss, 2005; Orlikowisk & Baroudi, 1991), and this means that social reality is a product of individual consciousness that occurs when humans interact with the environment. This therefore requires the researcher to be involved with the subjects.

This research aims to solve a real and practical problem, and seeks to understand how effective SCL approaches can be introduced with the support of ICT. In order to determine the most suitable SCL approach for improving the teaching and learning practices at UEM, the perceptions and attitudes of lecturers, students, managers and IT technical staff were explored. This required a fundamental understanding and a careful interpretation of the way the participants made sense of the world, meaning that interpretivism was particularly suitable. Another motivation for choosing interpretivism for this study was to improve the educational pedagogy, as there is a need to comprehend and define the inherent teaching and learning culture at UEM. A combination of action research and a case study was therefore
chosen as a research strategy, and this is discussed in the following subsections.

3.2. Action research and the professional development of teachers

Action research is associated with participative research projects in which the aim is to solve practical problems or to create organisational change while expanding scientific knowledge (Myers, 2009). Action research “seeks to bring together action and reflection, theory and practice, in participation with others, in the pursuit of practical solutions to issues of pressing concern to people, and more generally the flourishing of individual persons and their communities” (Reason & Bradbury, 2001, p. 1).

The involvement of teachers as researchers in investigating institutional change is not a new phenomenon. In the past, action research has been utilised in education for designing curricula and dealing with complex problems, although it was mainly performed by outside researchers (Masters, 1995). The teacher-researcher movement as we know it today originated in the UK with Stenhouse (1971, 1975, as cited in Masters, 1995) as an advocate for the involvement of teachers in teaching research and curriculum development. Today, action research as a starting point for professional development is a common approach used by teachers to change their educational practice for the better (Denscombe, 2010). By using a variety of data collection methods from traditional research, a teacher can carry out research that is both rigorous and systematic (Koshy, 2010), but which also involves processes of critical reflection and idea generation that translate into action plans that feed back directly into the practice (Denscombe, 2010).

There are several different action research models that a teacher can use to investigate knowledge. Although these models vary slightly, there are more similarities than differences between them. The essential idea of action research is that the research process contains several self-reflective stages that are undergone in a cyclical manner (Koshy, 2010). These stages help the teacher to build on existing knowledge and perpetuate his or her own professional development (Denscombe, 2010). One of the more widely used models was proposed by Kemmis and McTaggart (2000, as cited in Koshy, 2010) and contains three main steps: (i) planning a change; (ii) acting and observing the process and consequences of the change; and (iii) reflecting on these processes and consequences and then re-planning. This model provides the opportunity to the users to go back throughout previous stages, once the
re-planning of another change is done the action researcher moves on to acting and observing, and so the iterative process continues (see Figure 5). The knowledge obtained from one cycle improves the next cycle, as the reflections from the previous cycle are incorporated. This model is flexible, and gives users the opportunity to learn about their own actions.

Figure 5: Kemmis and McTaggart action research spiral (illustrated by Koshy, 2010)

This research study aims not only to change the obsolete educational pedagogy used at the university but also to enhance the professional development of the teachers. An action research strategy was found to be the most suitable for this study, due to its change-making and participative nature. According to Koshy (2010), “action research is a constructive inquiry in which the researcher constructs his/her knowledge on specific issues through planning, action, evaluation, refining and learning from experience” (p. 9). Hence, the instigation of change comes from within, and democratises the research process (Denscombe, 2010). Lastly, this study introduces another essential change, namely the use of ICT to support the shift in pedagogy.
This challenges both lecturers and students to change their ways of working and their attitudes and beliefs, and action research can help in this process. Furthermore, action research is seen as a continuous learning process in which the researcher can learn from the information collected and can share this knowledge with the people who have informed it, so that they also may benefit from it.

As part of its curricular reform, UEM encouraged groups of teachers to participate in professional development actions and to work on pilot projects to implement the new curriculum and its pedagogical model. Teachers from the faculties of engineering, education, medicine, law, science, arts and social sciences, economics, and architecture participated in this process. The training was organised in workshop formats, and all actions involved in the implementation of the different teaching and learning strategies were planned, discussed and designed, taking into account both the SCL approach and the use of ICT. This implementation used action research as a research strategy for the pilot studies, following the four stages proposed by Kemmis and McTaggart (Koshy, 2010). The first stage involved the identification of changes that should be made in the instructional design. The different groups raised issues related to real-world teaching and learning methods and strategies based on SCL approaches and the use of ICT that could contribute to improvements in the university’s courses. These groups also explored the current teaching and learning practices and the current pedagogical vision to identify aspects that could be improved through the adoption of SCL using ICT. At this stage, the teachers are recommended plan their research and elaborate research questions. The design of learning activities formed part of these workshops, and this was carried out, presented and discussed during the implementation phase. The learning activities designed in the workshops were implemented in teaching and learning in stage four, during which the learning activities were (re-)designed to improve their effectiveness, following the cycles. The final stage was a summative evaluation of all steps. For the widest possible benefits, teachers, researchers, IT experts and students were involved at each stage.

The author was directly involved in each of these research studies. Study 1 was conducted at the end of the first cycle, and study 2 at the end of the second cycle. Study 3 was carried out between the second and the following cycles, and studies 4 and 5 were realised after the introduction of new ICT tools into teaching and learning. Various types of methods of data collection were used in the pilot courses. It is important to mention that the cycles of the action research strategy do not need to be followed strictly, as
this would “adversely affect the unique opportunity offered by the emerging nature and flexibility which are the hallmarks of action research” (Koshy, 2010, p. 7). The pilot studies were disseminated via modules involving lecturers from various faculties.

Figure 6: Adapted action research spiral, showing the phases in which the different studies were carried out

Figure 6 shows the studies carried out in different phases of the action research cycles, and the data collection and analysis methods used in different studies.
3.3. The case study approach

There are many methods that can be used in a qualitative research study; however, when the intention is to study a contemporary phenomenon within its real-life context, there is no clear distinction between the phenomenon and the context, and this leads the researcher to an empirical case study. According to Yin (1994), a case study is “an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not evident; and in which multiple sources of evidence are used” (p. 13). Curricular reform via the introduction of pedagogical innovation is a complex process involving many stakeholders within the university as an organisation, and many activities are required in order to change practices and cultures. These lead to deals with a situation that is a unique case and it involves people in a real situation. This situation also allows readers to engage in and understand ideas more clearly than when they are simply presented as abstract theories or principles (Cohen et al., 2007). The researcher seeks to report his or her experiences during the study so that the reader or user can gain insight by reflecting on the details and descriptions (Melrose, 2009).

In this research study, the goals involve educational quality. One of the purposes of using a case study as a research strategy is to understand a phenomenon comprehensively and in depth (Easton, 2010). According to Yin (1994) “the case study contributes uniquely to our knowledge of individual, organizational, social and political phenomena” (p. 9). Despite certain limitations, the case study is the most appropriate research strategy for an in-depth understanding of the strengths, opportunities and weaknesses of a particular organisational phenomenon. Even if this applies only to a single case, it may be possible to generalise to some extent when the context involves decisive, rare, typical, revealing and longitudinal cases (Yin, 1994).

According to Houghton et al. (2013), one major strength of a case-study research strategy is the opportunity to use different sources of evidence through triangulation. A faculty and a class are selected as a case study, and act as a champion by taking responsibility for running the redesigned programs. This is a great opportunity to use this implementation as a case study. This method allows the researcher to explore and describe the interaction between students, lecturers and the other stakeholders involved in the implementation of SCL and ICT for teaching and learning. It also allows us to analyse and describe the phenomenon by focusing on a group or on individuals, and to stress the relevant aspects of the case. The UEM is used as a unique case study in this research, taking into account all curricular reform,
moving further to the single studies carried out for this research study. A timeline with a description can be found in Section 4.6.1.

Due to the complexity of the process of curricular reform, involving the introduction of new teaching and learning approaches and the use of ICT, it was necessary to solve certain immediate problems such as the introduction of these new approaches to teaching and learning, and to follow the process of change over time. It was therefore necessary to find research strategies that could be combined to meet the aims of this research study, and the selected strategies were action research and a case study. Teachers used action research in collaboration with researchers and IT experts to solve immediate problems such as pedagogical innovation using ICT in teaching and learning processes. A case study was used to allow an in-depth analysis of implementation of curricular reform with the pedagogical model using ICT over a long period, and action research to allow teachers to continuously design, evaluate and improve their course guidelines and learning activities (Ermeling, 2012; Pine, 2009). This combination allowed teachers, researchers and other stakeholders to be involved in problem setting, and to collaborate to understand teaching and learning approaches and instructional design. These two research strategies also focused on the measurement and evaluation of curricular reform and the implementation of SCL approaches using ICT. Collaboration between researchers and teachers from different faculties supported the design and implementation in practice and facilitated the introduction of improvements.

3.4. Data collection methods and data analysis

This research is composed by five different studies that are based on a mixture of qualitative and quantitative methods. These aim to accomplish the objectives and to answer the research questions (see Section 1.5) of the research study. A variety of methodological combinations can be employed to give a deeper understanding of a research subject (McKim, 2017; Yin, 1994). In order to obtain a holistic picture of the complex situation at UEM, several different data collection methods were used in this research study, including interviews, questionnaires, literature and document reviews, observations and workshops. One essential benefit of the use of different methods to collect data is that this improves the accuracy and authenticity of the findings by triangulating the data (Denscombe, 2010; Cohen et al., 2007; Creswell, 2003). Table 3 provides an overview of the various methods em-
ployed in the five studies, with (+) representing a method that was used and (-) one that was not used.

Table 3: Data collection methods

<table>
<thead>
<tr>
<th>Method</th>
<th>Study 1</th>
<th>Study 2</th>
<th>Study 3</th>
<th>Study 4</th>
<th>Study 5</th>
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<tbody>
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<td>Interviews</td>
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<tr>
<td>Workshops</td>
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<tr>
<td>Questionnaires</td>
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<td>Observations</td>
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3.4.1. Interviews

Interviews provide a useful way for researchers to learn about the world of others, although real understanding may sometimes be elusive (Qu & Dumay, 2011). This is because there is no way of guaranteeing that what people say corresponds to what they do (Denscombe, 2010). Interviews are particularly effective when the aim is to probe a topic in depth and in detail (Jamshed, 2014). It is also an excellent method for gaining a better understanding of the participants’ perspectives and the meaning that they attach to the world in which they live (Cohen et al., 2007).

There are three ways that interviews can be conducted, depending on the focus of the research study and the research questions. Structured interviews resemble questionnaires: there is a list of predetermined questions and answers, and these follow a predetermined order and have a limited number of categories from which the participants must choose a response (Stuckey, 2013; Denscombe, 2010). The advantage of standardised interviews is that all of the participants are faced with the exactly same questions and answers (Knox & Burkard, 2009), which makes it easier to analyse the data. However, this can also be restricting, as participants may find that the pre-coded answers are limited and do not fully correspond to their views (Denscombe, 2010). A more common type of interview used in qualitative research is a semi-structured format (Stuckey, 2013) in which the interviewer has an “interview guide” (a list of questions) that needs to be answered, but where the interviewer may stray from the list when he/she feels that it is appropriate, and the responses of the interviewees can determine the direction of the interview (Stuckey, 2013). This means that the topics of discussion do not have to be followed strictly, allowing the interviewees to speak more widely on their experiences of the questions raised by the researcher (Denscombe,
2010). The third type of research interview is an unstructured or narrative format in which questions tend to be open-ended, with no structured interview guide, although the interviewer has a clear plan in mind regarding the goal of the interview. According to Stuckey (2013), unstructured or narratives interviews “are stories that are based on the unfolding of events or actions from the perspective of a participant’s life experience” (p. 58). The interviewer and interviewee construct the interview together, and the interviewer encourages the interviewee to express his or her inner thoughts. This makes unstructured interviews especially suitable for research topics that are complex and require detailed understanding (Johnson & Turner, 2003).

Semi-structured interviews were used throughout this research study. Interviews were conducted with individual lecturers, managers, students, IT technical support staff and distance education experts. The interviews with lecturers and students in studies 1 and 4 focused on gathering information about the complications and advantages that the participants encountered during the implementation of the LMS with support from SCL pedagogy. The problems brought up in the interviews were related to planning, instructional design, pedagogy, technology, and other aspects of the design and execution of the pilot courses. Interviews with students were conducted every two weeks in study 4, and these were focused on students’ perceptions of whether and how Web 2.0 tools improved their competencies. In study 2, the interviews were based on the questionnaires, were made to collect additional data about ICT infrastructure, access and use of ICT, actors involved, institutional vision, pedagogical approaches, challenges, limitations, and current involvement in ICT for education. Study 3 provides a better understanding of the lecturers, students, managers, IT technical staff, distance education experts and managers opinions and perceptions and also gives a detailed and real evaluation of individual experiences concerned with the design and use of blended learning.

The advantage of semi-structured interviews that made them particularly suitable for use in this research study was that the researcher could use an interview guide to help in obtaining high-quality interview data (Denscombe, 2010). This interview guide allowed the researcher to keep the topic of discussion on track, and to make sure that all of the interview questions were answered. To ensure validity and to avoid misinterpretations of the answers, a brief summary of each interview was given. All of the interviews were recorded and transcribed after each interview, and field notes were taken to document the interviewer’s impressions and thoughts during the interview process. The transcripts were read and re-read to gain a deeper
understanding of what the interviewees were trying to say. All of the interviews were conducted in Portuguese, the native language of both the researcher and the interviewees.

3.4.2. Workshops

Workshops were used in studies 1 and 4 to create a dialogue with teaching colleagues. During these workshops, the findings and outcomes of previous stages of the action research were discussed with the participating lecturers. This practice strengthened the research credibility in terms of participant validation (Shenton, 2004) and also developed the participants’ visions for the next step in the research. The lecturers were asked to discuss their experiences and attitudes towards different SCL approaches, and to think about how their role had changed in the new teaching and learning methods. The lecturers actively cooperated in the research process by reflecting on how the use of ICT could enhance the quality of education, and this led to agreement on the objectives of the research and the actions to be undertaken. The action plan involved the selection of ICT tools and teaching and learning strategies based on SCL approaches. In this regard, action research is strongly empowering and emancipating through giving the participants a “voice” (Cohen et al., 2007). From these workshops, solutions were developed and brought forward by the lecturers to improve the next stage of the action research cycle.

3.4.3. Observations

By observing the reality in which the participants exist, the researcher obtains first-hand experience of their behaviour (Randolph, 2008). According to Kawulich (2005), participant observation is a process through which a researcher participating in certain activities learns about them through observation, when the people under study carry them out in a natural setting. In this research study, the researcher acted as a participant observer while collecting data from the participants. Since the researcher was an assistant lecturer at UEM, he had knowledge and personal experience of the working practices at the university, which is essential when performing participant observation in order to understand the complexity of the situation (Patton, 2002).

In studies 1 and 4, observation was carried out both in classrooms and in the LMS. The focus of these observations was on the learning activities that took place, taking into account the curriculum for each week. In study 4,
observation was carried out in the classroom, in the LMS, and across Web 2.0 websites produced by the students. As the researcher observed the online activities of the lecturers and students, he made field notes when aspects could be identified for improvement to realise the shift to SCL. It was important to write down these thoughts immediately in order to maintain the validity of the findings (Randolph, 2008). The researcher had a list of questions regarding the lecturers’ arrangements via the LMS; for example, one of the questions examined whether or not the students received instructions that allowed them to carry out their tasks successfully.

Observations were also performed in the classroom in studies 1 and 4. During these observations, the researcher observed (without interfering) how the lecturer applied SCL approaches, how the lecturers interacted with the students, and how the students interacted with each other. By observing students and lectures in real life, data could be obtained about what the participants did, rather than what they said. This triangulated the data from the interviews and questionnaires and further validated the research findings (Randolph, 2008).

One issue with observations is that the researcher’s ‘self’ is very much involved in the construction of data, and this can lead to a lack of verifiable data (Denscombe, 2010). As in all qualitative research, the aim of the studies was not to produce generalisable data but to give a detailed account of what was observed in the LMS, Web 2.0 tools, and classrooms.

3.4.4. Qualitative data analysis
Qualitative data analysis was carried out using Creswell’s (2003) data analysis spiral. A content analysis was used that involved three phases. The first consisted of transcribing the recorded interviews, with a focus on completeness, representativeness, homogeneity, relevance and exclusivity, and the data were sorted according to their content. This facilitated the organisation and preparation of data, meaning that it was easy to find and return to when needed. In the second phase, coding units were selected by adopting the procedures of semantic classification and categorisation, and important quotes were put into broader categories or themes. This significantly reduced the amount of data and ensured that only relevant data were included. In the third phase, the information from the first and second phases was interpreted to make it meaningful and valid (Bardin, 2011; Wragg, 2013). Once the data had been categorised, they were then put into subcategories and compared, classified and described through the lens of the researcher. The researcher
kept an open mind during data analysis and explored possible explanations for findings that could contradict any initial beliefs.

3.4.5. Questionnaires

A questionnaire is a method of data collection that is completed by the respondent in a written format (Marshall, 2005). This data collection instrument is primarily suitable for saving time, obtaining large quantities of data, gathering relatively accurate answers, allowing freedom in responses (anonymity), and granting more time to respond (Lethbridge, Sim & Singer, 2005). However, the use of a questionnaire can be a disadvantage, since when it is sent to respondents, a small percentage of the questionnaires are not returned, and there may also be unanswered questions. Another problem is related to the limited assistance that is available from the researcher when the respondent does not understand a question (Lethbridge, Sim & Singer, 2005; Marshall, 2005).

In this research study, questionnaires with closed-ended questions were used in studies 1 and 5. This type of question was chosen as it has standardised answers that can provide quantifiable data, thus facilitating statistical analysis (Denscombe, 2010). In study 1, three different questionnaires were developed; two of these were sent to lecturers and students prior to the start of the course, and the third was sent to students at the end of the course for a final evaluation. The questionnaires evaluated various aspects of the LMS used in the pilot study, such as user-friendliness, the organisational environment, technical maintenance, costs and benefits and other aspects, using a five-point Likert scale. The results of the study were presented using descriptive statistics. In study 5, a survey questionnaire with closed-ended questions was used as an instrument for data collection to evaluate the impact of professional development at UEM.

In studies 1 and 5, each of the closed-ended questions contained a statement to which the respondents had to indicate their attitude and behaviour using different continuum response categories, such as ‘strongly disagree—strongly agree’, and ‘never—always’. The Likert scale is easily quantifiable and facilitates the answering of questions by providing the respondents with simple but concrete answers. It also allows the respondents to give neutral answers if desired. Since the Likert scale in this study was presented in a consistent fashion, it was essential to make sure that the respondents did not fall into a pattern of answers (Denscombe, 2010), and to mitigate this problem, some of the statements were formulated negatively.
One disadvantage of a Likert scale is that it presumes that the distance between each possibility is equal for each respondent, which is not the case in reality. Hence, the respondents’ actual attitude is not precisely measured, and this has a negative effect on validity (Bertram, 2007). Another disadvantage of Likert scales is that the respondents may choose statements to please the researcher, or to portray themselves favourably, rather than giving truthful answers (Bertram, 2007). In this particular research study, in which various interventions were introduced, the respondents might have felt the need to answer in a way that satisfied the researcher, although it was made clear that participation was completely anonymous, and that only truthful answers were desired.

In study 2, the questionnaires were designed with pedagogical and IT managers and asked about the current state of implementation, institutional policies for obtaining information, ICT infrastructure, access to and use of ICT, the actors involved, the institutional vision, pedagogical approaches used, challenges, limitations and the respondent’s current involvement in ICT for education.

In study 2, questionnaires were sent to nineteen Mozambican HEIs, and contained open-ended questions about the current state of ICT implementation at these universities. The aspects covered in the questionnaires were related to policy and vision, ICT infrastructure, pedagogical approaches, perceptions of implementations, and support from the public and private sectors for ICT use in education. Open-ended questionnaires were found to be the most appropriate for study 2, since the aim was to obtain views from the respondents that were unfettered by the limitations of alternative answers.

3.4.6. Quantitative data analysis

The results were subsequently released, processed and analysed using Excel software, and descriptive statistics were produced for study 1. Study 5 used an entirely quantitative analysis, for which SPSS was used. In this process, principle component analysis and Cronbach’s alpha were used to construct factors to measure the variables that explained most of the variability of the data of each dimension (Pallant, 2013). The intention was to evaluate the impact of the training by comparing the group that participated with the group that did not. A t-test was also used for the developed dimensions to determine how much the participants gained compared to the non-participants in terms of participating in professional development.
3.5. Data triangulation

Triangulation is a method used by researchers to give meaning to their conclusions and reduce the subjectivity of personal opinions, especially when interviews and questionnaires are used as data collection instruments in a research study. Denzin and Lincoln (2005) define triangulation more broadly, considering it to be a combination of different methods for analysing the same phenomenon in order to consolidate the construction of social theories.

Triangulation can be seen as a qualitative alternative for validation of a research when multiple research methods are used to ensure a deeper understanding of the phenomenon investigated (Johnson, Onwuegbuzie, & Turner, 2007; Zohrabi, 2013). When applying triangulation, the researcher can use different types of intentional samples and combine diverse approaches to data measurement with different research designs and analytical approaches within the same study (Patton, 2002). During the period in which this research study was carried out, qualitative and quantitative data were collected and used to answer the research questions, and various methods of data collection such as interviews, surveys and observation were applied. Several different techniques of data processing and analysis were also used.

Triangulation of data from different sources and data collection methods was applied in four studies. In studies 1 and 4, the data from observations of the LMS, interviews with students, discussions with teachers, and data from student questionnaires were used to analyse the design of the courses, using acquisition and contribution as a pedagogical framework to determine the improvements offered by different aspects of flexibility. In study 2, data from interviews and questionnaires carried out with the pedagogical director and IT technician were used to analyse the factors important for successful implementation of SCL using ICT.

3.6. Selection of the participants

The five publications of this research project involved 106 students, 136 lecturers, 19 managers and 19 IT technical staff. In addition to UEM as the principal case study, the second study also involved 19 other HEIs with the purpose of studying the state of integration of ICT and SCL approaches in Mozambique. In all studies, purposeful sampling was used to select the individual informants. The selection of the participants was made via non-probability sampling, in which the researcher selects a particular group of individuals knowing that they do not represent the population as a whole.
Small-scale research samples do not typically utilise probability sampling. Although the drawback of this sampling method is that it may not be representative, it is less complicated to perform and may well prove the researcher’s claim, provided that it does not intend to generalise the results beyond the sample in question. Study 5 used a quantitative research strategy to evaluate the impact of professional development, using convenience sampling.

Within the context of action research, the participants were invited to participate in the study, which was carried out using different pilot projects. The lecturers and students selected in this research were: (i) lecturers who were already working directly with the researcher and who had a direct influence on the decisions taken in the pilot projects; and (ii) lecturers, managers, IT technical staff and students for whom the planning was convenient and who were available at the time of this research.

The same procedures were followed for the information gathered from HEIs. Information was drawn from the staff of the pedagogical and IT departments and was related to the different aspects identified in previous studies of the SCL approach.

Various issues were analysed, such as access to the Internet and barriers to this, the need for a different instructional design, different interaction patterns and ways of evaluating the new approach across the period of the research, and the period required to complete the program. The research also dealt with the use of ICT in teaching and learning and the various problems that arise when using new technology. Attention was primarily paid to what lecturers and students experienced, but the views of the faculties that were chosen to run the pilot courses were also taken into consideration. The research questions were answered by combining multiple data sources, thus contributing to the validity and trustworthiness of the data used in this research study. Table 4 summarises the process of data collection in terms of the purpose of the study, research strategy, data collection methods, the numbers of participants involved, and the related question answered by each study.
Table 4: Data collection methods

<table>
<thead>
<tr>
<th>Study</th>
<th>Main purpose of the study</th>
<th>Research strategy used</th>
<th>Methods</th>
<th>Participants</th>
<th>Location</th>
<th>Related research question(s)</th>
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<tbody>
<tr>
<td>Paper 1</td>
<td>To explore the effectiveness of the educational model and the introduction of the LMS, and to reduce the face-to-face teaching time in the courses. To analyse teaching and learning practices within the acquisition and contribution framework.</td>
<td>Action research</td>
<td>Pilot study, Semi/structured interviews, Observations, Questionnaires</td>
<td>Lecturers: 22, Students: 52</td>
<td>UEM/Faculty of Education</td>
<td>1 and 2</td>
</tr>
<tr>
<td>Paper 2</td>
<td>To analyse the current state of ICT implementation, institutional policies, ICT infrastructure, access to and use of ICT, institutional vision, pedagogical approaches, challenges, and ongoing involvement in ICT for education in Mozambican higher education. To explore the perceptions of the actors involved in the implementation of ICT in education, and the involvement of public and private institutions in supporting ICT for educational activities.</td>
<td>Case study</td>
<td>Semi/structured interviews, Open-ended questionnaires</td>
<td>Pedagogical directors, IT technicians</td>
<td>Nineteen different higher educational institutions in Mozambique</td>
<td>1 and 3</td>
</tr>
<tr>
<td>Study</td>
<td>Main purpose of the study</td>
<td>Research strategy used</td>
<td>Methods</td>
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<td>Location</td>
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| Paper 3 | To analyse the different factors that are considered as systems thinking, with the purpose of understanding blended learning systems. To analyse and compare the state of the art in the complex adaptive system framework of two selected HEIs from developing countries. | Case study             | Semi-structured interviews | Lecturers: 22  
Students: 25  
IT staff: 2  
Distance education experts: 2  
Managers: 2 | Different faculties of UEM and U. of Rwanda                                                  | 3                                                                         |
| Paper 4 | To explore students’ perceptions of SCL, and to analyse the role of Web 2.0 tools in facilitating SCL and competency development. To analyse the contribution of the intervention to the development of students’ generic competencies. | Action research         | Semi-structured interviews  
Observations                                             | Students: 29  
(8 of whom were interviewed)                                           | Faculty of Education, ICT for Environment  
Course at UEM                                                   | 1 and 2                                                                   |
| Paper 5 | To evaluate the contribution of professional development initiatives at UEM to change pedagogical practices and the use of ICT from the teacher’s perspective. | Case study             | Questionnaires            | Lecturers: 92                                                                 | Different faculties of UEM                                      | 4                                                                         |
3.6.1. Students
The voices of the students who participated in the studies were very important, and were related to the real context in terms of their experiences of the new course design and the other learning activities that were considered during the period of research. Further aspects were also addressed in this research such as access to computers and the Internet, the adoption of technology and its implications for learning and pedagogical issues that are critical to improve course design and programs offered at UEM. Students participated in studies 1, 3, and 4.

3.6.2. Lecturers
The perceptions of the lecturers from the different faculties selected to participate in the studies were identified with regard to the interaction with students. However, the central focus was on the problems faced by students when the common teaching and learning approaches change.

It is important to identify the attitudes towards innovation of the lecturers participating in the pilot projects and their degree of commitment to the use of ICT and the SCL approaches. In addition, it is important to evaluate their sensibility to the changes needed and their belief in and willingness to use ICT in their educational practices.

The study aimed to determine the extent to which lecturers were aware that introducing the SCL approach and the use of ICT into teaching and learning could be rewarding. It was also important to determine whether they were aware of the problems that could be faced when starting to use SCL and ICT; the change to a new approach and the use of new ICT tools are time consuming in the beginning. Furthermore, it was essential to consider the conditions that UEM offered to all stakeholders for successful implementation. Lecturers participated in studies 1, 3 and 5.

3.6.3. Managers, IT technical staff and distance education experts
In this study, it was necessary to understand the conditions and the context within which ICT and SCL were implemented. Managers and IT technical staff were in a good position to provide information on the future plans of UEM (and the other HEIs in study 2), the infrastructure and the vision of the institutions regarding the implementation of ICT and SCL approaches. The
managers and IT technical staff participated in studies 2 and 3, and distance education expert in study 3.

3.7. Timeline of the research study

Figure 7 shows a timeline that is subdivided into two, indicating different activities. The arrow indicating the time in years divides the activities carried out by the researcher of this study from those that were not. The curricular reform activities, that is shown above of the time arrow were carried out by a team from UEM of which the researcher was a member, and these activities did not form part of this research study. The activities carried out as part of this research study are shown underneath the time arrow.

As described in Section 1.2.3, UEM has been implementing curricular reform since 2000, and several activities were carried out to introduce curriculum-based competencies that integrate SCL and ICT into teaching and learning.

In 2000, following approval by the university council, the faculties and schools were requested to design new curricula for all the programs offered at UEM. Of the many recommendations to be taken into account in the new curriculum, it is important to mention the transformation of a content-based curriculum to a competencies-based curriculum that integrates SCL and ICT into teaching and learning. As part of this curricular reform, the UEM revised the professional development program in 2004, introducing several pedagogical models based on SCL approaches, such as problem-based learning, project-oriented learning, and participatory teaching and learning methods. In addition, this review replaced training for lecturers on how to use PowerPoint, Excel, Word and experimental data analysis with a new training course on the course management system, the LMS and open interaction tools such as the discussion forum. However, this new training was more theoretical and did not concern how to integrate ICT into teaching and learning. This program was offered until late 2012.

Between 2004 and 2005, several theoretical frameworks focusing on the use of ICT and innovative pedagogy were considered, and the flexibility-activity framework from Collis and Moonen (2001) was selected as an educational model to guide the implementation of new curricula. In 2006, a study of the educational/pedagogical model was carried out, and this was published as study 1. In 2017, based on this educational/pedagogical model,
UEM launched several mini-grants for teachers to design pilot projects and to introduce new teaching and learning approaches.

In 2010, a study of ICT tools for teaching and learning was carried out in order to analyse the use of ICT by lecturers, to adopt new models and teaching and learning strategies to replace traditional ones, and the results were used to address the next studies of new curricula and ICT implementation (Muianga & Mutimucuio, 2011). This study formed part of the curricular reform activities, but was not included in this research study.

Figure 7: Timeline of the research study with activities related to curricular reform

The introduction of ICT and SCL approaches into the new curriculum did not have the desired effect in terms of educational effectiveness. In 2012, UEM decided to re-evaluate its professional development training program (UEM, 2012). This evaluation culminated in the design and introduction of a
new program, which was implemented in early 2013. During the same period, a study of the factors and conditions that can contribute to the implementation of ICT in higher education institutions in Mozambique was carried out, and this culminated in study 2.

In late 2014 and early 2015, it became important to analyse the factors internal to UEM and compare them with those at other HEIs, and the state of the art in blended learning systems with reference to complex adaptive system frameworks (Wang et al., 2015). This study also analysed the interactions between the subsystems involved in the implementation of ICT and pedagogical innovation, and culminated in the publication of study 3.

Following the development of ICT and the integration of new tools for teaching and learning, taking into account the selected educational/pedagogical model (UEM, 2008), it was necessary to analyse how students perceived the introduction of ICT and SCL approaches, and a new study (published as study 4) was carried out in 2016. During the same period, a study was carried out of pedagogical teaching and learning methods and the strategies within the SCL approach that could be applied in the process of teaching and learning, taking into account the conditions and the context offered by UEM (CAD, 2016).

After the introduction of new professional development training, another study was carried out in 2017 to evaluate the effect of professional development initiatives to promote the use of ICT and the introduction of SCL, using the TPACK framework developed by Mishra and Koehler (2006), and this gave rise to study 5. In 2018, UEM worked on developing new evaluation instruments for teachers, to be used for quality assurance and promotion purposes, involving self-evaluation and the evaluation of teachers by students that include items concerning the use of SCL and ICT. In addition, the university is working on policy and action planning that will contain rules obligating teachers to use ICT and SCL approaches.

### 3.8. Research ethics

This study was conducted based on some key principles of research ethics. The first of these was to protect the interests of the participants (Gustafsson, 2017), meaning that no harm should be incurred to the participants as a result of participation. There were no physical, mental or social risks from participating in this research project. The identities of the participants were kept anonymous, and the data retrieved were kept confidential.
The second principle was that research participation should be voluntary and based on informed consent (MacColl, Cooper, Rittenbruch & Viller, 2005). Prior to participating, an informed consent form was given to each participant which they were asked to sign or agree to. In the case of the questionnaires, this informed consent form was presented on the first page. This ensured that the aim of the study was communicated in a clear way to the participants, including what kind of commitment was required of them. The participants were also informed that a copy of the research paper could be obtained once the paper was completed.

The third key principle was that research should be conducted in an open and honest manner (Turner III, 2010). One benefit of conducting research in a context in which the researcher normally operated was that the participants recognised the researcher and were aware of the ongoing efforts to improve the curriculum at the university. Throughout the research study, the researcher communicated the aim of the studies in an open and honest manner, and welcomed any questions that the participants might have. During data analysis, the researcher made every effort to analyse the data objectively and to report the results accurately.

The fourth and last key principle was that the research should comply with the laws of the country (Brewer, 2016). This research study followed the UEM Research Ethics Policy that was drawn up under Mozambican law.

3.9. Role of the researcher

As mentioned in Section 3.1, this study used a combination of action research and the case study research strategies. The author participated as a researcher, trainer and as a teacher, and was involved in the process of curricular reform with other educational experts in the areas of curriculum development, IT technical staff, distance education experts, university management, lecturers from several faculties conducting research for Master’s and Ph.D. degrees, students and others participating in the process of change.

The researcher graduated in the educational sciences in mathematics and physics and worked as an instructor in mathematics and physics in vocational teacher training school from 1992 to 1997. His interest in pedagogy began at that time, and he decided to continue with his studies in this area. The educational background of the author includes a Master’s degree in Educational Technology and E-Learning; since 2000, he has worked as a Lecturer in the Faculty of Education and in the Centre for Academic Develop-
ment, the unit with responsibility for professional development. As a member of this centre, the role of researcher was straightforward, since the professional development of lecturers was his regular day-to-day work.

The choice of action research allowed the researcher and the other participants in curriculum reform to be an integral part of the study, with honest and personal involvement in these experiences, in their emotional, sensory, imaginative, and rational lives (Postholm & Skrøvset, 2013). It was therefore essential to the researcher to be confident with the participants to know the reality of all involved. Some participants had already studied in universities with teaching and learning based on SCL, and where ICT was used as a teaching and learning tool. Those who participated in the pilot projects found that from the moment the workshops were proposed and the importance and the need for participation by all were demonstrated, they perceived great interest from those involved, and during the workshops, some of them gave up their previous teaching and learning methods and suggested new strategies. This meant that the environment was conducive to the development of research. The students also reported feeling motivated, since they were experimenting with something new for the first time. The researcher openly challenged the participants in terms of introducing SCL using ICT, as new ways of being in higher education, and this was critical. The participants in the research did not want to be seen as passive objects of the research, but as active individuals who were interested in understanding their role and making decisions on the events and changes in their environment. Also, the possibility of the participants has the return of the results obtained in the research. These facilitated the role of the researcher as a participant.

3.10. Validity and reliability

In qualitative research, the term ‘trustworthiness’ is used to replace the term validity, which in quantitative research refers to the rigor necessary to ensure that the research findings are to be trusted and can be believed in (Merriam, 1998). One of the most important issues in qualitative research is that the findings should demonstrate the credibility of the data that have been used to address the topic investigated. Cohen et al. (2007) state that in qualitative data, validity can be addressed through the honesty, depth, richness and scope of the data achieved, the participants involved, the extent of triangulation and the disinterestedness or objectivity of the researcher.
In this research, trustworthiness was addressed by making use of different instruments for data collection, such as literature and document analyses, interviews, discussions, questionnaires and observations. Furthermore, in designing the research procedure, several pilot projects were set up to try out the use of ICT and SCL (see studies 1 and 2). Some of these pilots were carried out in two cycles, following the process of action research. Furthermore, in the acting and observing stage, each of the participants presented a progress report for the project, and posed questions regarding the objectives of the research, the methodology, ethics and other research issues, through active participation in the workshops.

However, the purpose of using different data collection techniques was to generate different layers of data from each pilot. This can stimulate participants to improve the honesty, depth, richness and credibility of the findings. For the purposes of data triangulation, the studies presented in this research made use of lecturers, students, managers, IT technical staff and distance education experts as different sources of data. The data obtained through observations and interviews from students were triangulated in order to increase the validity of the findings. The findings obtained from lecturers and other informants were presented to them and discussed in the workshops.

According to Koshy (2010), most action researchers and those who use qualitative methods are concerned with validity rather than with reliability, insofar as their focus is on a particular case rather than on a sample. In this research, despite the similarities between the action plans used in different pilot projects, the focus was always on the specific aspects of each separate module. In setting up different pilot projects, the intention was not to generalise the findings, but to integrate ICT and SCL approaches in different situations and circumstances. In this way, the degree to which the findings of each pilot can be applied or transferred to other modules is more ensured.

3.11. Limitations

The strengths and weaknesses of case study research are well known (see Cohen et al., 2007; Creswell, 2003; Wolfer, 2007). In a case study, the emphasis is primarily on a description of reality and its interpretation, and this research method fits well with the objectives mentioned in the introduction. However, case study research can also help in an understanding of the complexity of the problem and the interpretation of outcomes.
The limitations described in the literature are that case study results are not generalisable, and are selective, biased, personal and subjective (see Cohen et al., 2007; Creswell, 2003; Wolfer, 2007). In this study, however, multiple method design are applied to enhance the validity and reliability, and triangulation is used to improve the validity of the conclusions. The sample size, particularly in quantitative data collection, was chosen in order to collect data from 100% of the lecturers and students involved, to increase the reliability of the conclusions. Despite this, the sample size depended greatly on the availability of the participants to participate in the studies, since it was made clear to the participants that they were agreeing to partake in the study voluntarily. The purposes of using action research in this study were twofold: firstly, the improvements in the teaching and learning approaches across the university formed part of the process of curricular reform, and secondly, the improvements in the teaching and learning competencies of the lecturers in the pilots, and the researchers experimented with the use of ICT in combination with SCL approaches. Action research has many positive aspects, but also certain limitations, as described in this study.

The second limitation of this study is the fact that most of the data were derived from the perceptions of the lecturers, students and other staff involved in the implementation of SCL using ICT, and were collected through interviews, questionnaires and observations. The studies used a non-representative sample, since the objective is not for generalisations, so the replication of these studies cannot produce the results founded in this research.

The third limitation of this research is related to the fact that the studies were conducted by the researcher, who was involved in some activities of curricular reform, as well as implementer of pilots. The results reported in this study are only those where the researcher was directly involved, and activities developed by other teachers are not reported here.

The fourth limitation is related to a lack of comparative elements that could be used to measure the achievements before and after the implementation of the pilot projects; only study 1 presents data from lecturers and students both at the beginning and at the end of the cycle of action research. In three studies, the numbers of informants were different, which made it impossible to compare the achievements of lecturers and students at the beginning and end of the cycle. The results for the improvements in performance shown in the three different studies are based on self-learning and on the opinions of the participants.
A further limitation of this research is related to the participants in the studies, all of whom took part voluntarily. The studies took into consideration only lecturers, students, IT staff, distance education experts, and university managers who were directly involved in the projects, and these have not been implemented in some of the courses which the teachers did not accept. The same applies to the number of HEIs that participated in study 3; of the 44 HEIs in Mozambique, the researcher was only able to contact 28, of which 19 responded to the survey. Since a non-probability sample was used, this hinders the generalisability of the results, despite the fact that the majority of HEIs have significant similarities.

The use of interviews as a data collection strategy can be seen as a limitation due to the ‘interviewer effect’. To minimise this problem, the researcher acted in a neutral way and was attentive during the interviews. Particular attention was paid to signs of inconsistencies, and clues that could reveal untruthful answers given to please the researcher. In the interviews with students, efforts were made to ensure that the students understood that participation was anonymous and that no negative consequences were associated with participation or no participation.
4. FINDINGS AND DISCUSSION

In this chapter, summaries are given of each of the five publications that make up this research study, and these are followed by a discussion of the four components of the adapted flexibility-activity framework. The new professional development scheme is then presented and the factors that contribute to the successful implementation of SCL and ICT for teaching and learning are discussed.

4.1. Study 1: Blended online and face-to-face learning: A pilot project in the Faculty of Education, Eduardo Mondlane University

This paper discusses the pilot project that was initiated as part of the curricular reform at UEM. A decision was taken that a new competency-based curriculum was to be introduced at the Faculty of Education and the use of course management system (CMS) and a student-centred pedagogy as an experiment. The long-term goal of the pilot project was to increase the flexibility of course delivery at the university.

The introduction of the CMS was found to be useful for the shift towards a more student-centred pedagogy. The students were motivated by the use of the CMS, and appreciated its flexibility in terms of time and place, content, instructional approach, and delivery and logistics. The students also acknowledged the possibility of interacting and communicating with teachers and other students online, reporting that they obtained more feedback from the teachers than before. The teachers, however, were more cautious with the use of the CMS, and were unsure how to best integrate a CMS into their teaching practices.

The resistance from the teachers was partly due to a lack of knowledge about student-centred pedagogy and a lack of confidence in the use of technology. To mitigate this problem, and to keep ICT for teaching and learning initiatives similar to this study, teacher training is required. This will ensure that teachers acquire more adequate technical and pedagogical
knowledge and skills. Without these competencies, teachers are unable to design and implement learning activities that best fit the growth of the students.

It was found that the best pedagogical model in the context of UEM was a combination of the contribution and acquisition models. Before the intervention, the learning approach at UEM was mainly teacher-centred and was based on knowledge being transferred from teacher to student (an acquisition model). When the CMS was introduced, students were encouraged to contribute to the learning community by participating in the learning process (a contribution model). This shift towards the desired contribution-oriented activities within a traditional context such as UEM must be introduced slowly and systematically, taking into the consideration the concerns of both students and teachers. Hence, a combination of these models was found to facilitate this transition.

4.2. Study 2: ICT in education in Africa-Myth or reality: A case study of Mozambican higher education institutions

It is widely recognised that education (mainly tertiary education) plays an integral role in the development of both human capacities and the growth of countries (Ngware, 2016). To increase both the quality of education in general and the use of ICT, it was decided that ICT should be implemented in higher education. The government launched its first ICT policy in 2000 and an action plan and strategy in 2002, with the aim of making ICT more accessible and useful to the population (Ofir, 2003).

Although opinions among researchers are divided on the usefulness and impact of ICT on students’ achievements, initiatives with respect to ICT in education are soaring in Mozambique, as they are in other sub-Saharan African countries.

This study described and analysed the current state of ICT implementation, institutional policies, ICT infrastructure, access to and use of ICT, institutional vision, pedagogical approaches, challenges, and the current involvement of Mozambican institutions of higher education in the project activities of ‘ICT for education’ (ICT4E). The study also looked at the commitments of the actors involved in the implementation of ICT in education, and the involvement of public and private institutions in supporting ICT4E activities.
One of the most important factors in the successful implementation of ICT in education has to do with ICT policy, both at national and institutional levels. The results of the study showed that there is no law that compels HEIs to use ICT for teaching, learning, and research; the existing strategic plans of the government, the prevailing institutional vision and the action plans for ICT in the HEIs seem only to serve a symbolic purpose, as ICT is not being used deliberately and in a goal-oriented way in education. For this reason, HEIs should work on the development of strategic goals and clear action plans for how to use ICT in teaching and learning.

Although significant progress has been made in the construction of a widespread power network and the telecommunication infrastructure, not all HEIs have been able to take advantage of this infrastructural progress. As expected, the poor ICT infrastructure in the country was found to be one of the reasons for the limited use of ICT in the institutions.

A positive finding regarding infrastructure is a project initiated by the Mozambique Research and Education Network (MoReNet) with the aim of interconnecting all HEIs, libraries, museums, and non-governmental organisations (NGOs) using a nationwide data network (Muianga et al., 2013). This initiative will improve educational programs, research and academic services, and will also be helpful in expanding the use of ICT, which will significantly reduce ICT-related costs for the institutions.

All of the HEIs that participated in the study had computer labs that could be used by students and lecturers. This is an important service, as a vast majority of students and lecturers do not own a computer themselves. A nationwide program, in collaboration with banks and IT companies, has been launched to grant loans to students and academic staff to purchase personal computers. As the price of ICT equipment has been decreasing steadily in the recent years, it is expected that access to ICT equipment will increase among students and lecturers in the near future. This is likely to create a growing demand for distance education offered by HEIs, as few universities currently provide this opportunity. In general, HEIs should take more advantage of the increasingly available ICT devices to communicate with students, independent of their location.

Regarding pedagogy, commitments were set down in the documents of several HEIs to work towards a shift to SCL. However, it was evident that teacher-centred pedagogy still dominated the universities. There is an urgent need for HEIs to move beyond a rhetorical commitment to transform teaching. A positive finding was that some of the universities did use problem-based learning and project-oriented learning.
The findings showed that the ICT infrastructure in public HEIs was financed by the national budget and funds from donors. With the increasing number of private HEIs, the government introduced a new model called ‘Fund for Quality Improvement and Innovation’ (QIF) with the support of the World Bank to fund both public and private universities. Among other things, QIF provides financial support for the delivery of good quality, relevant teacher training to enhance the efficiency of management and administration systems, and to create courses and programs that correspond to the needs of the 21st century workplace. International agencies such as UNESCO and USAID have also supported ICT capacity-building activities in Mozambican HEIs. Another source of funding came from private companies. In general, public universities were found to have better infrastructure, as they received funding from both the government and international agencies.

It can be concluded that Mozambican HEIs are still far from reaching the objectives stated in the official policy. The numerous constraints and challenges that characterise the implementation of ICT in Mozambican higher education must be dealt with systematically; there is a need for more interventions from the government, and HEIs must reinvigorate their obsolete strategic plans to ones that focus on action and fit well with modern society. Finally, the government must strengthen support for HEIs in using ICT and SCL to achieve the objectives stated in the national ICT and education policy.

4.3. Study 3: Blended learning systems in tertiary education: A comparative analysis of two universities from Rwanda and Mozambique

This paper analyses the state of the art of blended learning systems with the help of the CABLS framework. It is a comparative study about blended learning in two developing countries, namely Rwanda and Mozambique. Learning systems are blended when the instruction is partly face-to-face and partly computer-mediated.

The study aimed to explore different models, known as systems thinking models, with the purpose of selecting one that can best be used to gain more understanding of the impact of blended learning in Mozambique. The CABLS framework proved to be most useful in carrying out a proper analysis of which subsystems in an institution promote the use of blended learning and which work against it.
The current curricular reforms at UEM facilitate the introduction of a blended learning mode in combination with emerging teaching and learning approaches. Pilot studies have improved the quality of teaching and learning in the faculties, and it can be said that the curricular reform has been well implemented. One of the critical aspects of the successful implementation of blended learning in this curricular reform is the pedagogical paradigm shift towards SCL.

The case of UEM shows that the technology subsystem is mature enough to feed other subsystems, but that not all of those subsystems properly use the input from technology. For instance, the learner subsystem proved to have undergone significant development. Positive results were noted regarding issues of flexibility and cooperation within the institutional subsystem, and these are crucial factors for an effective and successful implementation of blended learning. The opposite occurs with the teacher subsystem, which does not interact well with the institution subsystem.

The latter should use strategies to create a working environment that allows smooth collaboration between learners and teachers, thus avoiding conflicts in the pedagogical processes. The institution should also closely involve teachers and learners in the planning and implementation of blended learning systems.

The CABLS framework allows the teacher subsystem to build content types and explore the learning support subsystem to provide timely and appropriate support. It is also essential to solve the misunderstanding between teacher, learners and institution subsystems of blended learning.

The main problems with the integration of the CABLS framework in UEM include the resistance of teachers to technology, the lack of a clear strategy to create a sustainable blended learning environment and a lack of understanding of how the blended learning environment, from a holistic perspective, could help to develop a more effective and efficient blended learning environment in UEM.

4.4. Study 4: From teacher-oriented to student-centred learning: Developing an ICT-supported learning approach at the Eduardo Mondlane University, Mozambique

UEM is in the process of transforming their instructional way of teaching via the introduction of SCL activities. The incentives to begin curricular reform at the university were an aspiration to improve the quality of education and
the intention to prepare future graduates more adequately for careers in the modern world. A pilot education project conducted by the Faculty of Education at UEM introduced a learning management system (LMS) called Moodle and various Web 2.0 tools in a course entitled ‘ICT in Environmental Education’. The objective was to use ICT as a tool to support SCL activities. According to Hayes et al. (2001), there are numerous pedagogical advantages to the introduction of ICT into education. For example, ICT can facilitate the creation and sharing of knowledge; can enable a transition from teacher-centred learning to SCL activities; can facilitate a shift in focus from local to global resources, and can provide opportunities to perform complex tasks and use multi-modal information. These new ways of teaching and learning should not be implemented separately from each other, since they are intertwined; some of the working methods that involve technology assume specific modern pedagogical approaches, while modern pedagogical approaches can benefit significantly from modern technologies (Muianga et al., 2015).

This study explored (i) students’ perceptions of SCL in the course ‘ICT in Environmental Education’; (ii) the role of Web 2.0 tools in facilitating SCL and competency development; and (iii) the extent to which this intervention contributed to the development of students’ generic competencies.

The interviews, observations and course deliverables confirmed that students developed the competencies that the course aimed to deliver, including skills related to problem solving, collaboration, e-learning, production of Web 2.0 information, generic ICT skills, and information searches on the Internet.

The students appreciated the structure of the course, and particularly the emphasis on collaborative learning. Working in groups requires excellent communication and interpersonal skills, which the students got to practice throughout the course. The decision-making process in the groups allowed students to explore the views expressed by other students, deal with possible disputes, and give constructive feedback. These skills are essential in the modern workplace of today and tomorrow.

The students explained that they experienced that the learning activities were more interactive, motivating and at the same time challenging. The environmental problems brought up in the course were real-life (and self-selected) challenges. This increased the students’ intrinsic motivation to work harder on the course, as they could relate better to the problems and theories studied. To deepen their knowledge about an environmental issue,
the students searched for relevant and diverse information to expand their understanding of the topic and come up with possible solutions. It is clear that the use of real environmental problems that interested the students helped them to learn and understand the subject better.

Self-regulated learning was new to the students. During the course, they had to learn independently by retrieving their own choice of learning materials online, by evaluating each other’s work, expanding their ideas, assessing their work against a rubric, and comparing their work with others. This was not always easy, as the students were not familiar with this approach and they felt that the lack of structure (previously provided by the teacher) got in the way of learning. Some students expected their lecturers to give a lot of feedback on their progress, rather than referring to the learners’ guide themselves. This indicated a lack of confidence, as most of these aspects were new to the students.

Some students had little previous experience with ICT and did not have e-mail or social networking accounts. At the beginning of the course, the students were asked to create these accounts, and they also became familiar with various Web 2.0 tools (wikis, podcasts, video sharing, social bookmarking, Facebook, Twitter and blogs). The students learned to how create multimedia content and how to upload content to different websites. There were three specific skills that the students mentioned as being particularly valuable: (i) tool-specific knowledge and skills (e.g. how to use Moviemaker to edit videos); (ii) knowledge of content and knowledge delivery (e.g. how to create awareness using blogs); and (ii) meta-knowledge of ICT and information literacy (e.g. how ICT can facilitate the search for, evaluation of and selection of relevant information).

In general, the students perceived the organisation of the course as pleasant, and were confident in using ICT and SCL approaches in other courses. The students particularly enjoyed working on real-life problems and thought that the method could be applied in similar courses.

4.5. Study 5: Teachers’ perspectives on professional development in the use of SCL approaches and ICT: A quantitative case study of Eduardo Mondlane University, Mozambique

UEM has been carrying out curricular reform since 2000 to introduce new methods and strategies for SCL and the use of ICT. To this end, new professional development training was introduced in 2013 for teachers. The
TPACK model was used as a theoretical framework for designing the program and for evaluating the teacher's pedagogical practices and the use of ICT in the four years preceding the research.

The objective of this study was to evaluate the contribution of professional development initiatives carried out at UEM that had as their goal the innovation of pedagogical practices and encouraging the use of ICT. The study was carried out from the teacher's perspective.

The use of the TPACK framework provided a novel perspective for professional development and an effective introduction to SCL and ICT. Table 5 shows the types of training related to different core knowledge areas of TPACK.

Table 5: Relation between core knowledge and type of training

<table>
<thead>
<tr>
<th>Core knowledge</th>
<th>Type of training</th>
</tr>
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<tbody>
<tr>
<td>CK</td>
<td>Courses/workshops on a specific knowledge field</td>
</tr>
<tr>
<td></td>
<td>Network of teachers specifically created for professional development training</td>
</tr>
<tr>
<td></td>
<td>Individual or collaborative research on a topic of interest related to the profession of the teacher</td>
</tr>
<tr>
<td>PK</td>
<td>Course/workshop about SCL and teaching methods</td>
</tr>
<tr>
<td></td>
<td>Course/workshop on problem-based learning (PBL)</td>
</tr>
<tr>
<td></td>
<td>Course/workshop on project-oriented learning (POL)</td>
</tr>
<tr>
<td></td>
<td>Course/workshop on peer tutoring</td>
</tr>
<tr>
<td>TC</td>
<td>Course on the use of ICT for teaching and learning</td>
</tr>
<tr>
<td></td>
<td>Course on the use of a LMS platform</td>
</tr>
<tr>
<td></td>
<td>Advanced course on Internet use</td>
</tr>
<tr>
<td></td>
<td>Course on multimedia use</td>
</tr>
<tr>
<td>TPK</td>
<td>Course on pedagogical issues regarding the use of specific ICT tools</td>
</tr>
<tr>
<td></td>
<td>Subject-specific course on software for teaching specific content goals</td>
</tr>
</tbody>
</table>

According to the results, the training activities had a considerable impact. Almost all respondents who participated in training activities with a focus on the CK area confirmed that all the courses had at least a moderate effect, and more than half of the courses had a significant impact. Related to
training activities in other areas (such as PK, TC and TPK), the opinion of the teachers did not differ much from the previous score in the CK area. The training activities were attended by less than 50% of the teachers, but more than 50% of the courses had a large impact. The number of teachers who were of the opinion that the training activities had no impact or a neutral or small impact was less than 9% for all training activities.

Regarding the contribution of professional development training to pedagogical practices and the use of ICT for teaching and learning, the results of the study showed that teachers who participated in professional development activities were more likely to use ICT. Moreover, the training had a more positive influence on the use of ICT to support SCL implementation according to participants in comparison to non-participants. The participating teachers also had a more positive perception of the importance and impact of professional development on their day-to-day work.

Another significant finding from this study is related to the combination of all areas of knowledge from the TPACK model in designing effective professional development training. A combination of knowledge areas is crucial for teachers to understand the pedagogical implications and the potential of using ICT and SCL. The training also has to be aligned with the institutional policy and strategic planning of the university. Professional development can therefore induce technological and pedagogical changes by the teachers and can contribute across the institution to improvements in the quality of education in general.

The findings also showed that the interests of teachers were essential in the use of SCL and ICT for teaching and learning, and all of the teachers who used SCL and ICT confirmed this. The particular interests of the teachers are to use the results in their study projects, or because they believe that ICT facilitate the processes of teaching and learning.

Finally, a significant recommendation resulting from this study was that UEM should develop policies and action plans that incentivise the use of ICT and SCL by teachers in order to speed up the implementation of new approaches. At the same time, they should introduce quality assurance tools for teachers, which include items related to the use of ICT and SCL.

4.6. Discussion

This section reports the relation between the findings presented in the five studies and some of the changes introduced at UEM as a result of these stud-
ies and others carried out at UEM, as can be confirmed by the timeline of some of the activities carried out in terms of curricular reform and related studies. The educational model, the proposed pedagogical model, and their impacts on curricular reform are discussed. The following section presents the new course design within the context of UEM. The new professional development training program, its design and impact are then explained. The section ends with a discussion of the factors that contribute to the effective implementation of SCL and ICT for teaching and learning.

The findings of this research study will focus on examining the key issue that answer the research questions. This will be achieved by analysing the findings from the different studies. In order to understand the relationship between the theoretical frameworks used in different studies, a comparison between them is presented in Table 6 using the four components of the flexibility-activity framework (Collis and Moonen, 2001). The factors identified by Nachmias et al., and the subsystems presented by Wang et al. (see Table 6) are integrated into technology, pedagogy, implementation and institution. Furthermore, in Table 7 the same framework is used to group different findings from different studies considering the flexibility-activity framework components.
Table 6: Relation between the theoretical frameworks used in different studies

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology</td>
<td>Computers, digital devices, Internet, and software</td>
<td>Domain of pedagogical innovation: Time and space configuration; Student role; Curriculum.</td>
<td>Content; Technology; Learning support;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Factors: Infrastructure</td>
<td></td>
</tr>
<tr>
<td>Pedagogy</td>
<td>Acquisition and contribution and participation models</td>
<td>Domain of pedagogical innovation: Time and space configuration; Student role; Teacher role; Curriculum.</td>
<td>Learner; Teacher; Content; Technology; Learning support.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Factors: Organisation of learning.</td>
<td></td>
</tr>
<tr>
<td>Implementation strategies</td>
<td>The 4-E model: Environment; Educational effectiveness; Ease of use; Personal engagement.</td>
<td>Domain of pedagogical innovation: Teacher role Student role</td>
<td>Teacher Learner Content Institution</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Factors: Organisational climate, staff training.</td>
<td></td>
</tr>
<tr>
<td>Institutional framework</td>
<td>Vision for learning and teaching; Social and educational climate; Institutional support structures; Infrastructure.</td>
<td>Domain of pedagogical innovation: Teacher role.</td>
<td>Teacher; Technology; Learning support; Institution.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Factors: Roles within the school; Roles outside the school; Infrastructure and resources; and, ICT policy.</td>
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</tbody>
</table>
In this analysis, the current situation is presented in terms of the implementation of SCL approaches using ICT for teaching and learning at UEM and the implications arising from the four components. These findings represent the factors for success and the challenges that have been identified for implementing SCL approaches using ICT at UEM (see Table 7).

The bandwidth of the Internet connection is one of the most important factors in the use of ICT in education, and particularly in higher education. UEM has been investing in upgrades to Internet speeds; until 2006, the bandwidth was 120 Bit/sec (Muianga et al., 2006), while in 2012, the bandwidth was 100Mb/sec (Domingos, 2012). Currently, the average speeds at UEM are 100.36 Mb/s for downloads, and 7.49 Mb/s for uploads (Broadband, n.d.). By 2022, there are expected to be increases in existing bandwidths of 150 MB per month, and increases on all campuses outside Maputo (CIUEM, 2017).

In terms of access to computers and devices, all lecturers at UEM have access to computers and the Internet in their offices (Muianga et al., 2013; Domingos, 2012). For the students, each faculty and school has one or more computer lab with between 25 and 50 computers connected to the Internet. Faculties or schools with postgraduate programs have two or more computer labs. Since 2011, the university has had agreements with banks and IT companies to provide loans to lecturers and students for the purchase of laptops and digital devices (Muianga et al., 2013; Muianga et al., 2016; Domingos, 2012). The university also finances students from low-income families through a program of one student, one laptop (UEM, n.d.). Lecturers and students with personal digital devices such as laptops, tablets and smartphones can access the Internet via Wi-Fi on the campus of the university and in university student residences.

UEM introduced an LMS for the first time in 2002, and this experiment was reported in a study by Muianga (2006). In the same year, the Faculty of Education introduced Moodle (Boer & Muianga, 2006; Eduardo, 2007; Muianga et al., 2016). Since that period, UEM have implemented LMSs in teaching and learning (Boer & Muianga, 2006; Eduardo, 2014; Maluleque & Costa, 2012). Another experience of using software is related to several educational pilot projects that were implemented to promote the use of ICT and SCL to improve educational processes.
Table 7: Summary of findings grouped by the four components of the flexibility-activity framework

<table>
<thead>
<tr>
<th>Theoretical framework</th>
<th>Results from the research studies (paper 1 to 5, Muianga et al.)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technology</strong></td>
<td><strong>Successful implementation:</strong></td>
</tr>
<tr>
<td></td>
<td>Internet connection; access to computers by both students and</td>
</tr>
<tr>
<td></td>
<td>lecturers; computer labs and personal computers; wireless</td>
</tr>
<tr>
<td></td>
<td>networks on campus; the use of an LMS; www-based system; use</td>
</tr>
<tr>
<td></td>
<td>of social media for teaching and learning; access to electronic</td>
</tr>
<tr>
<td></td>
<td>resources; provision of technical support by faculties to</td>
</tr>
<tr>
<td></td>
<td>lecturers and students both inside and outside the university.</td>
</tr>
<tr>
<td><strong>Challenges:</strong></td>
<td>Internet bandwidth; electronic resources not used effectively;</td>
</tr>
<tr>
<td></td>
<td>more involvement by lecturers in the use of technology.</td>
</tr>
<tr>
<td><strong>Pedagogy</strong></td>
<td><strong>Successful implementation:</strong></td>
</tr>
<tr>
<td></td>
<td>Pedagogical model already defined in the curriculum; student-</td>
</tr>
<tr>
<td></td>
<td>centred approaches used in teaching and learning; student</td>
</tr>
<tr>
<td></td>
<td>control; students more active and collaborative; planning own</td>
</tr>
<tr>
<td></td>
<td>learning paths and monitoring their own programs; less time</td>
</tr>
<tr>
<td></td>
<td>spent in classrooms and more independent work by students,</td>
</tr>
<tr>
<td></td>
<td>students interact with content; more flexibility in terms of</td>
</tr>
<tr>
<td></td>
<td>learning activities; time and space; permanent accessibility;</td>
</tr>
<tr>
<td></td>
<td>synchronous and asynchronous communication; electronic</td>
</tr>
<tr>
<td></td>
<td>submission of assignments; online access to learning content</td>
</tr>
<tr>
<td></td>
<td>such as slides and relevant references and links; student</td>
</tr>
<tr>
<td></td>
<td>contributions.</td>
</tr>
<tr>
<td><strong>Challenges:</strong></td>
<td>Involvement of the lecturers in the use of technology;</td>
</tr>
<tr>
<td></td>
<td>lecturers trained in innovative pedagogy; introduction of</td>
</tr>
<tr>
<td></td>
<td>other forms of assessment; more academic support needed for</td>
</tr>
<tr>
<td></td>
<td>students; some large classes.</td>
</tr>
<tr>
<td><strong>Implementation strategies</strong></td>
<td><strong>Successful implementation:</strong></td>
</tr>
<tr>
<td></td>
<td>Students are enabled to use technology and SCL approaches;</td>
</tr>
<tr>
<td></td>
<td>lecturers are resistant to change; some lecturers use the LMS</td>
</tr>
<tr>
<td><strong>Challenges:</strong></td>
<td>Lecturers still resisting the use of LMS; pedagogical project</td>
</tr>
<tr>
<td></td>
<td>in the faculties involving all stakeholders.</td>
</tr>
<tr>
<td><strong>Institutional framework</strong></td>
<td><strong>Successful implementation:</strong></td>
</tr>
<tr>
<td></td>
<td>The university has a vision and mission for teaching and</td>
</tr>
<tr>
<td></td>
<td>learning; the strategic and action plans of the university</td>
</tr>
<tr>
<td></td>
<td>support the introduction of SCL approaches and the use of</td>
</tr>
<tr>
<td></td>
<td>ICT for teaching and learning; SCL and ICT integrated into</td>
</tr>
<tr>
<td></td>
<td>the curriculum; investment in infrastructure; partnership</td>
</tr>
<tr>
<td></td>
<td>with other organisations and companies; professional</td>
</tr>
<tr>
<td></td>
<td>development inside and outside of the university.</td>
</tr>
<tr>
<td><strong>Challenges:</strong></td>
<td>Introduction of pedagogical projects in the faculties;</td>
</tr>
<tr>
<td></td>
<td>lecturers take on new roles; lecturers are resistant to</td>
</tr>
<tr>
<td></td>
<td>change; more training needed on innovative pedagogy for</td>
</tr>
<tr>
<td></td>
<td>lecturers.</td>
</tr>
</tbody>
</table>
The UEM has six LMS in use: four are hosted in CIUEM, two are used for distance learning programs, and two are used in regular face-to-face courses in blended learning format. Some faculties have their servers and host their own LMS, such as the Faculties of Engineering, and Agronomy and Forestry Engineering. The LMS used in blended learning courses has 106 registered modules/subjects, 68 teachers and 3,759 enrolled students. In 2018, 234 modules/subjects were registered, and 174 teachers and 7,216 students were enrolled. It was not possible to obtain LMS statistics for distance learning programs.

Another pilot project was entitled *Self-Study Material*, the objective of this was the production of study material (readers and class notes) by the lecturers for distribution or sale to students in order to overcome the lack of literature and allow students to save time in terms of taking notes during classes (Muianga & Mutimucuio, 2011; Domingos, 2012). Another pilot project was entitled *Course Information System*, which was a website containing learning programs, courses and relevant information in the form of lessons plans and venues for the classes. This website also contained study materials, information about assessments and examinations, information about the lecturers, and other useful information for students and lecturers (Muianga & Mutimucuio, 2011; Domingos, 2012). The development of this website resulted in the Integrated Academic Management System (SIGA) (see https://siga.uem.mz/users/login), a system used for academic management.

The *Knowledge Extension System* was another pilot project that aimed to create a dynamic online area in which lecturers from different fields of knowledge could make the provision of community outreach activities in order to ask and answer questions, and give advice to communities in areas such as agriculture, veterinary, health and law (Muianga & Mutimucuio, 2011; Domingos, 2012). The last pilot project was *ICT Tools for Education*, which aimed to experiment with various types of tools such as course announcements, e-mail communication, email lists, newsnet groups, up/downloading of files, internet links, synchronous and asynchronous communication, online formative testing, and working jointly on documents online (Muianga & Mutimucuio, 2011; Domingos, 2012). In addition, all of these technologies support synchronous, asynchronous, offline, and online access to content and resources.

In 2010, UEM started a dissemination process for the use of ICT among such as Web 2.0, to support areas such as pedagogical, scientific and university management (Domingos, 2012). The use of ICT in teaching and learning by both teachers and students, such as the use of Google groups, Google Drive and social networks (groups on Facebook and Whatsapp) for discussion and sharing of information and materials, such as readers and class notes, scientific articles, group work, and other issues related to the
modules/subjects of the course, were some other initiatives from teachers and students.

The university central library has a license agreement for access to 23,000 titles of electronic scientific journals (see www.dsd.uem.mz). The university introduced the use of Turnitin, software for plagiarism control, in 2016. However, due to the costs involved in license payment, this software is only used to check graduate monographs and Master’s theses.

Another important factor in making this accessibility work better is maintenance. The Centre of Informatics of Eduardo Mondlane University (CIUEM) is responsible for the acquisition and maintenance of all common equipment and infrastructure across the university, and each faculty or school has a technical team that is responsible for technical support to lecturers and students.

In terms of challenges, the UEM still needs to improve access to the Internet (CIUEM, 2017), as the bandwidth is far from satisfying the needs of the university. Most universities in Africa have the same problem (Echezona & Ugwuanyi, 2010). Another challenge is related to electronic resources; a study by González et al. (2013) demonstrates the low rate of use of digital resources at a UEM central library and highlights a lack of skills due to the lecturers and students not using them effectively. Another study conducted by Manhique and Casarin (2017) concluded that the UEM central library understands informational competence as a service, and not necessarily as a program. This may be the origin of the relative disarticulation between the library and other segments of the university. Providing training for users as an activity that is to a certain extent restricted to the library, without linking with university curricula, is not useful. The same study finds that lecturers play an essential role in students attending activities offered by the library (Manhique & Casarin, 2017). The CAD has introduced a course on the advanced use of the Internet in professional development programs as response to this problem. This course also includes the use of digital resources, and is taught by technicians from the central library.

Although the production of material is encouraged, lecturers do not do so, maybe because there is no incentive for this. Each faculty, school or department decides whether to produce material or readers. Some of the faculties or departments produce and use course guidelines.
4.6.2. Pedagogy

Educational researchers supporting the use of ICT in improving the effectiveness of teaching and learning have highlighted pedagogical innovation as one of the key factors (Albugami & Ahmed, 2015; Collis & Moonen, 2001; Meerza & Beauchamp, 2017; Sife, Lwoga & Sanga, 2007; Tarus, Gichoya & Muumbo, 2015). As in many other educational institutions worldwide, curricular reform has been seen as part of the solution to realise the development of a global economy, society, and culture (Dale, 2000). In this view, the education sector is assumed to play an important role by providing and training employees with the necessary competencies for today’s dynamic and complex society, with flexible professional profiles and knowledge that has changed from ‘knowing what’ to ‘knowing how’.

After carrying out a thorough literature review of teaching and learning theories and models that can easily be adapted in the context of UEM, it was necessary to select a model that could redefine the role of lecturers and students. Besides the traditional classes, lectures and seminars, the teaching and learning at UEM includes the accomplishment of practical work or theoretical-practical assignments, research projects in the field, simulations, learning by doing, case studies, group work and other teaching and learning modes that encourage the involvement and active participation of students in the construction of knowledge.

As a result of the curricular reform process, the new educational model presupposes participation by students as decision makers who are able to structure themselves and their academic careers in the faculties/schools. The following statements are used to guide the organisation of a teacher’s work:

1. The organisation of the curriculum is based on a system of credits. This system not only allows higher flexibility in the administration of the curriculum, but it also allows more interaction with other academic units in the university, and facilitates the students’ exchange and the transfer of credits between institutions.

2. The content of the curriculum is organised into thematic modules. This modular outline is seen as an effective model to make the structure of the course and content more transparent. This allows the interdisciplin ary connection between different subject matters to be seen more easily, which is a difficult objective to accomplish in the context of a rigid curriculum and excessive repetition of the content in several courses. Thematic modules also function as a forum, saving resources and facilitating exchange and collaboration with teachers of other units, both inside and outside the institution.
3. The production and organisation of the study plans and course programs are independent activities carried out by each faculty, and depend only on teachers’ groups that already exist or are under development. The aim of this principle is to avoid establishing a direct correspondence between departments and courses, and to stimulate the independence of each faculty in selecting content and teaching and learning activities based on the objectives defined in the courses.

4. The maximum duration of the courses in the numerous programs does not exceed one elective semester, and the weekly workload of direct contact between teachers and students decreases significantly from the first to the last year of each program. The average workload of the courses is four hours per week, with a maximum of eight hours per week; each hour of face-to-face working corresponds to between four and six hours of independent work. In no circumstances will the total number of weekly working hours be more than 24. These principles seek to assure a higher degree of flexibility in programming teaching and learning activities, and attempt to put enough time at students’ disposal for reading and individual study. They also encourage students to participate in research activities. In general, students’ involvement in research activities increases in direct proportion to the level of enrolment.

5. Special attention is paid to the pedagogical organisation; teachers should not become overloaded with teaching tasks, and time and space should be provided for research. In accordance with this principle, it is necessary to find a balance between Bachelor’s and Master’s degree programs. This principle opens up the possibility of saving resources (for teachers and supervisors of undergraduate or graduate degrees) and can lead to the better systemisation and integration of research activities. It also contributes to the formation of a “critical mass” of teachers who are dedicated to research and to the creation of a “research culture”.

6. Expansion of the profile components of the future graduate is necessary. Besides the scientific and cultural components of existing course programs, teaching and learning focuses on the integration of practical and professional competences. This integration is seen as a necessary condition to produce competent future professionals.

Without violating the regulations for student evaluation at the university, evaluation is more focused on the qualitative aspects of learning and the
development of student practice. This shift also requires lecturers to change their focus in learning activities from memorisation and the routine reproduction of facts to understanding, analysis, evaluation, problem solving and critical thinking.

Collis and Moonen (2001) demonstrate the relation between flexibility and pedagogy by using the flexibility-activity framework. This is an educational model that combines the dimension of activity goals focused on acquisition or contribution with the dimension of flexibility, with categories related to less and more flexibility.

In the planning and delivery of flexible learning course units, explicit attention is paid to pedagogical issues. The chosen pedagogy should be appropriate for the materials used, the students, the teacher, and the medium chosen for the learning experience. It is vital to establish which learning resources and learning activities match different contexts. A unit in an institution that is responsible for program design must be informed about learning objectives and outcomes, the characteristics of students and institutional constraints affecting staff, resources and infrastructure capacity. Figure 8 shows the sequence of curriculum implementation, based on the educational model proposed at UEM.
In terms of teaching and learning methods and strategies, since the beginning of the curricular reform process, UEM has promoted the use of several teaching and learning methods and strategies with a focus on SCL approaches through its professional development programs, as well as workshops on specific teaching and learning methodologies in different faculties and schools. In 2016, a study was carried out and presented at the UEM pedagogical seminar of the teaching and learning methods and strategies used at UEM. This study used a sample of 183 teachers and 779 students, who answered questionnaires. In addition, 42 classes were observed, and 32 teachers were interviewed. Table 8 shows the numbers and the respective percentages of the teachers and students who answered questions about the methods and strategies used in teaching and learning in 2016. The remainder of the
teachers and students answered that they did not use these, or did not know if they used these.

Table 8: Teaching and learning methods and strategies used in 2016 (CAD, 2016)

<table>
<thead>
<tr>
<th>Teaching and learning methods and strategies</th>
<th>Students</th>
<th>Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N  %</td>
<td>N  %</td>
</tr>
<tr>
<td>Lectures</td>
<td>548  70.3</td>
<td>57  31.1</td>
</tr>
<tr>
<td>Dialogue that stimulates the construction of knowledge through the active participation of students</td>
<td>495  63.5</td>
<td>158  86.3</td>
</tr>
<tr>
<td>Independent study/work</td>
<td>466  59.8</td>
<td>141  77.0</td>
</tr>
<tr>
<td>Group working</td>
<td>427  54.8</td>
<td>128  69.9</td>
</tr>
</tbody>
</table>

SCL teaching and learning methods and strategies

<table>
<thead>
<tr>
<th></th>
<th>Students</th>
<th>Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N  %</td>
<td>N  %</td>
</tr>
<tr>
<td>Case study</td>
<td>331  42.5</td>
<td>112  61.2</td>
</tr>
<tr>
<td>PBL</td>
<td>402  51.6</td>
<td>120  65.6</td>
</tr>
<tr>
<td>POL</td>
<td>427  54.8</td>
<td>85   46.4</td>
</tr>
<tr>
<td>Brainstorming</td>
<td>214  27.5</td>
<td>99   54.1</td>
</tr>
<tr>
<td>Demonstration and practice</td>
<td>375  48.1</td>
<td>120  65.6</td>
</tr>
<tr>
<td>Role plays</td>
<td>255  32.7</td>
<td>49   26.8</td>
</tr>
<tr>
<td>Problem solving</td>
<td>272  34.9</td>
<td>72   39.3</td>
</tr>
<tr>
<td>Simulations</td>
<td>283  36.3</td>
<td>51   27.9</td>
</tr>
<tr>
<td>Discussion and debate</td>
<td>540  69.3</td>
<td>59   32.2</td>
</tr>
<tr>
<td>Self-assessment</td>
<td>464  59.6</td>
<td>68   37.2</td>
</tr>
<tr>
<td>Experimental learning</td>
<td>343  44.0</td>
<td>115  62.8</td>
</tr>
<tr>
<td>Workshop</td>
<td>440  56.5</td>
<td>116  63.4</td>
</tr>
<tr>
<td>Learning by doing</td>
<td>581  74.6</td>
<td>55   30.1</td>
</tr>
<tr>
<td>Other methods/strategies (disseminate knowledge)</td>
<td>322  41.3</td>
<td>25  13.7</td>
</tr>
</tbody>
</table>

Some faculties have assumed the use of some SCL as the main teaching and learning approach in the curriculum, such as competence-based learning (e.g. the Faculty of Education and Faculty of Veterinary Science), POL (e.g. the Faculty of Architecture), and PBL (the Faculty of Art and Social Science, and Faculty of Medicine) (Muianga & Mutimucuio, 2011).
Nevertheless, the involvement of lecturers in the change from traditional teacher-centred teaching and learning to innovative pedagogy remains a challenge. Similar studies have shown that at the beginning of the integration of SCL and ICT into teaching and learning in similar contexts, it is hard for teachers and learners to assume new roles, as they must unlearn previous approaches (O’Neill & McMahon, 2005; Thanh, 2010). The shortage of staff trained in SCL poses another challenge (Tedre, Apiola, & Cronjé, 2011; Schweisfurth, 2011). Some lecturers believe that initial training in new pedagogy is therefore indispensable (O’Neill & McMahon, 2005).

This research study reported that despite the efforts made towards professional development at UEM, lecturers still do not see innovative pedagogy as a serious issue. This was confirmed by UEM (2012), who stated that most lecturers participate in professional development to fulfil the requirements for promotion, rather than for the development of professional competencies.

Despite the challenges faced at UEM in introducing SCL approaches and ICT for teaching and learning, the introduction of the educational model described here is made possible and easy by the introduction of distance learning by Distance Learning Centre. The UEM introduced the first online undergraduate program in business management in the economics faculty in 2008. The university has three undergraduate programs (BSc in Business Management in the Faculty of Economics, a degree in organisation and management of education in the Faculty of Education, and a degree in public administration in the Faculty of Arts and Social Sciences). The university also has three master's programs (in agricultural economics in the Faculty of Agronomy and Forest Engineering; a Master’s in animal production in the Veterinary School; and a Master’s in planning and management of informal settlements). These programs are completely online, and have students from all regions of the country, and use the pedagogical model referred to in this research study.

Some new schools are still not using ICT and pedagogical innovations. Most teachers have newly graduated, are unaware of SCL approaches and have never had experience of using ICT as teaching and learning tools. They are recruited without even participating in professional development actions, and begin to teach in total ignorance of the pedagogical model used in the UEM (Mendonça et al., 2012).
4.6.3. Implementation strategies

Implementation is a critical component of a move toward more flexible learning in an institution, and can create exciting new learning situations that involve changing the beliefs of the lecturers and the culture of institutions (Awidi & Cooper, 2015; Collis and Moonen, 2001; Hennessy, Harrison, & Wama-kote, 2010; Khan, Hasan & Clement, 2012; Piper, Jepkemei, Kwayumba & Kibukho, 2015). The university provides technology, innovation pedagogical guidelines, funds and training for the lecturers, and the faculties, schools and departments stand alone to decide whether or not to use these. The lecturers can also decide whether or not to use these, without any policies mandating implementation, or even incentives for such activities. Without implementation efforts and a proper and realistic strategy at the institutional level, only lecturers who have a personal interest in and/or believe in the effectiveness of SCL and ITC can use it for teaching and learning. Other researchers confirm this when they refer to the institutional context (Awidi & Cooper, 2015; Collis and Moonen, 2001; Hennessy, Harrison, & Wama-kote, 2010; Khan, Hasan & Clement, 2012; Nachmias et al., 2004; Wang et al., 2015). In addition, to ensure effective implementation, multimedia content should be regarded as an environmental feature, and since the institution regards knowledge as their institutional property, security concerns should also be priority.

In terms of educational effectiveness, some teachers confirm that the use of SCL with ICT increases the quality of teaching and learning, including teachers who only use SCL without using ICT. The university supports those lecturers, students and other employees in the process of adopting technology by providing access to computers, the Internet and technical support, and this is important. The lecturers, students and other employees that are using SCL and/or ICT for teaching and learning are more in favour of changing in the classroom and outside of class. This is confirmed by other researchers, who indicate that teachers have a positive attitude regarding the use of ICT in teaching and learning (Msila, 2015; Olakanmi & Batchelor, 2015; Yükselir, 2016).

The university still needs to do more to motivate the use of technology among these professionals, and it is also necessary to help them to use it in the best possible way. Hence, the UEM is providing professional development training in using technology and pedagogical innovation, and even providing technical support. Another issue that can contribute to educational effectiveness is to track each other's relationship with the technologies...
adopted to diagnose problems, receive feedback and promote constant improvement.

The use of computers and the Internet for various purposes by the lecturers and students is part of day-to-day life, even if this use is not for teaching and learning purposes. The introduction of Internet-based course management systems is not a problem. These systems are typically designed to be easy to use. Social media networks for educational purposes are part of normal life, since some of these applications are taught by professional training experts and institution staff who are subject matter experts, and the necessary support is provided to increase their ease of use. Students and lecturers require an initial training of about two hours in the use of LMS, as well as, personal helpdesk and via email. Both students and lecturers are assumed to already know to use email, the Internet, and social media networks.

Furthermore, the criteria for the selection of these applications was that they should be free and open sources provided on the Internet, and must contribute to educational effectiveness, ease of use, engagement, the organisational environment, and other kinds of interaction (such as synchronous and asynchronous communication).

In terms of engagement, the literature highlights many factors as barriers to ICT use in teaching and learning related to personal engagement (Hennessy, Harrison, & Wamakote, 2010; Isaacs, Kazembe & Kazondovi, 2018; Moeller & Reitzes, 2011; Muganga, 2015; Tedre, Apiola & Cronjé, 2011; Tedre, Apiola & Oroma, 2011; Teeroovengadum, et al., 2017; Tinio, 2003; Schweisfurth, 2011; Wallet, 2015). In some courses, the active role of the lecturers made the implementation of the new SCL approach more efficient, and this was particularly true for postgraduate programs. UEM has been training lecturers on subject matter including pedagogical knowledge and knowledge related to technology use for teaching and learning, and has been concerned with the access, usability, affordability, and sustainability of the individual use of ICT. The main challenges involve requesting the faculties and schools to pay attention to these factors and to provide more incentives at faculty or school level.

4.6.4. Institutional framework

Most of the factors related to the institutional framework have already been discussed previous in relation to the other components presented in this section. Here, it is important to note that all of the frameworks used in this research study suggest that the institution needs an ICT and pedagogical inno-
Innovation implementation policy and strategy (Collis & Moonen, 2001; Nachmias et al., 2004; Wang et al., 2015). UEM has worked to provide these documents since the beginning of curricular reform and ICT implementation; over time, the university has revised and corrected these documents, taking into account the need to improve and accommodate the necessary advancements. Based on the policy and the needs of the university, UEM has been applying for grants to support the development of ICT infrastructure and academic needs. Furthermore, the university has been providing support for both students and lecturers. The students require suitable conditions to develop different kinds of competencies such as research, practice, working in teams and collaboration.

An analysis of the other factors shows that UEM has most of these factors in place, some well implemented and others not. Some faculties and schools are not following UEM implementation policy and strategy carefully. Despite having these documents at faculty or school level, and despite lecturers participating in professional development, they are still not using these as guidelines to construct the social and educational climate of the faculty or school. Overcoming these problems is crucial to the faculties or schools design local strategic and action plans of SCL approaches and use of ICT for teaching and learning with support at university level. This is the main challenge.

UEM needs to continue to develop regulations at both the institutional level and at faculty and school level to encourage teachers to use SCL and ICT in teaching and learning. The use of ICTs and SCL approaches should also be used as essential indicators in quality assurance evaluation instruments. It is necessary to create pedagogical projects at faculty and school level in which teachers play important roles and can take ownership of these.

4.6.5. New professional development training

Offering support to lecturers to implement new teaching and learning approaches or to improve the quality of programs is not new to UEM, it is a part of institutional framework. However, the focus of innovation and the strategy of change have always been adapted to the views and needs of a specific period. According to Mandlate (2003), the first professional development program was launched in 1989 as a two-year pilot project. In 1992, it was decided to continue teacher-training activities and a new staff development project (STADEP) was established. With the revitalisation of UEM’s Faculty of Education (which was closed down with the opening of
the Pedagogical University in 1986), the STADEP program was integrated into the University and was renamed the Centre for Academic Development (CAD) (UEM, 2012; Mandlate, 2003).

Since 2010, CAD has collaborated with several international partners to initiate educational projects with the aim of facilitating the ongoing curriculum reforms. One of the projects that has positively influenced lecturers’ pedagogical and professional development was the NICHE Project, which was a collaborative effort between UEM and EP Nuffic, a Dutch organisation for strengthening higher and technical-vocational education capacity in developing countries through internationalisation. The NICHE program was implemented at UEM specifically to improve the quality of teaching, to reinforce the research capacity and to link education with the labour market (EP Nuffic, 2014). This intensified activities associated with the capacity building of staff at the CAD, the unit responsible for organising lecturer training at UEM.

Studies of curricular reform and the implementation of SCL approaches (UEM, 2012; Mendonça, 2014; Muianga et al., 2013; Muianga & Mutimucuio, 2011) and UEM’s own curricular reform documents have shown that most lecturers continued to use traditional teaching and learning methods. Students remained passive, acting as mere consumers and producers of knowledge transmitted by teachers, and ICT was still not used effectively as a tool for teaching and learning.

In 2011, the Rectorate of the UEM approved the creation of the Commission of Reflection on Professional Development in Higher Education. The purpose of this Commission was to carry out a study of the need for psycho-pedagogical training for UEM teachers and other partnering Higher Education Institutions. The focus was on training, with a view to the development and design of face-to-face and distance and/or mixed training programs and their corresponding implementation strategies (UEM, 2012).

The main result of the reflection study was the acknowledgement of the merits of the training activities offered by CAD, but there was also a general feeling that they should be improved to match the specific needs of the modern context of professional development (UEM, 2012). The same study also refers to the fact that the courses should be given by specialised teachers in specific areas and in a systematic way, allowing teachers to practice their learning and share their experiences (UEM, 2012).

Another finding of the reflection study has two aspects. Firstly, it deals with the creation of conditions for junior teachers to follow an all-round psycho-pedagogical training program (basic vocational training).
From this point of view, CAD courses are considered to be complementary to this training program. The study also calls for greater participation by senior teachers, as they need the opportunity to update their teaching methods and strategies and at the same time act as a source of inspiration for younger assistant teachers.

The results also indicate a need to reformulate CAD courses in a new way, requiring an in-depth discussion of relevant topics and SCL approaches such as PBL and POL, as well as critical thinking about different methods of student assessment. The central question is how these two elements can contribute to improvements in the quality of the teaching-learning processes in UEM and in other partner HEIs.

Considering the investment already made and the lifetime of ICT infrastructure at the UEM, it can be concluded that their use as teaching and learning tools should already be part of the academic culture. However, the adoption rate does not match the desired reality, and there is still resistance from teachers to the introduction of ICT in the teaching-learning process. Concerns have been expressed about the need to adopt the distance learning or blended models as a way to minimise some of the constraints related to time, space, a lack of printed course materials and other sources of information for the courses offered by CAD.

After analysing the factors mentioned above and carrying out a literature review of teachers’ professional development, the Commission of Reflection decided to design a new professional development training scheme based on the TPACK framework. The idea was that this model could cover all aspects of technology, pedagogy and content, which shaped this training to meet the demands and findings of the study mentioned above. TPACK covers all aspects/factors that are considered to be essential for the implementation of SCL and ICT.

According to Rienties et al. (2013), one issue is that the professional development of academics in higher education is often motivated by institutional goals rather than by the actual concerns of teachers about the weak focus on student learning. Hence, the concerns of the lecturers and pedagogical coordinators of all HEIs benefiting from the previous professional development program were taken into account in designing the new professional development program (UEM, 2012). The importance of studying whether academics have learnt something relevant, valuable, and applicable from professional development has been highlighted by previous studies (Rienties et al., 2013; Stes et al., 2010).
UEM is a large university, meaning that faculties and schools are governed with certain autonomy, and since teachers also have a certain level of autonomy this makes many of these processes difficult. Many senior teachers do not accept the need to change their teaching and learning methodologies, particularly when these suggestions arise from their assistants. However, most younger teachers are open to experimenting with pedagogical innovations. This has been confirmed by Mendonça (2014), who states that a lack of participation from senior and experienced teachers in professional development training hinders the individual development of teachers in pedagogical competencies and changes in the pedagogy and culture of the university (p. 23).

UEM has made efforts to create all the necessary conditions, such as a suitable institutional policy, infrastructure, and curricular reforms with a focus on pedagogical innovation and the use of ICT for teaching and learning, following a top-down implementation approach. However, the implementation continues to take a long time, without producing the desired effects. The institution has promoted individual initiatives via the provision of mini-grants for teachers to participate in projects such as the pilot studies reported in this research. Although this has been a success, it has not been able to massify the use at an institutional level.

Some scholars in the field of ICT in education argue that the use of the top-down approach accelerates the implementation of ICT in teaching and learning; many organisations have therefore supported governments, and particularly those of developing countries, in policy design for ICT and ICT in education in particular, as ways of accelerating the implementation process (Beukes-Amiss, 2006; Collis and Moonen, 2001; Dirckinck-Holmfeld & Lorentsen, 2003; Simon & Ngololo, 2015; Wambui & Black, 2009; Zagami et al., 2018). Other scholars prefer a bottom-up approach, arguing that if the teachers own the ICT initiatives, implementation can easily form part of their day-to-day activities (Collis and Moonen, 2001; Dirckinck-Holmfeld & Lorentsen, 2003; Fullan, 1994; Zagami et al., 2018).

What was learned in this research study is that there is no single proven approach that is most effective for the implementation of pedagogical innovations using ICT as teaching and learning tools if this is not of interest to teachers (Kreijns, Van Acker, Vermeulen, & Van Buuren, 2013). Successful and effective implementation depends on the context and other factors referred to in this research study.
4.6.6. Factors in the effective implementation of SCL and ICT

To enable effective implementation of SCL and ICT in educational programs, several factors must be considered. In this research, two frameworks were used as practical aids to review the state of affairs, and this led to a comparative analysis of the status of the implementation of SCL and ICT in HEIs in Mozambique in general and at the UEM in particular.

The first framework presents the most fundamental factors, which are specific to a developing country such as Mozambique and are crucial for the successful implementation of ICT in Education. It deals with the ICT policies of the government and of HEIs, ICT infrastructure, access to and use of ICT for education, the organisations involved in and supporting HEIs, and issues of pedagogy. These factors were extracted from Nachmias et al. (2004) and also include external factors such as the national and local ICT policies and rules within the school and the organisational climate.

Government ICT policies are usually laid down in a document that contains a variety of strategies or guidelines in relation to the integration of ICT, taking into account the specific economic, social and educational context of a country (Brown & Thompson, 2011; Kozma, 2005; IST-Africa Consortium, 2012). Almost every country in the world has established a national policy on ICT and education. Mozambique has also produced a document that enables the country to define the priority areas in which ICT can make a big difference in terms of economic, social and educational development. Unsurprisingly, education is treated in ICT policy documents as the most important area for the development of the country. The policy also underlines the need for the development of an ICT infrastructure, access to and use of ICT for education, and the creation of partnerships and support as key factors in the implementation of ICT in the country (Kozma, 2008; Muianga et al., 2013).

The second framework is CABLS. According to Wang et al. (2015), the integration of ICT into teaching and learning has made learning more complex than ever before. The same researchers show that education is also becoming complex; new elements are arising in teaching and learning, and many changes have been prompted by the interaction between these new and old elements. The framework identifies five fundamental attributes of complex adaptive systems: complexity, self-organisation, adaptability, dynamism, and the ability to co-evolve (Wang et al., 2015).

The CABLS framework identifies six subsystems of an organisation: the learner, teacher, content, technology, learning support and institution. The CABLS framework can be used to understand the interactions between
these six subsystems. If UEM aims to effectively implement ICT for teaching and learning, it must consider these six subsystems carefully.

From a deeper analysis of the situation of UEM, it can also be concluded that the use of ICT in teaching and learning has a further powerful component consisting of the interests of both teachers and students. These interests can be a key factor in the use of SCL and ICT for teaching and learning, as justified by the findings of this study. All of the teachers who participated in the pilot projects, and others who have launched their own initiatives to use SCL and ICT for teaching and learning, had particular interests in using the final results as study projects or found that they facilitated the processes of teaching and learning, depending on what they thought these processes were. This was also true in the case where students used the technologies without the action of the teacher. For these students, ICT facilitated the sharing of information or teaching and learning materials. Although the initiative from the teachers is very determinate for the students to use.

The factors affecting the implementation of SCL and ICT for teaching and learning presented in these three studies (Collis & Moonen, 2001; Nachmias et al., 2004, Wang et al., 2015) are often considered separately. Some decision makers determine the focus of integration based on what they think is most important; in some cases, they focus on the technological factor, equipping institutions with computers and other technological components, and in others, they focus on the institutional factor, designing policies and plans of action without considering the pedagogy or even the kind of technology to be used. They sometimes focus on pedagogy, drawing up a curriculum with a focus on pedagogical innovation without taking into account other factors. Others choose only two factors that they consider relevant for implementation, leaving other factors aside. As a result, the implementation never works as it should.
Figure 9 shows the way in which the factors or components of ICT and SCL integration should work. All factors are considered to have the same level of importance; this is critical in the implementation, since these factors function as if they were “clockwork gears”, where each factor is a determinant of the implementation and its operation depends on another factor, and the implementation must be considered as a single process. It is therefore necessary that in the implementation of pedagogical innovations using ICT as teaching and learning tools, institutions must take into account all of the factors involved. This is the only way in which the implementation can be effective.
5. CONCLUSIONS

This chapter summarises the answers of the research questions of this research study, conclusions, future directions for the implementation of SCL approaches and the use of ICT in teaching and learning. This chapter also discusses the limitations of this research and closes with recommendations and suggestions for further research.

The overall aim of the five research studies presented in this thesis was to explore the ways in which ICT can facilitate the shift from teacher-centred learning to SCL at UEM in Mozambique. The central question involved how far the use of ICT in education could contribute to improvements in teaching and learning in HEIs, initiated by the curricular reform recommended by the government of Mozambique for the sector of higher education. This aim is reflected in the title of this research study: The role of ICT in the shift towards student-centred learning in Higher Education: Eduardo Mondlane University, Mozambique: A case study.

Looking at the separate results and findings of the five studies, we can draw the conclusion that the progress has been made towards the shift to SCL with support from ICT tools by answering the following research questions:

R.Q. 1: What types of SCL approaches are suitable for UEM in order to improve teaching and learning, according to the literature? (Studies 1 and 4)

After carrying out a thorough literature review of teaching and learning theories and models that were easy to adapt to the context of UEM, it was necessary to select a model that was useful in redefining the role of teachers and students. A teacher in the role of educator is not just expected to transmit facts and information; his/her task is also to stimulate the imagination, the intellectual curiosity and the creativity of the students via the development of their capacity to analyse and think critically, using real situations taken from work or the community and maximising the learning opportunities.
The flexibility-activity framework, an educational model by Collis and Moonen (2001) that defines the relationship between flexibility and pedagogy, was used to describe the changes associated with the interventions that took place at UEM. The chosen framework provided guidelines for how to deal with issues related to the acceptance of ICT in the daily practice of lecturers and students.

The flexibility-activity framework proposes a combination of two central pedagogical models. The first is the acquisition-oriented model, which focuses on learning activities that are established in advance and are based on the acquisition of pre-specified knowledge. This pedagogical model is particularly suitable for individual learning and is used to obtain knowledge. The second is the contribution-oriented model, which focuses on learning activities in which students are interacting and communicating with others, learning together, exchanging and discussing ideas, creating a product, solving problems and thus contributing to the production of additional and personal learning materials. This pedagogical model is primarily a group or community model, and is used to build up a membership of a learning community. Collis and Moonen (2001) suggest that both models fit best within a pedagogical approach that focuses on contribution-oriented activities.

The learning activities are designed based on the flexibility-activity framework, and both the acquisition and the contribution model were useful in determining the number of working hours and designing the types of course/module activities. Face-to-face meetings were organised for theoretical and practical guidance and for independent work in order to acquire and develop pre-specified knowledge and pre-determined concepts. An LMS can be used both in groups and individually, and can contribute to interactions and exchanges of knowledge with other students. The development of ICT skills is fruitful not only in terms of acquiring the core knowledge of the course/module, but also in learning activities that deal with communication and collaboration, information research and information production, cooperation and self-learning, media and information literacy, critical thinking and problem solving.

A combination of the acquisition and contribution models made the transition from teacher-centred learning to SCL run more smoothly. The strategies used in the acquisition model are similar to those used in teacher-centred learning, while the contribution model introduced aspects of flexibility to teaching and learning, giving students the opportunity to be responsible for their own learning processes in interactions with each other.
The introduction of a new and innovative teaching and learning model changes the role of the teacher from a deliverer of knowledge to a facilitator of learning. The lecturer facilitates the learning process by providing different learning activities, and students work on these activities individually, in subgroups, inside and outside the classroom, online and with a lecturer, to develop skills that allow them to construct their own knowledge by applying their own learning strategies. The lecturers are also more involved in the organisation of the course activities and in monitoring each student’s interactions via the LMS.

The learning activities are designed based on the flexibility-activity framework and by taking into account the acquisition and contribution models. The number of working hours shows that the design of course/module activities are organised into face-to-face meetings for theoretical and practical guidance, independent work for the acquisition of pre-specified knowledge and the development of pre-determined concepts, and use of the LMS in groups or individually to interact, to contribute to knowledge production and to exchange knowledge with other students. The design of learning activities according to the proposed model must not only be oriented towards the delivery of core knowledge, but must also allow the development of ICT skills, communication and collaboration, information research and information production, cooperation and self-learning, media and information literacy, critical thinking and problem solving. This educational model offers the opportunity to use any teaching and learning approach by combining the acquisition and contribution models and the selection of teaching and learning methods or strategies. Depending on the learning objectives or competencies that the student needs to develop, the teacher can select and combine any teaching and learning methods and strategies such as those suggested in Table 8 or others that are not mentioned.

The students are expected to use the LMS and other ICT tools such as Web 2.0 tools: wikis, podcasts, video sharing, social bookmarking or social networking sites (blogs, Facebook and Twitter). In some courses/modules, they are expected to develop a blog as a portfolio. The new curriculum design model recommends that learning activities must focus on the creation of a realistic learning environment by giving real-world assignments. Students must work in a real context at tasks that link theory and practice.
R.Q. 2: How can ICT support SCL approaches with the aim of improving teaching and learning at UEM? (Studies 1 and 4)

From an analysis of the flexibility-activity framework, it can easily be seen that degrees of flexibility are introduced. The use of ICT gives rise to different dimensions of flexibility that are related to time, content, instructional approaches and resources, delivery and logistics and entry requirements. The use of ICT in teaching and learning covers most of these dimensions. ICT makes teaching and learning more flexible in terms of time and place, and offers more possibilities for interaction, in terms of social organisation and learning resources. Students can choose a time and place to conduct their studies, and have the opportunity to interact with lecturers and other colleagues, even when they are not present at the same time and in the same place. With the help of the Internet, the students can access various resources for use as learning materials. Since the use of ICT facilitates the introduction of SCL, curriculum reform that aspires to improve the quality of teaching and learning in HEIs can benefit from these findings in terms of acknowledging the integration of SCL and ICT as a catalyst to implement the change from traditional teacher-centred teaching to a new student-centred approach.

R.Q. 3: What factors/aspects are most significant for the integration of SCL approaches and ICT to improving teaching and learning processes at UEM? (Studies 2 and 3).

In the integration of SCL and ICT for teaching and learning, there are several factors that must be considered. In this research, two frameworks (see studies 2 and 3) were selected. Key factors were studied and discussed in depth, to allow for a comprehensive analysis of the status of implementation of both models in Mozambique in general and at UEM in particular. The framework in study 2 involves the most fundamental factors that should be considered in a developing country such as Mozambique. For the successful implementation of ICT in education, it is important to examine factors such as the ICT policies of governments and HEIs, ICT infrastructure, access to and use of ICT for education, the organisations that are involved in and supporting HEIs, and the pedagogy used. These factors were extracted from Nachmias et al. (2004), and the model also includes external factors such as national and local ICT policy, and rules within the school and organisational climate.
A governmental ICT policy is a key document providing a variety of guidelines for the integration of ICT within a country. Mozambique has a national policy document that defines the priority areas in which ICT can make a significant difference in terms of economic, social and educational development, although education is seen as the most important area for the development of the country. The policy also underlines the need for development of an ICT infrastructure, access to and use of ICT in education, and the creation of partnerships and support as key factors in the implementation of ICT in the country.

In addition to the factors mentioned above, another important aspect is that the interests of teachers and students form an additional key factor in the effective use of SCL and ICT for teaching and learning. The literature discusses both teachers and students as essential factors in pedagogical innovation, but does not mention their particular interests as determinants; only the incentives and commitment of teachers are discussed (Collis & Moonen, 2001; Nachmias et al., 2004, Wang et al., 2015) without specifying their intrinsic and extrinsic reasons for choosing to use SCL and ICT in teaching and learning.

An analysis of the results of all of the studies showed that curricular reform that entails the introduction of new approaches to teaching and learning with the use of ICTs as teaching and learning tools involves several factors, and that these factors must be considered from a holistic perspective.

R.Q. 4: What is the effect of the professional development of teachers on the use of ICT in teaching and the use of SCL pedagogy in the classroom at UEM? (Study 5)

The SCL approach and ICT for teaching and learning cannot be viewed in isolation, but can be effectively studied in combination; hence, in order to build up more concrete knowledge about the use of both elements for both effective teaching and learning, it is necessary to look at SCL and ICT together. The curriculum should integrate these two elements, and teachers should be able to contribute to this improvement by obtaining knowledge and skills in terms of how to combine different approaches in their daily teaching practice.

This research study also contributed to the design and implementation of corresponding professional development training for teachers in how to use ICT effectively for the enhancement of SCL. Based on recommendations from different studies, the TPACK framework was chosen as a guideline for
the design of this new training. Several modules were developed in different areas dealing with the coherent implementation of SCL and ICT. These modules were a combination of the knowledge areas defined in the TPACK framework, such as pedagogical content knowledge (PCK), technological content knowledge (TCK) and technological pedagogical knowledge (TPK). Mastering all of these related knowledge areas is crucial in the professional development of teachers, particularly when they need to adopt new approaches to teaching and learning.

By looking at the new pedagogical practices and the use of ICT for teaching and learning, we can see that the training activities for professional development have had a considerable impact. Teachers who participated were more likely to use ICT for teaching and learning than non-participants. In addition, the training had a positive influence on the use of ICT to support the implementation of SCL.

The study also showed that teachers who participated had different perceptions of the importance and impact of professional development in their day-to-day work than those who did not participate.

The decision to take the combination of knowledge areas in the TPACK model as the leading principle in the design of the professional development training contributed significantly to the positive results. This combination was crucial in allowing the participants to understand the pedagogical implications and potential of the use of ICT and SCL. Similarly, the training induced both technological and pedagogical changes in the teachers and contributed across the institution to improvements in the quality of education in general.

5.1. Reflection

The findings of this research study demonstrate that the introduction of ICT and changes in teaching and learning approaches are complex processes. The use of different theoretical frameworks in these studies contributed to the identification of the different factors that can contribute to the successful implementation of SCL and ICT approaches in the Mozambican context.

There are several components, factors or subsystems that should be considered. Components such as technology, pedagogy, implementation and institution and introduction, or factors such as the roles inside and outside of the school, the organisation of learning, the organisational climate, staff training and development, infrastructure and resources and ICT policy, and
the learner, the teacher, the content, the technology, and learning support at the institution are all very important for the successful adoption of ICT for teaching and learning. All of these components, factors or subsystems must be considered interdependent and to have the same level of importance. The interests (intrinsic and extrinsic motivations) of teachers and students are also important in the successful use of SCL and ICT for teaching and learning.

The identification of the factors that contribute to successful implementation at UEM is crucial for keeping what is a well-implemented and put effort to what was neglected.

The introduction of ICT as a tool to foster a shift from teacher-centred approaches to SCL approaches at UEM followed several stages, beginning with the creation of infrastructures and resources in the 1980s. Although the university has succeeded in creating a rough infrastructure that can successfully be used for educational purposes, it is keen to improve it.

The second stage that UEM completed successfully was curricular reform that accommodated new approaches to teaching and learning with an emphasis on both student-centred teaching and the harmonisation of the instructional design, using the flexibility-activity framework as the pedagogical model. This model accommodates any teaching and learning methods and strategies with a focus on student-centred approach.

The professional development program has taken a long time to achieve, but has been designed based on the TPACK framework, which allows teachers to be trained to integrate pedagogical invocations successfully, and this has been essential for the implementation of SCL using ICT.

The implementation is in progress at UEM. Both lecturers and students have institutional support at the university and faculty/school levels. When analysing the institution as a component or subsystem, it can be seen that UEM has advanced in terms of the implementation of some factors.

The university has developed an institutional policy and action plan, and the implementation is taking place. SCL approaches and the use of ICT for teaching and learning form part of the objectives of these documents. The university has developed a professional development scheme made up of 14 modules covering important areas for the development of desired competencies in a teacher. This training is mandatory for all lecturers, and particularly for the assistant lecturers.

However, despite the advancements mentioned above, the university still needs to work on other areas. The use of ICT for teaching and learning is still not part of the university culture, since there are many lecturers who
are not using it for teaching. Some mechanisms (university policies and regulations) created at the level of the university are not being followed up at faculty or school level, due to the level of autonomy that they have. Some of these lecturers use only PowerPoint presentations and emails rather than an LMS or other ICT tools as part of teaching and learning. Other lecturers use SCL approaches without using ICT, and do not follow what is defined in the course programs, or even in the curriculum.

Another aspect contributing to the slow pace of implementation is related to the higher education quality assurance system introduced a few years ago by the CNAQ. In this system, the use of ICT and pedagogical innovation are not seen as important indicators. In the CNAQ quality assurance system, these two indicators are not clearly discussed as being important in the curriculum when the issue is teaching and learning. The design of strategy and action plans at faculty and school level is crucial to the implementation at the university. The faculties and schools also still need to create incentives for those who are not yet using SCL and ICT.

The business sector is also playing an essential role in the transformation of UEM into a research university in the field of ICT. UEM can act not only as a partner that benefits from services provided by the business sector, but also as a preferred source of knowledge, technology and innovation that can contribute to the solution of problems and catalyse the development of the national business sector. In conjunction with UEM and its faculty, researchers and students, IT companies can create new start-ups that can respond to the needs and opportunities of the national, regional and global economy.

Successful implementation depends on all of the factors being considered at the same level of importance. In this way, the implementation of ICT in education has to be considered as in heuristic approach, where each factor contributes to the development of university culture and can better prepare students for the modern workplace.

An example of a successful implementation in the academic area is the use of Turnitin, a plagiarism checker software. Teachers have used this since it is in their interests, and many realised the need for Turnitin after a study that evaluated 150 undergraduate and Master's theses from five of the largest universities in the country including UEM revealed that 75% contained significant plagiarism (Coughlin, 2015).

Another example of successful implementation of ICT at UEM is in academic registration via the implementation of an Integrated System of Academic Registration (SIGA). This system was in the interests of both the
university and the teachers, and is designed for academic management, including functionalities such as admission management, admission, enrolment, lessons (and absences), the development of guidelines, issuance of certificates and declarations, communication with students (via SMS, email, internal messages), and student record management. The implementation of SIGA was based on the need to help the organisation following the growth of UEM in terms of the number of students, with a need to simplify and automate student enrolment, grading and the control of tuition fees.

There are several other administrative management systems that operate successfully due to the interests of the users and the contexts in which they are implemented. The following systems are real examples:

- Human resources management subsystem (SGRH)
- Integrated financial management subsystem (IFRS)
- Records management and offices
- e-SisQual - academic quality management
- e-SiPMA - integrated planning and monitoring system
- Shared resource management (rooms, vehicles)
- Graduate management and monitoring system
- University residency management

All of these systems were requested and developed by students and lecturers due to the interests of staff and the entities responsible for the related activities.

In 2016, the UEM created the Innovation Space, an important precondition allowing innovative ideas to be incubated and applied in response to concrete situations. In 2017, this entity developed innovative solutions with social impacts both inside and outside the academy, such as a mobile solution for management of the process of solid waste collection by tax inspectors for the municipality of Maputo, and a platform that allows the sharing of academic material among students of UEM. The Innovation Space has also carried out several activities such as the promotion of innovation, studies, academic internships and the elaboration of a program that can accelerates the implementation of startups.

5.2. Research limitations

In this research study, four out of the five studies placed a greater emphasis on a qualitative research approach; only study 5 used solely a quantitative...
approach, namely questionnaires. Although study 1 used questionnaires as one of the methods, these data were used only descriptively.

In this research study, most of the data were derived from the perceptions of the lecturers, students and other staff involved in the pilot projects, and were collected through interviews, questionnaires and observations. Since the studies used a non-representative sample, this did not allow generalisation of the results found in this research.

Another limitation is related to the lack of comparative elements in this study that could be used to measure the achievements before and after implementation of the pilot projects. Studies 1 and 4 present data from students at the beginning and at the end of the cycle of action research. In the other three studies, the number of informants was different, which made it impossible to compare the achievements of lecturers and students at the beginning and the end of the cycle. The results for the improvements in performance shown in the three different studies are based on self-learning and on the opinions of the participants.

The final limitation of this research study is related to the participants. All participants in the studies were voluntary. The studies took into consideration only teachers, students, managers, IT support staff and distance education experts who were directly involved in the pilot projects. The same was true of the HEIs that participated in study 3. Of the 44 HEIs in Mozambique, the researcher was only able to contact 28, of which only 19 responded to the survey. Since this is a non-probability sample, this hinders the generalisability of the results, despite the fact that the majority of HEIs have similarities.

Qualitative research methods were primarily used in this study. To assure quality in qualitative research, the terms validity and trustworthiness are used to indicate the rigour necessary to assure that the research findings are to be trusted and can be believed (Merriam, 1998). One of the most important issues in qualitative research is that the findings should demonstrate the credibility of the data used to address the topic investigated. Cohen et al. (2007) state that for qualitative data, validity can be addressed through the honesty, depth, richness and scope of the data, the participants approached, the extent of triangulation and the disinterestedness or objectivity of the researcher.

In this research, the issue of trustworthiness was addressed by making use of different instruments for data collection, such as literature and document analyses, interviews, discussions, questionnaires and observations. Furthermore, in designing the research procedure, several pilot projects were
set up to try out the use of ICT and SCL (see studies 1 and 4). Some of these pilots were carried out after two cycles, following the action research procedure. Furthermore, in the acting and observing stage, each of the participants presented a progress report on the project, and posed questions regarding the objectives of the research, the methodology, ethics and other research issues through active participation in the workshops.

However, the purpose of using different data collection techniques was to generate different layers of data from each pilot. This would stimulate participants to improve the honesty, depth, richness and credibility of the findings. For the purposes of data triangulation, the studies presented in this research involved lecturers, students, managers and IT technical staff as different sources of data. In the specific case of the data obtained from observations and interviews with students, the data collected was triangulated in order to increase the validity of the findings. The findings obtained from lecturers and other informants were always presented to them and discussed in the workshops.

According to Koshy (2005), most action researchers and those who use qualitative methods are concerned with validity rather than with reliability, insofar as their focus is on a particular case rather than on a sample. In this research, despite the similarities in the action plans used in the different pilot projects, the focus was always on the specific aspects of each separate module. The intention of setting up different pilot projects was not to generalise the findings, but to integrate ICT and SCL approaches in different situations and circumstances. In this way, the degree to which the findings of each pilot can be applied or transferred to other modules can be more closely ensured.

5.3. Further research

Considering the range of challenges that arise in terms of the integration of SCL approaches and ICT into education, there are several topics that remain outside the scope of this thesis but that would be valuable to study further. One interesting topic that has not been discussed in detail in this thesis is how this pedagogical model can be used to drive HEIs to adopt SCL approaches and e-learning. Furthermore, it would be interesting to study in more detail the interests of teachers and students regarding the use of SCL and ICT for teaching and learning, how it can accelerate the implementation, and how it can improve the educational effectiveness. Another fundamental
issue is related to the acceptance by lecturers and students of the use of ICT in education. Socio-cultural and economic factors that can influence the learning performance of students must be identified and analysed, as well as the implications of those factors for teaching and learning.

Based on the recommendations of the studies conducted in this research, UEM has designed and implemented a strategy policy and action plan to incentivise teachers to attend and complete all modules of the professional development for academic promotion, and to cover the introduction of quality assurance in faculties and schools and the annual evaluation of teachers. The university will also design a policy that will introduce the use of SCL and ICT in teaching and learning to incentivise teachers, and will revise teaching evaluation and quality assurance instruments to introduce items referring to the use of SCL and ICT in teaching and learning.


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