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Innovative use of Information Technology to Enhance Knowledge Management Practices at the Marist International University College, Nairobi – Kenya

Mini-dissertation

By

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Student number

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Submitted in partial fulfilment of the requirements for the

Degree of

MASTER OF INFORMATION TECHNOLOGY

In the

School of Information Technology

In the

Faculty of Engineering, Built Environment and Information Technology

at the

University of Pretoria

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December 2016

DECLARATION

I, Everlyn M'mbone Anduvare declare that this mini-dissertation, ***Innovative use of information technology to enhance knowledge management practices at the Marist International University College, Nairobi - Kenya***, which has been submitted in partial fulfillment of the requirements for the degree Master's in Information Technology at the University of Pretoria, is my own work and has not previously been submitted by me for any academic award to any institution. I further declare that I have referenced all sources that I have used in this mini-dissertation.

ABSTRACT

Information technologies have become relevant enablers in knowledge management (KM) initiatives in academic institutions. A previous study by Anduvare (2015) revealed that the Marist International University College, Nairobi – Kenya had not adequately adopted information technologies into KM practices entwined in teaching, learning and research. This research study, therefore, set out to explore technologies that are capable of supporting KM practices in academic institutions in order to recommend some to the MIUC. Purposive sampling was used to select the MIUC full-time academic staff members as the target population as the researcher believed that they actively use knowledge at the MIUC and hence, would be in a position to understand the extent of information technology usage in KM practices. The study employed a qualitative research design that involved the use of Google forms to conduct an online survey in order to collect data from the target population. The study achieved a 100% response rate. Content analysis was utilised to analyse the data during which data within the specified themes (collaborative and distributive learning; knowledge discovery; knowledge mapping and knowledge application) was scrutinised for meaning. The data was then interpreted, presented and discussed based on the research sub-questions set for the study. The findings of the study confirmed the existence of KM practices at the MIUC. The study, thus, recommended some information technologies that support the KM practices to the MIUC which had been established through a review of literature.

Keywords: *Collaborative Learning; Distributive Learning; Educational Technologies; Emerging Technologies; Higher Education; Information Technologies; Knowledge Application; Knowledge Discovery; Knowledge Management; Knowledge Mapping; Marist; Kenya.*

DEDICATION

To my greatest supporters,

Evita

&

Loren

God Bless!

ACKNOWLEDGEMENTS

"We = Power" – Lorii Myers

This mini-dissertation could not have been a reality without the support of many individuals:

Foremost, I thank our God almighty for the opportunity to study M.IT, and for the strength and good health bestowed upon me throughout the studies.

I am grateful to the University of Pretoria and the Carnegie Corporation of New York for the opportunity and funding for the M.IT program. This program has been enriching and quite an eye opener. I feel so empowered. Thank you.

Much appreciation to my supervisor, Ms Marietjie Schutte who trained and pushed me to be better. I have learnt so much through your remarkable academic supervision.

I would like to acknowledge with much gratitude the support and love accorded to me by my family and friends. In the midst of so much stress they stood by me and cheered me on. May God bless you abundantly.

To the entire M.IT team: administrators, faculty and, my student colleagues, thank you so much for understanding the struggles and trials that accompanied this program and for being my family the entire period. The amount of motivation and inspiration that I derived from you is immeasurable. As for Bright Avuglah, I lack words, thanks fan!

I convey much gratitude to the Marist community led by Bro. Dr. Cyprian Gandeebo, the family spirit lives on indeed. Thanks for the unwavering support. "You are the light of the world."

I am thankful to my boss, Professor Joseph Kavulya, thanks for the patience, time and support that you accorded me during the studies.

Lastly, to the University of Pretoria library and the Catholic University of Eastern Africa library. I appreciated all the valuable and reliable information resources that I was consistently able to access from the libraries.

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LIST OF ABBREVIATIONS AND ACRONYMS

AI	Artificial Intelligence
APQC	American Productivity & Quality Center
CL	Collaborative Learning
CMap	Concept Map
CSCL	Computer Supported Collaborative Learning
DL	Distributed Learning
DM	Data Mining
DBMS	Database Management System
DGMS	Dialog Generation and Management System
DLEs	Distributed Learning Environments
DSS	Decision Support System
ES	Expert Systems
GBL	Game-Based Learning
HTML	Hypertext Markup Language
ICT	Information and Communication Technology
IHMC	Institute for Human & Machine Cognition (The)
IR	Institutional Repository
IT	Information Technology
KD	Knowledge Discovery
KDD	Knowledge Discovery in Databases
KDSs	Knowledge Discovery Systems
KM	Knowledge Management
KMAT	Knowledge Management Assessment Tool
LCD	Liquid Crystal Display
LMS	Learning Management Systems
MIT	Master of Information Technology
MBMS	Model-Base Management System
MIUC	Marist International University College

NMC	New Media Consortium (The)
PDAs	Personal Digital Assistants
PLEs	Personal Learning Environments
RSs	Recommender Systems
RSS	Really Simple Syndication
UNESCO	United Nations Educational, Scientific and Cultural Organization
VLEs	Virtual Learning Environments

CHAPTER ONE: INTRODUCTION

1.1 Background to the study

We are living in an age where technology has taken a central role in various aspects of our lives. UNESCO (2005:27) asserted that there are new conditions for the emergence of knowledge societies driven by new information technologies (ITs). According to Sedziuviene and Vveinhardt (2009:79-80), "earlier, the source of welfare and power was land, then capital and nowadays in a newly formed informational and knowledge society the welfare source is knowledge." This indicates that knowledge is, therefore, an essential asset in the current knowledge societies and hence the need for organisations to manage intellectual capacity. Sedziuviene and Vveinhardt (2009:79) further asserted that knowledge forms the basis for competitive advantages in organisations. In support of this, Mavodza and Ngulupe (2012:1) stated that, "organisations that can identify, value, create and evolve their knowledge assets are likely to be more successful than those that do not." This study proposed to investigate technologies that support knowledge management (KM) practices at the MIUC.

This first chapter sets out to briefly highlight KM and related concepts. Further, the chapter highlights the contextual setting by providing background information about the MIUC, presents the problem statement; aim and objectives; research question and sub-questions; research methodology; scope and limitations of the study; significance of the study; clarification of key terms; highlights the mini-dissertation chapters; and finally, ends with a conclusion for this chapter.

1.1.1 Conceptual setting

The purpose of this section is to briefly discuss the major concepts related to KM in academic institutions in order to enhance the understanding of the scope of the study.

a) The knowledge pyramid

The knowledge pyramid, also referred to as the DIKW pyramid, "is widely referred to in KM studies to articulate the transformational interrelationship between data, information, and knowledge" (Intezari, Pauleen & Taskin, 2016:4194). Intezari, Pauleen and Taskin (2016:4194) cite a number of authors such as Intezari and Pauleen (2014); Liew (2013); Vandergriff (2008); Rowley (2007); Bierly, Kessler and Christensen (2000) and, Fricke (2009) who have criticised the validity of the knowledge pyramid model by arguing that it has failed to provide a clear interaction between the concepts data, information, knowledge and wisdom

by solely providing a linear interrelationship between the terms. The model has, however, been adopted in this study to provide a basic distinction between the terms data, information and knowledge as these terms are used in the study.

According to Bernstein (2011:68); Ackoff (as cited by Rowley, 2007:166), the knowledge pyramid entails data, information and knowledge, in which case, data consists of symbols signifying properties of objects, events and their environment and are considered to have no value until they are processed and made useable as information. Information, inferred from data, is confined in answers and questions and responds to questions beginning with words like who, what, when and how many. Knowledge, on the other hand, makes possible the transformation of information into instructions and is acquired through transmission, instructions or via experience.

Kebede (2010:419) and Rowley (2007:164) asserted that there is a natural development of data to information and information to knowledge, with knowledge turning out to be the most valuable and useful. According to Kebede (2010: 419), knowledge is the most enriched and desired of the three (data, information and knowledge) and requires management to be of value to the users. Kebede (2010:420) further noted that knowledge incorporates data and information. It is, therefore, evident that the three concepts relate to each other. This relationship has, however, not been very distinct. This is expressed by Chen *et al*. (2009 as cited by Baskarada & Koronios, 2013:6) who highlighted that often, data and information are used synonymously. For instance, Fayyad et al. (1996) as cited by Baskarada and Koronios (2013:6) indicated that "in the context of data mining, knowledge has been equated with useful information." This signifies that information and knowledge are also equated in some contexts. In the context of this study, the three terminologies will be applied as distinct rather than synonymous.

b) Tacit and explicit knowledge

"Knowledge includes the set of facts and rules of thumb that experts may have acquired over many years of experience" (Liebowitz, 2001:1). Knowledge takes various forms such as tacit and explicit forms. Explicit knowledge refers to knowledge presented in the form of words, text, sentences, tables, diagrams, documents, organised data, computer programs, product specifications and so on (Apurva & Singh, 2011:930; King, 2009:4). This type of knowledge is more obvious as it is in recorded or documented form (Kebede, 2010:420; Liebowitz, 2001:1-2). According to Kebede (2010:420), recorded knowledge has been largely viewed as being equal to information but he argues that this type of knowledge is more enriched considering that it has occurred through "many increments of information, personal experience,

insights, reflections, and logical reasoning created in the minds of human beings over a period of time," while information "is specific to a situation on which data has been collected and organized to give a meaningful picture about the specific situation." This explanation by Kebede (2010), therefore, suggests that there is a distinction between explicit knowledge and information.

Tacit knowledge exists in unrecorded form, that is, in the human mind (Kebede, 2010:420). This type of knowledge "cannot be expressed" (Apurva & Singh, 2011:929). Tacit knowledge provides a challenge in KM efforts as making it explicit and usable is a fundamental problem (King, 2009:4). Liebowitz (2001:1-2) emphasises this challenge by asserting that this form of knowledge occurs involuntarily thus it poses a challenge with regard to its extraction from experts.

Based on the above highlights on the two types of knowledge, it is evident that they both exist in the academic context in that one will find both recorded knowledge and experts. In *section 1.1.1a: Knowledge pyramid*, knowledge was found to be at the highest point of the knowledge hierarchy and thus the most relevant to organisations. The need to manage knowledge, thus, becomes apparent.

c) Knowledge management

According to Kebede (2010:240), "KM is a purposeful and systematic management of knowledge and the associated processes and tools with the aim of realizing fully the potential of knowledge in making effective decisions, solving problems, facilitating innovations and creativity and achieving competitive advantage at all levels (personal, group, organization, country and so on)." Thus, taking an academic context, despite the natural existence of knowledge both in tacit and explicit forms, this knowledge can only be useful if a conscious effort is made to manage it. Liebowitz (2001:1) asserted that KM involves heightened knowledge sharing with the aim of creating "value-added benefits" to an organisation. King (2009:4) finds the need for managers to enable the achievement of KM goals through motivating employees to be part and parcel of the processes leading to the prescribed KM goals and this can be done through the creation of social processes. According to Mostak, Hoq and Akter (2012:93), the ultimate importance of KM lies in the application of knowledge to the organisation's purposes.

Wiig (2002, as cited by Dalkir, 2011:7) finds two knowledge-related aspects to be viable. "knowledge *assets* that must be applied, nurtured, preserved, and used to the largest extent possible by both individuals and organizations; and knowledge-related *processes* to create,

build, compile, organize, transform, transfer, pool, apply, and safeguard knowledge." Knowledge-related assets consist of documented knowledge such as knowledge in repositories and best practices databases, employees and teams' knowledge and, knowledge embedded in "products, processes and relationships." On the other hand, KM processes include: knowledge acquisition, creation, refinement, organising, storage, transfer, sharing, utilisation, sustaining and renewing both the tacit and explicit knowledge forms (King, 2009:4; Soundararajan, Joseph, Jayakumar, & Somasekharan, 2005:141). The management of both knowledge assets and processes proves crucial for the benefit of an organisation.

One of the misconceptions about KM lies in believing that KM involves the translation of tacit knowledge into explicit knowledge that is then stored for retrieval (Dalkir, 2011:11). Dalkir (2011:11) points out that KM goes beyond this by "leveraging the value of the organizational knowledge and know-how that accumulates over time. This approach is a much more holistic and user-centered approach that begins not with an audit of existing documents but with a needs analysis to better understand how improved knowledge sharing may benefit specific individuals, groups, and the organization as a whole." Thus, the greater focus of KM is more on the needs for knowledge and facilitation of knowledge sharing rather than on existing codified knowledge.

d) Knowledge management in academic institutions

According to Mavodza and Ngulupe (2012:2), "KM is a process that enables an organisation to improve its performance by enabling learning and innovation whilst solving its problems, acknowledging and resolving gaps in its operations, and recognising knowledge (comprising people and information) as an organisational asset which has to be managed through enabling policies and institutional tools." Britianu (2011:2) states that from history, the mission of the university lies in the creation, preservation and transfer of knowledge to students and to society. Wiig (1997:7) also stated that staff members in academic institutions have been charged with knowledge creation, transfer and application for several millennia. According to Fullwood, Rowley and Delbridge (2013:123), "universities are knowledge intensive environments" characterised by the creation and dissemination of knowledge through research and publication; transferring of knowledge through their collaborative works with other organisations in an effort to sustain innovation, social and cultural endeavours, and; supporting learning teaching and research activities. Dhamdhere (2015:1) supported this by indicating that knowledge is majorly generated through human efforts which are sustained "through conducting good educational activities, research activities and generating innovative concepts

in the area of interest." Therefore, institutions of higher learning play a big role in knowledge creation and thus ought to have KM initiatives to leverage their knowledge assets.

Universities are generally assumed to be learning organisations based on the teaching, learning and research activities that take place but this assumption should not suffice. A learning organisation involves the transition of knowledge from individuals to collective learning facilitated by critical functional conditions (Bratianu, 2011:2). KM would therefore, be crucial to provide these required conditions through the effort of enhancing collaborations among the members of the organisation. The challenge in an academic institution with regard to KM is partly because of a complex structure in terms of the people being dispersed into units, departments and even campuses. Such a complex setting may, therefore, call for the use of technologies to enable KM practices. Alavi and Leidner (2001:124) found that "utilising information technology implies attention not only to improving the individual and group level processes of knowledge creation and storage, but also to improving the linkages among individuals and between groups."

e) Innovation in academia

Innovation refers to the process of taking up a new idea in an organisation and this can be in the form of "a new product, a new service or a new technology" helping to enhance value for the organisation (Du Plessis, 2007:2). The importance of innovation lies in the production of unique products and services and further, innovation is crucial due to the rapidly changing needs and preferences of customers (Akram, Siddiqui, Nawaz, Ghauri & Cheema, 2011:123). "Organizations have to ensure that their business strategies are innovative to build and sustain competitive advantage" (Du Plessis, 2007:1). In order to do this, there is a need for KM as indicated by Akram, *et al*. (2011:123) who stated that activities such as "knowledge gathering, managing, sharing, learning, reuse and retrieval" aid in sustaining innovation. They further suggest the necessity for organisations to create appropriate channels to enhance collaborations. According to Leal-Rodriguez, Leal-Millan, Roldan-Sagueiro and Ortega-Gutierrez (2013:63), "the essence of knowledge management (KM) with respect to innovation is that it provides a framework for management in their attempt to develop and enhance their organizational capability to innovate." Thus, KM forms a crucial component in the innovation process. In the context of this study, innovation will be viewed in the sense that IT will be recommended for adoption by the MIUC to enhance the existing KM practices that are intertwined in the teaching, learning and research practices of the institution. The researcher hopes that by adopting these technologies, the institution will have better ways of managing knowledge and providing enhanced services to its customers.

f) Information technology and knowledge management

There has been much discourse in relation to the role technology plays in KM with emphasis on technology being a KM enabler (Subashini, Rita & Vivek, 2012:545; Alavi & Leidner, 2001:111; McDermott, 2000:22). Knowledge resides in people thus without their active participation and involvement in KM, the initiative cannot succeed (Mostak, Hoq & Akter, 2012:93). In the same breath, Liebowitz (2001:2) asserted that KM goes beyond the use of technologies to involve people and culture which are more critical when it comes to enhancing a knowledge sharing environment.

On the other hand, technology is also relevant to KM effort. According to Subashini, Rita and Vivek (2012:545), technology has enhanced the speed at which knowledge can be accessed thus adding value to the users. Brinkley (2006:5) stated that "the ability to store, share, and analyse knowledge through networks and communities using the new ICT technologies allows firms to exploit the unique properties of knowledge to gain competitive advantage." Further, IT has enhanced ways through which organisations are able to leverage knowledge (McDermott, 2000:22). Technology can, therefore, be a critical enabler for successful implementation of a KM initiative in an academic institution.

Wankel and Blessinger (2013:4) asserted that technology by itself cannot ensure interactions and retention, but rather, in the context of academic institutions, there has to be a focused strategy that embeds goals and objectives in the use of technology in KM. They however, warn that technology is pervasive and should not be viewed as a passing fad. Bates (2000:42) indicates that there is a need to understand the audience when integrating technology in KM in academic contexts as the level of adoption and application will vary. They raise the following cases to be noted:

i. "Technology-based teaching and learning is perfectly appropriate; for others, it is not. We will need to be selective and sophisticated in our decisions as to how we want to use technologies to learn and teach."
ii. Second, "the roles of both learners and teachers will change, in order to exploit the benefits of new technologies. This in turn will have a major impact on our educational institutions."
iii. Third, "our move to representing knowledge in various ways through technology will change the nature of our understanding. This does not necessarily mean that our understanding will be better or worse - just different."

It is, therefore, evident that IT is vital in enabling KM. Liebowitz (2001:2) terms it as "a chicken and the egg situation" and explains that without technology to support KM, the KM effort may be wasted time. On the other hand, even with appropriate technologies in place, if people are not willing to participate and share their knowledge then KM will fail – thus, both the people and technologies must be adequately addressed for KM to be effective.

1.1.2 Contextual setting

Anduvare (2015) carried out a study on developing a knowledge management strategy for the Marist International University College (MIUC); a Christian - based academic institution located in Karen, Nairobi – Kenya. In the study, a KM assessment was conducted with a focus on the five aspects of processes, leadership, technology, culture and measurement as provided for by Arthur Andersen (*see* Anduvare, 2015:28). Gourova, Antonova and Todorova (2009:610) stated that KMAT model strove to achieve two aims: "to ascertain the position of one company with regard to KM in comparison to other companies, and secondly to evaluate the efficiency of the realization of the knowledge management process."

With regard to technology, the findings indicated that even though the MIUC has some IT infrastructure in place it was not sufficient to support KM because of some challenges including insufficient KM tools, insufficient Internet bandwidth and knowledge gaps (Anduvare, 2015:172). Hasanali (2002:4) identified approach, content, common platforms, simple technology and adequate training as the critical KM success factors related to IT. These aspects are a direct reflection of the challenges identified at the MIUC with regard to technology available to support KM. The study, hence, recommended that the MIUC should develop policies and procedures to guide in the proper utilisation of IT tools to enhance KM. The dissertation further recommended that the MIUC should invest in a systems upgrade of its IT infrastructure in order to adequately support KM (Anduvare, 2015: 181).

The current study, therefore, set to uncover some of the ITs that can be used innovatively in managing KM practices at the MIUC. Gold, Malhotra and Segars (2001:188) pointed out that, "collaboration and distributed learning technologies allow individuals within the organisation to collaborate. Knowledge discovery technologies allow the firm to find new knowledge that is either internal or external to the firm. Knowledge mapping technologies allow the firm to effectively track sources of knowledge, creating a catalog of internal organisational knowledge. Knowledge application technologies enable a firm to use its existing knowledge." This study intended to investigate KM technologies through these four lenses adopted from Gold, Malhotra and Segars (2001:188): Collaboration and distributed learning technologies;

knowledge discovery technologies; knowledge mapping technologies and knowledge application technologies. These four concepts are discussed in detail in the second chapter.

1.2 Aim and objectives

The aim and objectives of the study are presented below:

1.2.1 Aim

The aim of the study is to investigate information technologies that can be used innovatively to support KM practices at the MIUC.

1.2.2 Objectives

The objectives include:

i. To investigate the KM practices that are still apparent at the MIUC in view of the findings presented in a previous study by Anduvare (2015).
ii. To find out from literature which information technologies that can support collaboration and distributed learning; knowledge discovery; knowledge mapping and knowledge application at the MIUC.
iii. To inspect the technological needs of the MIUC academic staff with regard to collaboration and distributed learning; knowledge discovery; knowledge mapping and knowledge application.
iv. To suggest how the revealed information technologies can be used innovatively to support the KM practices at the MIUC.

1.3 Research question and sub-questions

"A research question is a question the research itself is trying to answer" (Punch, 2009:62). According to Oso and Onen (2009:38), "a question becomes a research question if it cannot be answered unless fresh data is collected on it." Better planning in research starts with a clear and do-able research question. A research question provides a key rationale for a research study and motivates one to see their research through to completion (Ng & Coakes, 2013). The specific research question and sub-questions that informed the study will include:

Which information technologies can be used innovatively to support KM practices at the MIUC?

i. What KM practices are still apparent at the MIUC in view of a previous study by Anduvare (2015)?
ii. Which information technologies can enhance collaboration and distributed learning; knowledge discovery; knowledge mapping and knowledge application at MIUC?
iii. What are the technological needs of the MIUC academic staff with regard to collaboration and distributed learning; knowledge discovery; knowledge mapping and knowledge application
iv. How can the information technologies be used innovatively to support the KM practices at the MIUC?

1.4 Limitations of the study

The study was limited to the academic staff members who were the target group, with an assumption that having been surveyed about KM before; they had an understanding about KM and were, therefore, able to provide reliable feedback. By adopting a purposive sampling and selecting the academic staff of the MIUC as the target group, this study may also not be generalised to all academic institutions.

1.5 Scope of the study

The study covered two aspects highlighted below:

1.5.1 Geographical scope

The study was conducted at the Marist International University College because the researcher intended to perform a study that was connected from the findings of a previous study by Anduvare (2015) which had been conducted at the same institution. This was to enable the researcher to find some solutions to the gap related to limited IT adoption in KM practices that had emerged from the findings of that study.

1.5.2 Conceptual scope

This study is more of an exploration seeking to discover information technologies in support of KM practices in universities as discussed in the literature. In an attempt to contain the exploration, the study has opted to focus on four areas of the KM technologies namely: collaboration and distributed learning technologies; knowledge discovery technologies; knowledge mapping and knowledge application technologies.

1.6 Significance of the study

The study by Anduvare (2015) fell short of suggesting specific technological tools that can be used to facilitate KM practices. The main purpose of this study was, therefore, to ascertain IT that can be applied innovatively in KM at the MIUC. This study is significant in helping the MIUC to adopt these technologies in order to enhance knowledge creation, sharing, storage and application in support of promoting research and lifelong learning. Moreover, this study may be of value to other academic institutions looking at embracing KM technologies. The study may also be a useful tool of reference to students and researchers interested in exploring further on the subject of KM and technologies.

1.7 Clarification of key terms

The terms indicated below are defined in the way they provide meaning within the scope of the study.

1.7.1 Collaboration and distributed learning technologies

"Distributed learning and collaborative learning apply computer and communication technologies to allow students and instructors to participate in learning activities anytime and anywhere. While distributed learning provides an environment where resources can be shared and dispersed students may participate in learning, collaborative learning puts more emphasis on providing a shared workplace for students to interact and learn through cooperation" (Li et al.; 2008:2). In this study, collaboration and distributed learning technologies refer to the technologies that facilitate collaboration and learning in KM in academic institutions.

1.7.2 Knowledge discovery technologies

The definition by Barclay and Osei-Bryson (2012:2) which states that "knowledge discovery technologies generally refer to a series of activities to discover or identify knowledge of domain(s) from data-bases" was adopted in this study.

1.7.3 Knowledge mapping technologies

"Knowledge mapping acts as an explicit example within a business process of who has the knowledge, where the knowledge is located, and why it is important" (Powers, 2002:1). Knowledge mapping technologies, in this case, will refer to the technologies that the MIUC can use to identify where critical knowledge lies within the organisation with the aim of increasing access and conversation.

1.7.4 Knowledge application technologies.

"The knowledge application process is defined as the physical enactment or performance of the organisation's processes. It is important to understand that here the process itself represents knowledge while the act of performing the process is the knowledge application process" (Mostert & Snyman, 2007:12). For this study, the knowledge application technologies hence refer to the technologies that will facilitate the application of knowledge that has been created at the MIUC.

1.8 Division of chapters

The study has five chapters structured as follows:

Chapter 1: Introduction

This includes: background of the study which covers the concepts and the context of the study; problem statement; aim and objectives; research question and sub-questions; limitations and scope of the study; significance of the study; and clarification of terms.

Chapter 2: Literature review

This chapter includes a review of the literature on the concepts and information technologies based on the four aspects: collaboration and distributed learning; knowledge discovery; knowledge mapping and knowledge application. The chapter further highlights the KM practices available at the MIUC.

Chapter 3: Methodology

This chapter contains a description and explanation of research design, selection of research location, target group and sampling, data collection methods, application of questions to the study and data analysis and interpretation.

Chapter 4: Data presentation, analysis and discussion of findings

This chapter includes the presentation and discussion of findings from the data that was collected which has been presented as a report supported with tables and diagrammes.

Chapter 5: Summary, conclusion and recommendation

Based on the findings, a summary, conclusions and recommendations are presented in this chapter.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

The ever-evolving technologies are presenting opportunities for universities to rethink and redesign their teaching, learning and research practices. Veeranna and Elshheibia (2010:226) indicate that it is hard "to imagine a day without using a computer" in the modern world considering not only the visible impact universally, but also the societal need for learners with appropriate technological skills set.

This chapter sets out to expound on the concepts: collaboration and distributed learning; knowledge discovery; knowledge mapping and knowledge application. The chapter also attempts to determine and present the major Knowledge Management (KM) practices at the Marist International University College (MIUC) and these should enable the researcher in the determination of technologies to support these practices. Further, literature on information technologies (IT) with reference to the KM concepts under study is reviewed and presented. These technologies enhanced the determination of technologies that have been recommended for the MIUC in chapter four in order to enhance KM practices. The concepts related to knowledge management and technologies in the context of an academic institution have been discussed in chapter one (see *section 1.1.1: Conceptual setting*).

2.2 Information technologies

According to Veeranna and Elshheibia (2010:226), information technology "means the use of hardware, software, services, and supporting infrastructure to manage and deliver information using voice, data, and video." Rouse (2015) asserted that "information technology (IT) is the use of any computers, storage, networking and other physical devices, infrastructure and processes to create, process, store, secure and exchange all forms of electronic data." There is a wide range of IT tools that can be applicable in a university setting and this study set out to explore some of these technologies that are more appropriate for an academic setting and more so in support of KM aspects as discussed in the sections that follow in connection with research, teaching, and learning.

2.3 Collaborative and distributed learning

Traditional teaching has involved a form of teaching and learning whereby lecturers dictate notes to students in a face-to-face environment hence the dissemination of knowledge has

majorly been one-sided from the lecturer to the students (Javis, 2012:59). Crawford (2001:68) described the traditional model of learning as one that involved students being given assignments with the expectation that they should provide feedback by a specified date, a scenario that was not ideal to facilitate interactions between the students and lecturer and neither among the students themselves. Temdee (2015:2) stated that there has been a shift from these models to collaborative learning (CL) which has been applied in face-to-face and virtual learning environments. Long, Nah, Eschenbrenner and Schoonover (2012:606) identified CL as a constructivist model of learning in which the focus is on providing learners with an appropriate learning environment and then allowing them to discover, create and solve problems especially through collaborative social interactions.

The CL process entails the creation of new knowledge through collaboration; knowledge storage and retrieval which entail learning and knowledge retention by groups or individuals; knowledge transfer which involves the delivery of knowledge among individuals and the conversion of knowledge from tacit to explicit form or vice versa and finally knowledge application which is the process of putting the acquired knowledge into action and future applications (Long, *et al.*, 2012:616).

Economides (2008:244) asserted that CL involves learners working together to innovate and find solutions for problems whilst aiming for the same goals. In this context, the instructor is still an active participant but is not required to stamp authority and transmit knowledge to the learners but rather play the role of guiding the team as well as support individual weak learners. Duffy and Kirkley (2004:3) referred to this as "elimination of the lecturer as the central teaching activity."

According to Damon and Phelps (as cited by O'Donnell & Hmelo-Silver, 2013:2), CL may be characterised by high levels of equality and mutuality with regard to influence while participating in knowledge sharing. Hence, all participants have equal chances to share knowledge. Considering the need for interactions anticipated from all learners involved, Amara, Macedo, Bendella and Santos (2016:258) find that "forming effective learning groups represents one of the important factors that determine the efficiency of CL." Temdee (2015:2) raised the need for assessing the participants by stating that once they work as a team, it is critical that each member's participation should be defined and measured. Temdee (2015:1-2) further recognises that the learners vary with regard to performance and experience levels hence besides working in groups, they ought to be responsible for each other's learning above their own.

The emergence of IT opened up a platform for knowledge construction and delivery that was pursued by researchers leading to a new learning model known us computer-supported collaborative learning (CSCL) since the late 1990s (Amara, *et al*., 2016:258). CL thus not only works in face-to-face interactions but also via computer technologies. Prieto, Asensio-Perez, and Munoz-Cristobal (2013:324) asserted that lecturers have an added responsibility to ensure an effective learning experience whilst students are using CSCL platforms which can be a challenge given the social component required in such settings. Capdeferro and Romero (2012:37) find that CSCL can be a source of frustrations for the students if sufficient support is not offered and indicate that the instructor ought to know when they need to intervene and to what degree. Instructors are, therefore, required to be proactive in the provision of assistance, feedback, and evaluation at the appropriate opportunity.

Long, *et al.* (2012:617) suggested that in order to have an appropriate fit that will support a CL process and, therefore, enhance CL outcomes, there is a need to look at the objectives and tasks required for CL and CSCL technologies to identify the level of complexity and sophistication as these technologies vary with regard to functionality and sophistication. Amara, *et al.* (2016:258), for instance, identified mobile technologies that have promoted a new form of learning referred to as M-learning that allows learners to interact via mobile devices such as PDAs, tablets and smartphones at their own convenient time and place.

Distributed learning (DL), on the other hand, provides an environment where resources can be shared and dispersed allowing students to participate in learning (Li, *et al.* 2008:2). This includes learning resources geographically distributed in various locations (Li *et al.* 2008:4). Crawford (2001:68-69) suggests that Distributed Learning Environments (DLEs) eliminate the need for a student to worry about time and place of study as learning can easily be facilitated using technologies. According to Prieto, Asensio-Perez, Munoz-Cristobal, Jorrin-Abellan, Dimitriadis and Gomez-Sanchez (2014:9), the combination of Virtual Learning Environments (VLEs) and web 2.0 tools is what some authors refer to as DLE. Crawford (2001:69) adds that "virtual learning environments must specifically, meaningfully include interactive activities into the virtual environment so as to simulate the learning community involvement." According to Prieto, Asensio-Perez and Munoz-Cristobal (2013:324), there is, currently, an ongoing shift from the use of virtual learning environments (VLEs) due to limitations in their use to enhance collaborations in learning to accommodate more personal learning environments (PLEs) or web 2.0 tools such as wikis and blogs in learning. CL and DL environments are, therefore, relevant in KM as they promote knowledge creation and sharing through interactions ideally to promote lifelong learning.

2.4 Knowledge discovery

A global knowledge economy requires that institutions should be able to discover, apply and transfer new knowledge to the marketplace (Duderstadt, 2013:1). Academic institutions, in particular, could play a critical role in this given the amount of research output usually expected to be generated. Saadatdoost, Sim, Hee, Jafarkarimi and Saadatdoost (2014:28) stated that the advancement of technology has enabled data to be of great value and hence it should not be set for archival purposes only. "The accessibility and abundance of data today makes knowledge discovery and data mining a matter of considerable importance and necessity" (Maimon & Rokach, 2005:1). This means that, with the inception of technology, a lot of data is easily created and shared and this can pose a challenge in terms of finding valuable data for use. The need for measures to find this useful data, therefore, becomes indispensable.

"Knowledge Discovery (KD) refers to the overall process of discovering useful knowledge from data, and data mining refers to a particular step in this process. Data mining involves a collection of tools and techniques for finding useful patterns relating the fields of very large databases" (Soundararajan, Joseph, Jayakumar & Somasekharan, 2005:142). According to Maimon and Rokach (2005:2), the term data mining was coined to depict the practice of searching and filtering through large databases with the aim of finding interesting patterns and relationships. Ramamohan, Vasantharao, Chakravarti and Ratnam (2012:191) asserted that data mining has been usually treated as a synonym to knowledge discovery in databases (KDD) but they posit that data mining is in actuality an aspect in the KD process. The aspects of the KDD process as presented by Maimon and Rokach (2005:3) include: "domain understanding & KDD goals; selection & addition; preprocessing: data cleaning etc.; transformation; data mining; evaluation & interpretation and discovered knowledge (visualization & integration)." Maimon and Rokach (2005:1) define KDD as an "organized process of identifying valid, novel, useful, and understandable patterns from large and complex data sets." They further add to the idea that data mining is part of the KDD process and emphasise the fact that it is a core process that involves "inferring of algorithms that explore the data, develop the model and discover previously unknown patterns. A model used for understanding phenomena from the data, analysis, and prediction."

In academic institutions, it is possible to find repositories of stored data. Maimon and Rokach (2005:2) reckoned that with the increased amount of this stored data, there is a likelihood that the ability to understand and use this data may drag. This point is supported by Pechenizkiy, Tsymbal and Puuronen (2010:1) who indicate that it is highly capable of collecting and storing a lot of data while exceeding the ability to "analyze, summarize and extract knowledge from

this data." They further add that one may make use of knowledge discovery systems (KDSs) which make use of achievements from technical areas that include: "Data Mining (DM), statistics, AI, machine learning, pattern recognition, decision support systems, and knowledge-based systems." Hence, knowledge discovery tools become necessary in aiding to retrieve relevant knowledge from repositories. Soundararajan, *et al*. (2005:144) implied that KD tools "hold the promise of an enabling technology that could unlock the knowledge lying dormant in huge databases."

The Hague Declaration (n.d:1) added to the voice of knowledge discovery and indicated content mining as one of the methods for discovering knowledge. They stated that "content mining is the process of deriving information from the machine-readable material. It works by copying large quantities of material, extracting the data, and recombining it to identify patterns and trends." In the declaration, it was realised that efforts for content mining have been majorly disrupted by "legal uncertainties and restrictions" raising the need for researchers to have the "freedom to analyse and pursue intellectual curiosity without fear of monitoring or repercussions." Therefore, legal issues should be noted whilst an academic institution considers KDD processes.

In the context of KM, KD is considered relevant. Natek and Zwilling (2014:6400), for instance, asserted that in the KM process, data mining is applied to extract and discover relevant knowledge from large amounts of data. The importance of retrieving knowledge from a KD process as highlighted by Soundararajan, *et al*. (2005:142) is: "to support users' decision-making processes" and incorporate discovered knowledge "into the performance system, taking action based on the knowledge or simply documenting it for management/later use." Ramamohan, *et al* (2012:191) also indicate that the ability of data mining tools to predict future trends and behaviours by analysing data in databases for concealed patterns allows organisations "to make proactive, knowledge-driven decisions and answer questions that were previously too time-consuming to resolve." KD is, therefore, a useful process in a university as data is continuously created and stored and requires mining to fish out the relevant knowledge.

2.5 Knowledge mapping

Exploiting relevant knowledge in the midst of vast knowledge bases has become a challenge for many organisations as the process can be difficult, time-consuming and frustrating (Lee & Fink, 2013:15). Davenport and Prusak (2000, as cited by Zablith, Faraj & Azad, 2016:3)

indicated some of these challenges of knowledge flow in organisations as the inability to identify who knows what; unequal distribution of knowledge within organisations and employees consulting people that they know or who are close to them rather than people who know. These challenges are more inclined towards facilitation of tacit knowledge. There are other challenges that impact on effective access and use of knowledge stored in databases or repositories in organisations.

The ever-expanding amount of stored knowledge in organisations renders it difficult for potential users to comprehend the relations and connections of the knowledge hence raising the need to determine ways of creating those relations (Watthananon & Mingkhwan, 2012:1176). The advent of IT has enabled the availability of large amounts of data leading to the need for mining in order to facilitate one to stem knowledge from these data that can be shared among stakeholders both internally and externally in the organisation (Gupta, Mehrotra & Singh, 2012:5). Watthananon and Mingkhwan (2012:1170) indicated that improper data storage and limited access to knowledge bases is an issue that can lead to stored data being unrecognised. According to Lee and Fink (2013:16), most organisations in the current day have knowledge bases thus they do not majorly suffer from lack of access to knowledge but rather the means to access and exploit it. Okada (2008:1) asserted that easy access to these bases does not equate knowledge acquisition. Thus, given these challenges, there is a need for organisations to consider knowledge mapping to aid in identifying effective knowledge sources.

"Knowledge mapping is a process of surveying, assessing and linking the information, knowledge, competencies and proficiencies held by individuals and groups within an organisation" (Gupta, Mehrotra & Singh, 2012:5). Knowledge mapping is a useful way of guiding and identifying relevant, available knowledge sources and enables a better understanding of how it flows within an organisation thus enabling members to be able to quickly locate needed knowledge and experts (Lee & Fink, 2013:17; Jalalimanesh & Homayounvala, 2011:2). Knowledge maps also serve to reveal "weak links and bottlenecks in the flow of knowledge" (APQC, 2015). Lee and Fink (2013:26) clarify that a knowledge map should not be seen as a repository in itself but rather as a pointer to where key knowledge originates. Jalalimanesh and Homayounvala (2011:2 citing Eppler, 2001) provided five categories of knowledge maps:

i. "Knowledge source maps to answer questions about organization capability for handling projects."

ii. "Knowledge asset maps visually exhibit the existing stock of knowledge of an individual, a team, a unit, or the whole organization."
iii. "Knowledge structure maps depict the global architecture of a knowledge domain as well as the way in which its parts are interconnected."
iv. "The application maps demonstrate which type of knowledge should be applied in a specific business situation."
v. "Knowledge development maps can be used to illustrate the necessary stages to develop a certain competence."

This categorisation indicates that there are several ways that an organisation can approach knowledge mapping. Davies (2011:279) posits that "the choice of a mapping tool largely depends on the purpose or aim for which the tool is used and that the tools may well be converging to offer educators as yet unrealised and potentially complementary functions." Yasin and Egbu (2010:806) further add that, in order to fully exploit knowledge mapping techniques, consideration has to be made on a range of factors and the main purpose of using the map. Based on this, it can, therefore, be said that there is no specific knowledge mapping tool for particular knowledge maps but rather, an organisation can explore and innovate.

Knowledge mapping presents a variety of benefits to an organisation. In the interest of recognising how, when and where to access valuable knowledge, a knowledge map aids because it uses visual representations of knowledge assets for performing particular activities (Balaid, Rozan, Hikmi & Memon, 2016:451). Knowledge mapping helps to explore individual and group competencies whilst outlining how knowledge flows in an organisation. This is quite essential as one can easily identify effective knowledge sources without wasting time. In relation to that, knowledge maps are used to effectively categorise knowledge assets "among people, processes, content and technology" thus helps to represent the views and interrelationships of the members (Gupta, Mehrotra & Singh, 2012:6). Since the organisation's knowledge flow becomes clearer through knowledge mapping, there is increased teamwork as suggested by Balaid, *et al.* (2016:451) who find that an increase in "communication and sharing of common practices across an entire organisation" is an essential attribute that is derived from knowledge mapping.

The leadership of an organisation also benefit from knowledge mapping. Gupta, Mehrotra and Singh (2012:6) indicated that "the knowledge maps are subsets of the ontology and can be used as an analytical tool in the decision-making process" thus, should be recognised as essential tools that facilitate strategic decision-making through identification of crucial knowledge areas. Yasin and Egbu (2010:804) recognise the benefit of knowledge mapping in terms of building

the knowledge base through hastening the knowledge curve among employees by facilitating them to "locate an effective route of the processes, prevent repetitive and overlapping activities and identify new knowledge and new focus of the emerging quest for actionable information." In summing up, Okada (2008:8) indicates that "knowledge maps may be considered strategic, speculative and heuristic tools to represent what is important, interpret and reconstruct meanings, record and share new structures of components and connections essential to foster critical thinking and make better decisions in social learning communities."

In relation to knowledge maps, are concept maps. Concept mapping is a term that Lin and Hsueh (2006:553) found to have been used interchangeably with knowledge mapping in many spheres. Stoica, Moraru, and Miron (2011:568); Vitulli, Giles and Shaw (2014:2); and Watthananon and Mingkhwan (2012:1170) define a concept map as a graphical tool used to organise and represent knowledge and to visually represent complex relationships by showing how the concepts relate. According to Davies (2010:283), they are designed as hierarchies with relations indicated by the use of phrases that help one to understand how they relate. Vitulli, Giles and Shaw (2014:2) describe the hierarchies as being "enclosed in nodes, typically depicted by words enclosed in circles, ovals, or rectangles. The relationships among the concepts are represented by a link or line with an arrow to connect multiple concepts."

Stoica, Moraru and Miron (2011:571) provided benefits for using concept maps as the ability to clarify and arrange difficult concepts in a logical order; enhancing understanding and learning through visualisation of summarised related concepts; provision of an avenue for teachers to easily evaluate students and pinpoint misconceptions in the maps and, it can be used as an assessment tool to monitor students' achievement. Stoica, Moraru and Miron (2011:575) further compared concept mapping to brainstorming sessions through which ideas are expressed through drawing and they become clear as one continues to create associations whilst at the same time new knowledge is internalised.

In the case of education, a university can take advantage of knowledge and concept maps to enhance learning. Gupta, Mehrotra and Singh (2012:6) asserted that knowledge mapping techniques can be pivotal in enabling an educational institution to explore and identify knowledge entrenched in systems, their relations, and gaps. Shaw (2010:255) finds that knowledge maps can be effective tools in the presentation of e-learning materials because they have a structure that is easy to digest hence they have a potential to provide better learning performance as compared to traditionally designed e-learning content.

Davies (2010:280); and Stoica, Moraru and Miron (2011:569) reckon that there is an increased chance for students to have a deeper understanding of concepts because of the process of

representation, manipulation, clarification, analysis and identification of associated topics that they go through while designing the maps, that is, while these students are involved in the designing of concept maps. Teachers, on the other hand, can use knowledge maps "to represent the collective construction of knowledge" (Okada, 2008:6) and also, in the generation of alternative sources of information while instructing. Davies (2010:283) further suggested that mapping can enhance meaningful relations and engagements among students. That is, through collaboratively creating maps, students engage and share knowledge which aids in enhancing collaborative learning. For instance, maps can be integrated into game-based learning. Thus, knowledge mapping in the context of academic setting seems to take two directions: the creation of knowledge maps that direct people to sources of knowledge and, knowledge or concept maps that are created to enhance collaborative learning which ultimately facilitates the sharing of tacit knowledge.

Both the students and the teachers can, therefore, collaborate actively in the construction of maps (Stoica, Moraru & Miron, 2011:567). Knowledge mapping thus becomes essential in the learning process. Gupta, Mehrotra and Singh (2012:5) stated the need for an educational organisation to ensure identification of information flow while designing knowledge maps. This can be particularly relevant if the organisation is to map knowledge in the entire organisation and not only for an e-learning environment.

Knowledge mapping has a key role to play in knowledge management. According to Lee and Fink (2013:10), technology has revolutionised KM and this has resulted in huge data storage of captured knowledge and great retrieval systems. They, however, find that this has not necessarily been the ultimate solution for capturing and storing all forms of data raising an issue about finding the path to knowledge sources. Yasin and Egbu (2010:799-800) provided that knowledge mapping is an essential tool when it comes to assisting with the flow of information and knowledge in an organisation especially once awareness has been made towards knowledge management initiatives.

According to Bautista-Frista, Romero-Gonzalez and Morgan-Beltran (2012:48), a knowledge map should contain "key processes and activities, information and the strategic knowledge necessary to carry these out; who the people, clients and associated internal and external users are and who the information and knowledge suppliers are; and how the people use the information and knowledge."

Knowledge mapping aids in the designation of a wide range of methods that are used to "organize and structure knowledge sources, to map best practices, to develop insightful concepts, to create expert networks and to provide a more efficient memorable representation

of knowledge assets" and this is achieved through "mapping best practices and by identifying the gaps in processes" (Gupta, Mehrotra & Singh, 2012:5). Watthananon and Mingkhwan (2012:1176) add that "knowledge maps become contents presented to users in the form of relations increasing knowledge spirals in organizations and ability to create progression towards mutual targets of organizations." Knowledge spirals include processes that facilitate knowledge creation and conversion from tacit to explicit and vice versa.

Knowledge mapping tools help in "conveying, sharing, linking, sourcing and manipulating data and information" and this can be done using tools such as online databases and intranets (Yasin & Egbu, 2010:800). On the other hand, there are techniques that can be applied through manipulating knowledge mapping tools to map out knowledge. Jalalimanesh and Homayounvala (2012:8) identify data mining as one of the most useful and widely applied techniques in KM to map knowledge whilst applying techniques such as "clustering based on users, books and projects" to provide knowledge about the organisation's knowledge capital. Data mining was found to be a process in knowledge discovery (Ramamohan, *et al*, 2012:191) thus, we can say that knowledge discovery and knowledge mapping are closely associated processes.

2.6 Knowledge application

Knowledge application refers to the actual use of knowledge with the aim of benefitting an organisation or individual hence knowledge found and mapped in an organisation is translated into action (Jovović & Draskovic, 2008:35). Some of these actions may include learning, research activities, training, testing and actual application of knowledge for instance, in problem-solving.

Samoilenko and Nahar (2013:1280) highlighted the aims of knowledge application as to: "a) enhance understanding, b) improve problem-solving, c) decrease uncertainty in decision-making, d) increase critical knowledge application, e) nurture various skills and capabilities (i.e. technical), f) expand level of intelligence, g) support innovativeness, h) speed up productivity, i) enlarge know-how, j) encourage not only being reactive but also proactive organisation in general as well as, k) facilitate the development of complex software and systems, communication and knowledge sharing in globally distributed teams of high-tech organisations in particular." It is, therefore, evident that knowledge has to be put in use in organisations and consequently effort should be made to enable availability and ease of access

to useful knowledge. Universities, in particular, can gain a competitive advantage both in the academic and administrative spheres if these aims can be achieved.

Ghaedian and Chen (2012:17) stated that knowledge application and knowledge reuse are used interchangeably and further highlighted that the accessibility of knowledge does not necessarily indicate that it is applied. People's perceptions about the role of knowledge play a critical role in knowledge application.

Dhamdhere (2015:176) suggested that the lack of knowledge application in an organisation renders the other KM practices of gathering, storage, creation and sharing in vain. Thus, people should be able to apply knowledge to augment returns, create new knowledge and enhance innovation. In support of this, Ghaedian and Chen (2012:62) purport that the ultimate goal of KM work should be in the application of knowledge thus, knowledge capturing, sharing and storing efforts should be geared towards knowledge reuse. The challenge of knowledge application was also highlighted by Nesheim, Olsen and Tobiassen (2011:837) who stated that firms do set up mechanisms to facilitate intra-organisational sharing and dissemination of knowledge but not much thought is put into the application of this knowledge. "For reusing knowledge to happen, people first need to recall the knowledge (where the knowledge is), then recognize knowledge (the knowledge meets the users' need) and finally applying the knowledge" (Ghaedian & Chen, 2012:19), thus, it essential for an organisation to enable access to relevant knowledge for it to be reused.

2.7 Knowledge management practices at the MIUC

KM practices in academic institutions aim at enhancing the two perspectives of knowledge in higher education institutions namely: academic knowledge which is core and results from learning and teaching activities and, organisational knowledge which is overall to the business operations of the institution (Pinto, 2014:1). Pinto (2014:2) categorised some of the knowledge management practices likely to be found in an academic institution as highlighted in table 2.1 below:

Table 2.1: KM Practices in academic institutions adopted from Pinto (2014:2)

KM Practices	Description
Communities of practice	"Communities of practice are formed by people who engage in a process of collective learning in a shared domain of human endeavor: who deal with a common organizational process, who have interest in solving similar problems, who work in the same project, etc."
Best practices	"Identifies and incorporates the practices considered most suitable to each task. It may result from benchmarking or incorporation of best practices among organizations."
Lessons learned	"Represent the acquired and validated knowledge, as a result of the development of a particular project or activity."
Formal training	"Structured sessions with instructional material designed to support the processes of teaching and learning about a particular subject; it can include seminars, conferences, workshops."
Social interaction	"Collaboration, social bookmarking, chat rooms, discussion forums."
Competence maps	Involve "the representation of knowledge and skills / competencies available in the organizations."
Corporate education	"Strategy to develop and educate employees, customers, and suppliers, in order to align them with business strategies."

The study by Anduvare (2015:86) assessed the KM processes at the MIUC. It was found that the respondents (academic staff) had a wide and varied understanding of what KM processes are. While some employees appreciated some of the ongoing processes that had been listed, others could not realise any of it or very minimally, while others pointed out hindrances to having effective processes in place. It was, therefore, realised that there were KM practices at the MIUC but due to a lack of strategy, employees were unable to determine them. This study, therefore, finds it necessary to provide a general overview of some of the major KM practices at the MIUC guided by the list provided by Pinto (*see Table 2.1: KM Practices in academic institutions adopted from Pinto (2014:2)*) and the results presented in Anduvare (2015:82-86). It should be noted that the levels of activeness in the KM practices presented below varied as expressed by the respondents surveyed. This study focuses on determining technologies for the highlighted KM practices at the MIUC as presented whether the practices are scarcely or extensively explored at the MIUC. The practices are presented in the two categories of knowledge in academic institutions, that is, organisational and academic knowledge.

Table 2.2: Organisational and academic KM practices at the MIUC

Organisational knowledge:	
i.	Identification of knowledge experts and knowledge capture.
ii.	Access to organisational knowledge.
iii.	Recording and sharing of best practices.
iv.	Application of knowledge created at the MIUC.
v.	Training through academic workshops.
Academic knowledge:	
vi.	Knowledge creation through research and contribution of ideas.
vii.	The contribution of research works into the institutional repository.
viii.	Transfer of tacit knowledge among employees through consultations and collaborations.
ix.	The knowledge that is most shared at the MIUC is for students (teaching and learning activities).

To facilitate innovative selection and use of technology and to bring the relevance of this study to the MIUC, an attempt has been made to further categorise the MIUC KM practices into the four KM aspects being applied to this study that they are likely to tie closely with *(see table 2.3*). Thus, categorised under the collaboration and distributed learning; knowledge discovery; knowledge mapping and, knowledge application.

Table 2.3: The MIUC KM practices categorised under: collaboration and distributed learning; knowledge discovery; knowledge mapping and, knowledge application.

KM Aspects	**KM Practices at the MIUC**
Collaboration and distributed learning	✚ Training through academic workshops. ✚ Knowledge creation through research and contribution of ideas. ✚ Transfer of tacit knowledge among employees through consultations and collaborations. ✚ Teaching and learning activities.
Knowledge discovery	✚ Recording and sharing of best practices. ✚ The contribution of research work into the institutional repository.
Knowledge mapping	✚ Identification of knowledge experts and knowledge capture. ✚ Access to organisational knowledge.
Knowledge application	✚ Application of knowledge created at MIUC.

2.8 Technologies that support knowledge management in academic institutions

Using Google Scholar as the search engine, some of the technologies that support collaboration and distributed learning; knowledge discovery; knowledge mapping and, knowledge application were identified from literature that was reviewed and is presented below. The scope of the search was limited to articles dated 2012 – 2016 with the intention of capturing technologies that have been currently applied.

2.8.1 Collaboration and distributed learning technologies

Msonde (2013: ii) discusses the integration of podcasts in e-learning. He asserts that podcasts can be coupled with discussion forums hence enhancing "social interactivity, higher order thinking, and academic achievements."

Clickers, defined as transmitters used by students to respond in class anonymously while their responses are computed and relayed, instantly, as correct or incorrect (Blasco-Arcas, Buil, Hernandez-Ortega & Sese, 2012:105). According to Martyn (2007: 71), clickers incorporate a 'game approach' hence it is more engaging for students as compared to the traditional mode of class discussions. Blasco-Arcas, *et al.* (2012:102) examined the use of clickers as a technology that enhances collaborative learning and learning performance. The study revealed that clickers enhance a deeper understanding of concepts while increasing the collaborative nature of students thus increasing the learning process.

Zheng, Niiya and Warschauer (2015:357) suggested the use of a wiki to support collaborative learning considering their "built-in collaborative writing and social communication functions." In their study, it is indicated that wikis provide an environment that supports the constructivist model of learning which is characterised by having a shared learning space which can be used by lecturers to design wiki activities that permit students to generate content individually or in groups. Further, wikis provide hyperlinks which enable contribution and use of collective knowledge. "Instructors can provide as much or as little guidance as required by editing student-created wiki pages and providing feedback on wiki discussion pages" (Zheng, Niiya & Warschauer, 2015:359).

Lau, Yen, Li and Wah (2014:190-192), discussed the use of multimedia technologies in e-learning. They indicated that multimedia technologies have enhanced 24-hour access to shared learning environments aside from facilitating the presentation of materials in different forms enabling collaborative and distributed learning. They identified three types of media: Communication technologies such as mobile phones that enhance access to learning content and application of web 2.0 in the provision of personalised learning environments; Social

networks that have enhanced online communities that facilitate discussions and sharing of knowledge; and, Game-based learning (GBL) which incorporates multimedia, graphics and human-computer interaction with the aim of supporting learning by the use of games that mix entertainment, visualisation and interactive tasks thus enhancing students' deeper understanding of concepts.

Li *et al.* (2008:22) outlined game-based learning as another effective technology that can be applied for the creation of an internal world in specific contexts with the aim of encouraging learners to tackle problems together hence leading to the promotion of problem-based collaborative learning.

Popescu (2014:200) advocated the use of social media technologies such as wikis, blogs, microblogging tools, social bookmarking tools and media sharing tools to support collaborative learning. In his argument, he indicated that social media tools are effective as they are designed with a focus on user-centeredness, participation, openness, interactivity and collaboration which foster social-constructivism. This point is supported by Clegg, Yip, Ahn, Bonsignore, Gubbels, Lewittes and Rhodes (2013:2) who stated that "social media technologies inherently tap into the sociable desires of individuals and thus may offer insight into ways of designing social support for collaborative learning." Popescu (2014:200) therefore, finds that in this context, knowledge is created by the users through collaboration rather than through transmission enhancing efficiency in learning. In this study, it is proposed that social media tools should be combined for an enhanced learning experience.

Kitsantas (2013) discussed the role of technology in fostering students' self-regulated learning. He pointed out that Learning Management Systems (LMS) such as Blackboard, Moodle and Sakai are designed with a variety of web 2.0 technologies that can facilitate distributed learning activities. Resource sharing tools such as wikis and blogs were found to be effective in supporting self-regulated learning practices such as "goal setting, self-monitoring (use of online calendars, scheduling tools), and self-evaluation" (Kitsantas, 2013:236), while communication tools such as emails, discussion forums, and document sharing tools enhance "help-seeking." Self-efficacy can be achieved through the use of links to motivational videos. Wikis were highlighted as useful in collaborative activities such as content creation and management. Delicious is highlighted as an essential bookmarking tool that enables learners to access their content from anywhere via the website. Blogs were found useful for self-reflection that is achieved through writing.

Mallon and Bernsten (2015:1-2) recognised some emerging technologies that can enhance collaborative and distributive learning. They identified tools like Google Docs, Padlet,

Mindmeister and Lino as being effective for group brainstorming. With regard to document creation tools, Google Drive, Zoho, Etherpad and Evernote were highlighted. Further, they stated that collaboration tools can enhance synchronous communication like "online meetings, office hours, informal chats, guest speakers, and webinars" and gave supporting tools for these activities which include: Skype; Adobe Connect; Google Hangouts; Vyew; GoToMeeting and MeetingBurner thus, these tools can support collaborations for both training for staff and teaching and learning.

The next section provides a discussion on the potential technologies in support of collaborative and distributed learning. The section is organised four sections: multimedia technologies; social media technologies; media sharing technologies, and, brainstorming tools.

2.8.1.1 Multimedia technologies

Multimedia entails the application of various media types such as texts, images, sound, video, graphics and other dynamic elements such as animation in the presentation of information to an audience making it one of the best educational techniques as it addresses more than one sense concurrently that is, sight and hearing. Consequently, presenting to students and learners a wide range of learning resources that can be used to stimulate learning (Aloraini, 2012:76; Oshinaike & Adekunmisi, 2012:2 & Bates, 2000:40). Lau, *et al*. (2014:189) asserted that multimedia has played a critical role in the transformation of conventional media such as "books, tables, figures and blackboard writing" into more collaborative forms that have enriched effective learning that integrates more suitable media types such as "video, audio or text."

Oshinaike and Adekunmisi (2012:2) stated that the advancement of multimedia technologies has enhanced an active and more participatory learning among learners in that it has promoted "self-paced, learner-controlled and individualized" learning that has enhanced the use of the technologies in the creation of multimedia applications in their projects, helping to eradicate passive learning among the students. According to Lau, *et al*. (2014:189), the different types of media used in multimedia supports a variety of learning styles among students thus promoting effective learning.

Malik and Agarwal (2012:468) find that multimedia technologies have an impact on the learning process in that they increase collaborations between instructors and students. They further cite Neo and Neo (2009) and indicate that these technologies enhance a "constructivist learning environment" that facilitates self-discoveries, interactions and vigorous involvement in learning.

Wankel and Blessinger (2013:5) provided some sort of summary to the benefits offered by multimedia technologies in education by stating that these technologies can be integrated in a variety of teaching and learning modes in order to: i) "increase student participation through more authentic and effective ways to hold their attention and interest", ii) "create a learning environment that is more consistent with modern learning theory and how the human mind learns best, and, iii) "improve learner sense-making by creating instructional methods, course materials, and learning activities that are appropriately integrated and coherently constructed using multimedia that more completely engages the human senses."

Malik and Agarwal (2012:469) offer two ways in which multimedia is offered in education by universities: the first is to instruct on approaches used for "multimedia content creation" thus teaching about software applied to create and author multimedia content, and secondly, how to employ "interactive multimedia content and technology for effective teaching, which include the various methods of engaged learning like multimodal interactive information delivery; and personalized and enhanced anytime-anywhere access of the content." However, despite being beneficial to education, Wankel and Blessinger (2013:5) indicate that multimedia by itself offers no guarantees to enhanced learning but rather has to be designed to have a purpose within the particular courses being taught in order for it to have an impact on learner engagement.

Some multimedia technologies that are employed in academic institutions include: podcasts; clickers and game-based learning technologies. These are discussed in detail below:

i. Podcasts

Podcasting refers to the process of regularly producing a series of audio files that are made available online to users who can subscribe to the audio files and further be able to download to computers or other portable media players (Pegrum, Bartle & Longnecker, 2014:144). The use of video podcasts in education was driven by the inception of YouTube, increased speed and availability of bandwidth, and, adoption of high internet speed in homes and schools (Kay, 2012:821). McGarr (2009, as cited by Pegrum, Bartle & Longnecker, 2014:144-145) highlight three main uses of podcasting in higher education as:

- ***Substitutional (course-casting) podcasting*** – This entails audio recordings consisting of tutorials which are availed to students to enable them to review the material as often as they would want.
- ***Supplementary podcasting*** – This entails providing students with additional material that assists them to have a deeper understanding of particular topics.

- ***Creative podcasting*** – Identified as the form of podcasting that is least common. It entails involving students in creating their own podcasts that are supposed to deepen their understanding of topics. Pegrum, Bartle and Longnecker (2014:142) find that to enhance collaboration, students can be given a chance to explain concepts using podcasts which can thereafter be listened to and commented on by their peers.

Verdusco (2016:224-225) indicated some advantages of using podcasts as: easily accessible through the internet; ability for one to cover many topics using the tool; ability for consumers to fill up their mobile gadgets with as much content from podcasts as they are able to store; ability to support smaller audiences with a variety of content and programs; ability to support various formats such as informational content, talk shows, music, training content and storytelling; minimal investment is required to implement; the end users only require a device such as a smartphone, tablet or computer that has the appropriate software to play a podcast; availability of free applications that can be used to download podcasts; availability of search and discovery features that support name and keyword searches; ability to support an average playtime of podcasts that can range from five minutes to two hours; ability for podcasts to be kept until they are played which promotes convenience as the users can access the files at their convenient time hence episodes are not missed as is the case of one missing a traditional class session.

A study by Kay (2012:823) identified enhanced learning, control over learning and, the ability to make up for missed classes as some of the key reasons for using podcasts. According to Verdusco (2016:224), Podcasts can be located and subscribed to via an application downloaded onto a smartphone, tablet or computers which are either purchased, but as well there are free apps that are available for use.

ii. Clickers

"Clickers are educational technology tools that are commonly used to facilitate students' interaction with an instructor in real time" (Daniel & Tivener, 2015:260). They are known by a variety of labels such as student response systems, personal response systems, audience response systems, and classroom feedback systems (McDonough & Foote, 2015:236).

Clickers are an interactive technology in which students use a hand-held pocket-sized remote control that uses signals to instantly transmit and record participants' electronic responses anonymously to clicker questions, which can be either multiple-choice or true-false questions. These questions are embedded in a slide-show presentation such as PowerPoint. There is usually a receiver connected to the classroom computer that collects the feedback from the

students and automatically summarises them whilst at the same time, generates graphical representations which are then instantly projected onto the screens for students and educators to see (McDonough & Foote, 2015:236; Lantz & Stawiski, 2013:280; Oigara & Keengwe, 2011:16).

In a traditional class setting, Oigara and Keengwe (2011:16) asserted that students may not be as involved in the learning process as they need not work hard to make sense of the material being presented to them by their lecturers. Due to the fear of the possibility of being incorrect when answering questions in class, students may also be unwilling to take the risk of being incorrect, thus, very few have the opportunity to respond to questions. On the other hand, the lecturer has no way of gauging if the other students are aware of the correct answers. Therefore, clickers become useful in this context as they provide an opportunity for all students to participate anonymously and the lecturer, on the other hand, is able to gauge students. According to Keough (2012:824); Caldwell as cited by Oigara and Kengwee (2011:18); Oigara and Keengwe (2011:18); Johnson (2005) as cited by Oigara and Keengwe, clickers encourages every student in class to actively participate due to anonymity of the responses while the lecturer is able to test the students' level of understanding of the subject matter which ultimately improves instruction.

Lecturers benefit from clickers in that they can: determine the quality of their instruction delivery because they can gather immediate feedback for individuals hence be able to determine how well they have understood the lesson; administer examinations; mark and provide feedback instantly which also enables students to track their progress in relation to other students (Keough, 2012: 824; Premkumar, *et al*., 2011:337). Keough (2012:824) asserts that "the benefit of instantaneous feedback on student understanding alone should serve as an incentive for instructors to consider adopting clicker technology."

Clickers are also beneficial in education in that: students have a chance to be exposed to the logic and thought process of their peers in cases where the lecturer allows them to have discussions prior to providing their responses using clickers and this enhances greater integration of concepts (Lantz & Stawiski, 2013:282). Oigara and Keengwe (2011:16) point this out by saying that "during the question-and-answer session, the instructor allows the students to discuss their responses with their peers before showing them the correct answer." Daniel and Tivener (2015:260) added that clickers facilitate active learning through asking students to work in teams in order to reach a consensus before responding using clickers. Caldwell, as cited by Oigara and Keengwe (2011:18) found that clickers have successfully been used primarily to "increase classroom interactivity; "assess student preparation";

"conduct formative assessments" and, "review class materials and practice questions." By distributing clicker questions in a lecture, students are aided in learning through proper segmenting of a lecture into sections and subsections. This enhances the students' attention to the course content which is necessary for facilitating deeper processing (Lantz & Stawiski, 2013:282). Furthermore, Lantz and Stawiski (2013:281) state that a higher retention rate of the material in live classes using clickers can be achieved.

Anonymity is considered advantageous when using clickers. "An additional benefit of clickers over other active learning strategies is the possibility of students to respond anonymously to instructor questions. It facilitates instructors to engage the less vocal and docile students" (Premkumar, Coupal, Tinder & Majd, 2011:337-338). The ability to obtain anonymous responses also decreases discrepancies among friends and further enables students to be less reticence when it gets to responding to controversial questions. This opens up the chance for lecturers to use the responses to begin discussions (Premkumar, *et al*., 2011:337). Fryling (2013:2) indicated that responses from individual students can be completely anonymous or clickers can be assigned to the individuals in which case, only the instructor can know from whom the answer has come from. Oigara and Keengwe (2011:16) explained this by stating that, clicker devices used in class could be numbered by the lecturer in order to track the students as they respond and this enables recordkeeping after the sessions. Consequently, the lecturer will be able to gauge the level of understanding of each student and thus act accordingly. Thus, the lecturer has some leeway to know from whom responses are coming from if they deem necessary.

Owing to their interactive nature, Oigara and Keengwe (2011:17) suggested that clickers can be particularly useful in large lecture classes or the ones scheduled at moments when lecturers and students are tired. Premkumar, *et al*., (2011:336) also asserted that clickers can be useful in distributed learning environments in that students can "assemble in a remote classroom and use clickers to respond to queries." According to Johnson (2005, as cited by Oigara and Keengwe (2011:18) clickers are fun to use as the generation of current students loves technology and also, clickers follow the principles of game-based learning thus short sessions with the use of clickers make class time more enjoyable by breaking up the monotony of the lecture.

In as much as instant feedback is positive for both the students and the lecturer, using clickers is likely to pose "technical and software" limitations (Spark & De Klerk, 2015:199). Premkumar, Coupal, Trinder and Majd (2011:338) also highlight the issue of unanticipated technological challenges whilst using clickers especially in the case of distributive learning

whereby the participants are dispersed geographically. Lantz and Stawiski (2013:280) highlighted the disadvantage of using clickers in the classroom with regard to time management. They asserted that the form of questions as presented through the use of clickers take up on class time and it takes time for the questions to be prepared prior to the class commencing. Another limitation with clickers is that it does not provide an opportunity for the students to apply follow up questions anonymously in the same way they are able to respond to questions (Oigara & Keengwe, 2011:26).

In view of these unforeseen challenges, Spark and De Klerk (2015:199); Lantz and Stawiski (2013:281); Oigara and Keengwe (2011:27) suggested that there is a need for lecturers intending to adopt the use of clickers in the classroom to gain the appropriate training, familiarize with the software and hardware that support clickers and gradually adopt the technology until they are fully acquainted in applying them in the classroom setting. Oigara & Keengwe (2011:27) find that the use of clickers also necessitates the need for a change in the mindset for the instructor from lecturing to a more interactive method of teaching.

Premkumar, Coupal, Trinder and Majd (2011:336) highlight the need to remember that clickers by itself are just a tool and that more focus should be put on the learning process and the learners involved. In line with this, Lantz and Stawiski (2013:281); and Oigara and Keengwe (2011:27) indicate that the effectiveness of clickers relies on how the educators make use of them in manners that enable the students to integrate the course content into their own existing knowledge base appropriately.

iii. Game-based learning

Gamification is the process of applying game concepts to solve problems by encouraging learning through the application of suitable game basics (Kapp, 2012:15). Game-based learning is competitive and has set educational goals that students need to achieve which are meant to enhance learning (Erhel & Jamel, 2013:156). According to De-Marcos, Garcia-Lopez and Garcia-Cabot (2016:99), these games are designed to be meaningful and motivating by integration of "game mechanics and dynamics with a compelling narrative and a feedback system to create a sense of seamless progression that captures players' attention and can keep her deeply immersed in the experience." The idea is to engage students through the use of game-based technologies that are fascinating yet educative. Kapp (2012:10) states that if well engaged, gamification has the power to be engaging, informative and educative.

Pho and Dinscore (2015:3) highlighted possible challenges to using games:

i. Consideration has to be given as to whether the particular game is actually used to impact or improve learning.
ii. Students' ability to adopt and use game-based learning technology has to be considered by the instructors so as not to become a barrier to the learning process.
iii. Designing the games is very challenging even for experienced designers as careful thought is needed to ensure that the game is engaging and that it teaches effectively.

Qian and Clark (2016:51) add that game-based learning has the potential to facilitate the development of skills but there is a need for people involved to familiarise themselves with the media and technology and consequently be creative thinkers. According to Qian and Clark (2016:56), game designing is found to have the greatest impact in terms of determining the effectiveness of game-based learning. Pho and Dinscore (2015:1) add to the design aspect when they assert that there is more to game-based learning than just designing the games. There is a need to have actions that bring in ideas and guide the students towards some goal.

Critical aspects to effective game-based learning design as pointed out by Clark and Mayer (2016:369) include: a) "Adding coaching (explanations after moves and advice before moves)" b) "Self-explanation (questions requiring the player to explain or select an explanation from a menu)" c) "Pre-training (pre-game activities that highlight key concepts)" d) "Modality (presenting words in spoken form)" and, e) "Personalization (presenting words in conversational style)."

2.8.1.2 Social media technologies

This includes Wikis, blogs and social bookmarking technologies which are discussed below:

i. Wikis

Wikis are simple and user-friendly web 2.0 platforms that mainly support collaborations among users on interlinked web pages (Hadjerrouit, 2013:301; Ortega-Valiente, Reinoso & Munoz-Mansilla, 2012:447). Wikis offer a variety of benefits as discussed below:

a) Collaborative learning:

Since a wiki is a simple tool to use, it facilitates collaborative creation of web pages which enables substantial collaboration processes that support numerous users in different locations to be able to modify the same website concurrently. In the context of collaborative learning, wikis can support "dynamic real-time teacher-student and student-student interactions" which are necessary in active learning (Jaksch, Kepp, & Womser-Hacker, 2008 as cited by Palomo-Duarte, Dodero, Garcia-Dominguez, Neira-Ayuso, Sales-Montes, Medina-Bulo, Palomo-Lozano, Castro-Cabrera, Rodriguez-Posada & Balderas, 2014:638).

Ortega-Valiente, Reinoso and Munoz-Mansilla (2012:447) point out that wikis mainly focus on supporting simple ways that users can simply adopt for collaborative purposes. Hadjerrouit (2013:301) provides students as an example of this user group and asserts that wikis provide an opportunity for them to work on assignments and written tasks collaboratively. Palomo-Duarte, *et al.* (2014:648) add on the relevance of wikis for students and indicate that the open nature of wikis enables students to "interact dynamically to create content" which leads to the production of remarkable information for their assessment that includes "the usual skills exercised by a traditional paper-based handout: both the general ones (information organization, suitable use of references, etc.) and the ones specific to the subject under study."

b) Collaborative writing:

Wikis are characterised by a "simple user-friendly interface", ability to keep history of any editing done on the articles, it is easy to modify hence allows integration of multimedia content and it is interoperable with other platforms such as "blogs, webpages, intranet portals or office suites" (Ortega-Valiente, Reinoso & Munoz-Mansilla, 2012:447). These features make it attractive for collaborative writing.

Pifarre, Marti and Guijosa (2014:57) highlighted three affordances through which collaborative writing is enhanced on a wiki:

> (a) "Editing function that supports multiple users to create and modify articles, texts, or documents. This function provides navigation for the non-linear organization of the wiki."
>
> (b) "History function that records all edits, by means of color coding, allowing users to trace all revisions being made. The history log enables edits to be traced to the users, and helps the teacher to monitor and assess students' progress."
>
> (c) "Discussion page that enables asynchronous written communication between users by providing explanations and posting comments on various issues related to the wiki."

With the ability to edit content, review the history of activities carried out on the wiki and facilitation of interactions anytime anywhere, a wiki presents itself as a useful tool for teaching and learning.

According to Hadjerrouit (2013:302), comments posted on wikis by students that are connected to collaborative learning can be analysed by the lecturers through the use of quantitative and qualitative approaches to check their extent of collaborations. These levels of participation can be checked through the use of history logs and creation of statistics using specific prescribed criteria.

c) Knowledge management:

Birzniece (2011:7) pointed out that wikis have great potential to widely source for knowledge thus can enhance four key KM needs namely: "capturing knowledge from those who have it, converting knowledge into an explicitly available format, connecting those who want knowledge with those who have it, and linking knowledge to knowledge." Wikis are, therefore, crucial in facilitating KM in academic contexts.

d) Personal Learning Environments (PLE):

Three levels of using wikis to support self-related learning (ability to take control of one's own learning process) in PLEs as noted by Kitsantas and Dabbagh (2012:7) include:

i) Using a wiki as a personal information management tool: "Instructor encourages students to use a wiki as a personal space for content organization and management."

ii) Using a wiki as a social interaction and collaborative tool: "Instructor encourages students to enable the wiki's collaborative editing and commenting features for feedback."

iii) Using a wiki as an information aggregation and management tool: "Instructor demonstrates how to view a wiki's history to promote student self-evaluation of their learning across time."

Wikis also present a variety of challenges to the users some of which are discussed below:

Ortega-Valiente, Reinoso and Munoz-Mansilla (2012:450) cite intimidation as one of the challenges that lecturers face. This is in the case where a wiki is viewed by some as a new technology and, therefore, some people have fears in adapting it for use in an education setting. This has however not stopped some lecturers from adapting it. However, low-level collaboration has also been faced in cases where a wiki has been adapted. Hadjerrouit (2013:304) states that it has been hypothesised that there is low-level collaboration with wiki usage and this is due to "unfamiliarity with wikis, lack of experience, dominant learning paradigm, limited student contribution, reluctance and resistance to using wikis, lack of motivation and engagement, time management, problem of ownership, and lack of appropriate pedagogy."

Another challenge would be to distinguish whether students are actually collaborating (efforts are coordinated to accomplish a task) or cooperating (participants split tasks and work independently) while using wikis (Hadjerrouit, 2012:49). Palomo-Duarte, et al. (2014:638) found that location and time constraints have been to some extent a hindrance to effective collaboration among students. As a result, they have a tendency to take up on a task meant for

collaboration and divide it into several independent works that are given to different students who then work independently and merge the final work for presentation. This poses a challenge to the lecturer in terms of assessing collaborative efforts. According to Hadjerrouit (2013:301), the inability to fully give a picture of how students collaborate has been a challenge for wikis even though recent studies have indicated that a data log can be generated from the history function on wikis. This is echoed by Palomo-Duarte, et al. (2014:649) who stated that the more the students collaborate, the harder it becomes to manually assess the contributions, hence, it is vital to adopt automated tools that can objectively aid in the assessments.

Technical and pedagogical usability issues may be experienced while using wiki. "Basically, technical usability involves techniques for ensuring a trouble-free interaction with the software while pedagogical usability aims at supporting the learning process" (Hadjerrouit, 2010). Both of these aspects are a requirement when using wikis for educational purposes thus, efforts have to be made to reduce the limitations. Hadjerrouit (2011:46) posits that "the use of wikis does not automatically ensure collaboration, and that, additional elements, or even a new pedagogy, are required to promote collaborative learning."

ii. Blogs and microblogs

A blog, contracted from weblog refers to an online platform that supports online publishing. Conventional internet publishing required the application of technical computer knowledge such as HTML hence hindered the majority of internet users from internet publishing. The evolution of blog technology has made it easy for any internet user to publish not only text but also multimedia content such as images, links, and videos. Further, blog users are able to post comments on blog entries which then appear in a reverse chronological order. Blogs have, therefore, developed into "a knowledge sharing and collaboration platform" (Cakir, 2013:245). Tess (2013:A64 citing Sim and Hew, 2010) highlights six major and general uses of blogs in the education and social context as: "(a) a learning journal for gathering or reporting course-related information, (b) a record of daily experiences that disclose personal information, (c) an outlet for expressing emotions and feelings, (d) a communication tool for social interaction with other people, (e) an assessment tool for peer evaluation, and (f) a task management tool for posting assignments." Blogs are, therefore, presented as useful tools for publishing both personal and educational content.

According to Tess (2013:A61), blogs support a variety of online dialogues focused on particular topics. Noel (2015:618) adds that blogs enhance constructivist learning and thus are

suitable to support a variety of educational activities. The role of blogs in the educational context is further discussed as follows:

a) Role of blogs for students:

Blogs can be used as a collaborative tool by students who are able to post content as text and multimedia and get responses from peers (Cakir, 2013:245; Dawson, 2010). According to Blair and Serafini (2014:3), blogs promote collaborations among students because feedback from instructors is provided in such an informal manner thus encouraging participation among students without fear of criticism. Students are also in a position to link up among themselves away from the classroom by creating project or group blogs.

b) Role of blogs for instructors:

Cakir (2013:245-246); and Dawson (2010) discussed a variety of ways in which blogs can support instructors:

i. They can engage students in active learning.
ii. They can initiate collaborations among students.
iii. They can use blogs to provide instant feedback.
iv. The can monitor students' online documented collaborative activities hence they are able to guide them appropriately.
v. They are enthused to partner with the students in collaborative efforts rather than to broadcast ideas.

According to Blair and Serafini (2014:3), blogs are an effective substitute to teaching as they enable the use of reference and multimedia and enable instructors to share current information for different courses of which they have control over.

In line with Personal Learning Environments (PLEs), Kitsantas and Dabbagh (2012:7) highlighted three levels of using blogs to support self-related learning:

i. As a personal information management tool: "Instructor encourages students to use a blog as a private journal to set learning goals and plan for course assignments and tasks."
ii. As a social interaction and collaborative tool: "Instructor encourages students to enable the blog comment feature to allow for instructor and peer feedback enabling basic interaction and sharing."
iii. As an information aggregation and management tool: "Instructor demonstrates how to configure a blog to pull in additional content and how to add the blog to RSS aggregation services."

The benefits notwithstanding, blogs are also subject to some limitations. The first challenge is the need for instructors to understand the potential factors likely to affect students' collaborations before designing a curriculum to be integrated on blogs (Cakir, 2013:246). Lack of control over the content can lead to decreased enthusiasm to participate among the students especially because of overwhelming topics being created which can lead to speedy short answers and less meaningful responses (Noel, 2015:620).

"Blogs have potential to be used in teaching of subject matters that require students to discuss, write, reflect, and comment about the content or the ideas" (Cakir, 2013:246). To enhance the effective use of blogs, Halic, Lee, Paulus and Spence (2010: 207) suggest their integration into learning management systems to support interactions. Noel (2015:620) states that "sustained interaction is essential for both cognitive and social constructivism" and further indicates the relevance of instructors providing an area of focus for the students. Kim (2008) suggests the need for instructors to utilise "the RSS (Really Simple Syndication) system, which enables users to receive automatic notifications regarding blog contributions." Noel (2015:620) supports the use of RSS feeds by asserting that it "increases time efficacy for blog activities, by minimizing the time required to search for specific blogs and posts." This can be crucial for the participants as their time is saved and the motivation to use the blogs can be improved.

iii. Social bookmarking tools

Social bookmarking entails a list of hyperlinks which Internet users find to be relevant hence they want to share. The applications enable a user to vote or comment on the links of websites that they find to be pertinent (Farwell & Waters, 2010:397). Through that process, users create sets of metadata which contain "uncontrolled keywords, referred to as tags" which consequently aid in the creation of new information about resources (Haustein & Siebenlist, 2011:447; Kakali & Papatheodorou, 2010:192). The contemporary social bookmarking is web-based and incorporates the use of collaborative creation and management of folksonomies[1] to classify web content (Ruffini, 2011).

The benefits of using social booking marking sites include: the ability to access the identified sites via any Internet browsers thus one can access them from anywhere globally as long as one has access to the Internet; no programming knowledge is required to bookmark links thus makes it easy for any Internet user to tag and save useful sites; the social bookmarking search application is similar to those used on search engines making it familiar and easy to use, and,

[1] A folksonomy is a categorisation of content on the web. The term is derived from 'folk' (meaning people) and 'taxonomy' (a classification). People create folksonomies by tagging web content in a collaborative way, thereby creating categories of content.

finally, social bookmarking provides a possibility for the users to track what others are finding to be relevant. For instance, "it shows how many people have added a resource to their own account (Delicious.com) or have given it a thumbs-up rating (Digg.com)" (Farwell & Waters, 2010:400).

One of the limitations of using social bookmarking is that it requires an active Internet connection to access the saved links which can be a challenge to learners who do not have consistent access to the Internet (Farwell & Waters, 2010:400). Another challenge is the lack of control in the terminology created for tags. Since the users can use any terms, it leads to the creation of many synonyms that are lacking in consistency (Farwell & Waters, 2010:400; Kakali & Papatheodorou, 2010:192).

2.8.1.3 Media sharing tools

Media sharing sites, like MySpace, YouTube, and Flickr have a focus on the use of shared videos and photos (Kietzmann, Hermkens, McCarthy & Silvestre, 2011:242). Bower (2015:6) finds that such sites support asynchronous sharing of videos via "public repositories" which can be a good platform for instructors and learners to engage in video content acquisition, remixing and dissemination through sharing such content among themselves.

Bower (2015:3) further provides us with a range of sites that can support media sharing:

i. Flickr - (http://flickr.com): "Provides a large repository of publicly shared photos (and more recent videos) that people can use or share subject to the Creative Commons Licenses specified by the creators."
ii. Instagram – (http://instagram.com): "Facilitates photo (and video) sharing through individual postings."
iii. Pics4Learning - (http://www.pics4learning.com): An open repository that provides "archives of pictures that can be used for education."
iv. Openclipart - (http://openclipart.org): An open repository that "offers general purpose clip art."
v. Wikimedia Commons (http://commons.wikimedia.org): "Incorporates images (and videos) that can be reused under Creative Commons Licences."

2.8.1.4 Brainstorming tools

The brainstorming technique aims at breaking from the conventional method of thinking and learning to enthuse creative thinking and collaborations which can only be achieved in a convenient environment without conditions and judgement. "The result should be a very

creative, new solution to problems, a generation of original, relaxed and informal ideas" (Sim & Pop, 2012:78). Brainstorming tools, therefore, become relevant in enhancing a learning that is engaging among peers (Mallon & Bernsten, 2015:3). These tools are characterised by some features that support live collaborations as well as the ability to "type, draw, share images, chat or talk with collaborators, and even record work to review or submit to an instructor later" (Mallon & Bernsten, 2015:4).

Basic rules in brainstorming as provide by Sim and Pop (2012:79) include:

i. The need for participants to focus on the quantity, that is, as many ideas as possible should be presented before they are narrowed down to quality content.
ii. There should be no criticism or judgement during collaborations in order to encourage the participants to freely contribute their ideas.
iii. Uncommon ideas should be welcomed as they can lead to better solutions.
iv. Ideas floated by various participants should be combined so as enhance the resulting ideas or solution.

2.8.2 Knowledge discovery technologies

There are different ways through which organisations can discover knowledge in an organisation. Use of crowdsourcing technologies is one of the ways. Crowdsourcing seeks to get information from undefined crowds through releasing a task to them and acquiring information in believing that individuals have the potential to provide valuable information (Zhao & Zhu, 2014:417). "Using information technology as a facilitator, crowdsourcing organisations implement socio-technical systems to channel the contribution of the human workforce, knowledge, skills, or perspectives into the generation of digital information products and services" (Geiger & Schader, 2014:3). According to Xintong, Hongzhi, Song and Hong (2014:7987), crowdsourcing is an emerging and powerful tool for information procurement that has equally played a vital role in data mining. Solemon, Ariffin, Din and Anwar (2013:2066) asserted that crowdsourcing enables challenging problems to be tackled by large groups of people who can work asynchronously at their own pace.

Several strategies are used in education for crowdsourcing such as crowd creation whereby crowdsourcers contribute in the creation of a service such as the creation of class content and, crowd voting which involves engaging crowdsourcers to get opinions and ideas on issues (Solemon, Ariffin, Din & Anwar, 2013:2066). Xintong *et al.* (2014:7988) identify Facebook as being popularly used in crowdsourcing considering its potential which includes having more

sources of information, blogs, and picture abilities. Other crowdsourcing that has emerged include CloudCrowd (used to write and edit projects) and Crowdflower.

Recommender systems provide another platform for knowledge discovery (KD). KD is relevant in KM as it facilitates knowledge retrieval hence use. Recommender systems are, therefore, vital in supporting KM practices. A recommender system consists of an engine that recommends items of relevance in a particular information need (Erdt, Fernandez & Rensing, 2015:326). The difficulty in finding suitable information for specific needs on the web due to information overload calls for a system to help reduce the burden through prediction of users' needs (Erdt, Fernandez & Rensing, 2015:326). In an educational context, recommender systems can be used to enhance personalised educational experiences especially in an e-learning setting (Klasnja-Milicevic, Ivanovic & Nanopoulos (2015:571).

The recommender systems serve to filter information and present results based on users' personal preferences. According to Barbieri, Manco and Ritacco (2014:1), recommender systems are push systems that explore a range of catalogues that contain varied choices hence, when a user inputs a query, the system responds by corresponding it with the user's past interactions in the system and provides other related results. Barbieri, Manco and Ritacco (2014:11) also indicate that there are collaborative filtering works, which are recommendation systems techniques that work by "matching the target user with other users with similar preferences and exploits the latter to generate recommendations." Recommender systems can play a significant role in knowledge discovery. Lee, Lee, Kim and Kim (2015:1) find that these systems have previously concentrated on media items such as movies but are increasingly being extended to academia.

2.8.2.1 Crowdsourcing technologies

Crowdsourcing refers to a process through which the effort of a crowd is obtained to assist in performing specific tasks through sourcing for their ideas by majorly using "advanced internet technologies" (Olson, 2014:125). Aitamurto, Leiponen and Tee (2011:2) define it as a "tool to gather collective intelligence for certain tasks." Weld, Adar, Chilton, Hoffmann, Horvitz, Koch, Landay and Lin (2012:1) find that crowdsourcing is a relevant endeavour in education because it facilitates the delivery of valuable education in some areas especially since it involves collaborations among many people who generate ideas; "existing techniques are ready for application to this new area" meaning that technological platforms currently applied in education setting may as well facilitate crowdsourcing and; "online education represents a new,

relatively unexplored way of creating crowds" hence the electronic platform already presents the right space to be explored for crowdsourcing.

Ellis (2014:4) posits that the "collective intelligence" presented through crowdsourcing offers an opportunity to harness quality information from the 'crowd'. This is also voiced by Howe (2008, as cited by Amrollahi, Ghapanchi & Talaei-Khoei, 2014:3) who stated that outsourcing enables one to achieve broader viewpoints which lead to better ways of solving problems. Surowiekci (2005, as cited by Ellis, 2014:3) stated that crowdsourcing is characterised by user diversity, power devolution and independence hence it is suitable for accruing a range of useful ideas from a crowd which can enhance decision making.

Estellés-Arolas and González-Ladrón-de-Guevara (2012:197 as cited by Ellis, 2014:2) identified characteristics that ought to be met to qualify as crowdsourcing. These included: (a) "a clearly defined crowd"; (b) "a task with a clear goal"; (c) "the recompense received by the crowd is clear"; (d) "the crowdsourcer is clearly identified"; (e) "the compensation to be received by the crowdsourcer is clearly defined"; (f) "it is an online assigned process of participative type"; (g) "it uses an open call of variable extent"; and (h) "it uses the Internet."

The challenge with crowdsourcing is that one is sourcing for information from a wide range of users who are not vetted hence both novice and experts may be involved in the contribution of information which can serve as a helpful resource or otherwise (Heffernan, Ostrow, Kelly, Selent, Van Inwegen, Xiong & Williams, 2016:617). Ellis (2014:5) pointed out that the efficiency of crowdsourcing relies on the person managing it, just like any other project is managed in that, there needs to be a consideration in the crowd being approached and this requires appropriate leadership and further there is the need to let the crowd feel valued and engaged.

Social media platforms such as Facebook and Flicker have as well provided a platform for crowdsourcing activities. Heffernan, *et al*. (2016:618) gives an example of a successful platform for crowdsourcing to be Wikipedia which has an open authorship of which they pointed out that the challenge arises in terms of malicious edits. They further stated that "without a principled approach for evaluating the quality of contributions beyond user opinion, Wikipedia faces skepticism from those in education about the reliability and the veracity of its content."

Saxton, Oh and Kishore (2013:2) as cited by Heffernan, *et al*. (2016:620) summarised the challenges that continue to face crowdsourcing especially in the educational context as i) what

is being outsourced, ii) the collaboration required from the crowd, and iii) managerial control over the quality of crowd based contributions."

2.8.2.2 Recommender systems

A recommender system (RS) is a technology that proactively seeks to suggest information items of interest to users such as movies, music, books, news, images, web pages, papers, etc. (Tejeda-Lorente, Porcel, Bernabe-Moreno & Herrera-Viedma, 2015:778; and Pu, Chen & Hu, 2012:317). With vast amounts of information, it becomes relevant to have tools that can help researchers in the identification of up to date and useful information related to their areas of interests (Tejeda-Lorente, *et al*., 2015:778).

Ricci, Rokach and Shapira (2015:1) asserted that it can be more complicated to find relevant resources if the user lacks the appropriate competency or technical skills to find information. Recommender systems will, therefore, come in handy in the evaluation of "the potentially overwhelming number of alternative items that a website." Verbert, Manouselis, Ochoa, Wolpers, Drachsler, Bosnic and Duval (2012:319) add that in the context of education, these systems are crucial in the filtering of content presented in various learning settings. RSs also support users through the presentation of diverse personalised suggestions (Ricci, Rokach & Shapira, 2015:1). According to Pu, Chen, and Hu (2012:317), "the technology is used to improve users' choice satisfaction, while reducing their effort, in finding preferred items."

The challenge with RSs is that they depend on the preferences displayed by the users when searching or by the items explored by other users. The system thus has to "maintain user profiles updated in order to provide good recommendations" (Tejeda-Lorente, Porcel, *et al.*, 2015:779). Yeung (2015:13) argues that these actions may be equal to what happens in draws which is usually a process of random selections thus, users may become reliant on the recommendations vis-à-vis their own real tastes.

According to Ricci, Rokach and Shapira (2015:19), an effective RS for a domain can only be designed prior to an understanding of: "the domain, its requirements, application challenges and limitations. Only after analysing these factors can one be able to select the optimal recommender algorithm and to design an effective human-computer interaction."

2.8.3 Knowledge mapping technologies

A "knowledge map is considered as a key solution for successful KM in an organisation since it provides knowledge users with a roadmap of where the knowledge flows, who has it and where it is located" (Balaid, Rozan, Hikmi & Memon, 2016:453). Creating a map entails the

identification of an organisation's vital knowledge and then creating a list or image that indicates where this knowledge can be found (Bautista-Frista, Romero-Gonzalez & Morgan-Beltran, 2012:48). According to Rogerio and Correia (2012:1980), team collaborations in classrooms are vital to the traditional learning environment can be transformed. On the other hand, collaborations among multi and interdisciplinary research groups are also critical in the identification of ideas. Collaborations can be enhanced through identification of appropriate knowledge sources. Online mapping tools can be adapted for use in an academic context.

Hanewald and Ifenthaler (2014:11) highlighted two types of freely available mapping software as:

i) Bubbl.us (https://bubbl.us/) which is "text based but without the option to format except for the colour icon which indicates hierarchies. It is easy to use as text 'bubbles' are created and connected with a paper clip." Stair (2013:1) pointed out that Bubbl.us is based on web 2.0 technologies and enhances seamless interactive online sharing of mind maps among students – students and student – tutors.

ii) Cmap tool (http://cmap.ihmc.us/) which is an "open-source web-based concept mapping tool" is freely available for download onto a computer enabling users to create maps, access and share them from anywhere. It can also be used for collaborative mapping for instance on discussion forums. Hwang, Wu and Kuo (2013:275) indicated that researchers developed Cmap tools among others to facilitate mapping out of knowledge.

2.8.3.1: Bubbl.us

Bubbl.us is "a useful online application that seamlessly enhances student-student and student-tutor engagement" and "is based upon Web 2.0 technology and facilitates an interactive online sharing of mind maps among students and/or with their tutors" (Stair, 2013:1). He goes further to provide a SWOT analysis of this tool which helps to highlight its usefulness and limitation in the learning environment. This includes:

i. ***Strengths:*** It is user friendly and easy to use; it can be used to develop/print mind maps without account creation; has a "Drag-n-Drop" feature that allows for easy editing, re-linking of concepts, and changing positions of sub-topics; supports collaborative development; no downloads are necessary as it is browser based.

ii. ***Weakness:*** It is flash-based (doesn't work on iPads); It requires free account creation to save mind maps; It requires a premium account (by the lecturer) to allow collaborative sharing of mind maps.

iii. ***Opportunities:*** Educational discounts are provided for premium accounts; team accounts for special projects are available.

iv. ***Threats:*** Similar free web-based tools are available, such as MindMeister, XMind, FreeMind.

2.8.3.2: Cmap tool

Concept maps refer to "graphical tools for organizing and representing knowledge in an organized fashion" (IHMC, 2014). Concept mapping is a useful tool in codifying individual mental accounts and further in fostering collaborative processes, both activities of which are critical in facilitating knowledge management in classrooms (Correia, 2012:1980). Correia (2012:1981) states that a Cmap can aid in the clarification of core concepts that are to be used during discussions in an introductory class. Hence, lecturers would find Cmaps useful in this regard. Cmaps enhances "the explanations of one's thoughts about how something works in the real world" (Correia, 2012:1979). According to Martinez and Perez (2013:205) concept maps are promising since they highlight "issues of knowledge, knowledge structure, and the way ideas are related."

Concept mapping plays a critical role in supporting collaboration. Correia (2012:1980) asserted that this sort of collaboration is critical among classroom peers as it transforms a learning environment from the traditional setting to one associated with increased interactions. These collaborations, which he also suggests for "multi – and interdisciplinary research groups," are also vital in the pursuit of research grants. Correia (2012:1985) also finds that through collaborations in creating Cmaps, knowledge gaps can be identified and useful ideas can be floated among the collaborating teams. Nonak and Canas (2008) added to the voice of collaboration by stating that Cmaps facilitate interactions between people either while they are in the same room or anywhere in the world and those interactions are supported through both synchronous and asynchronous models, thus, the issue of time and place while creating a concept map does not become a limitation to the users.

Other advantages of Cmaps are presented by Derbentseva (2008:7) who highlighted that, they: articulate relationships among concepts through the provision of a big picture of the topic in a graphic form and enables easier understanding of materials; enhance "creative thinking, representing cause-effect and cycle relationships, and helping to memorize material in the CMap form."

A study by Derbentseva (2008:7) revealed some challenges experienced while using Cmaps especially for novice users as: "difficulties with planning and organizing a CMap and

maintaining focus and scope"; "creating propositions (i.e. concepts and relationships)"; "difficulties associated with organizing propositions into a coherent system, prioritizing information, and realizing the inadequacy of one's knowledge of the subject revealed by the map construction process."

When creating a concept map, one must ensure to link up every two concepts together with their corresponding connecting phrases to form a meaningful unit. "Any concept-link concept triad is a meaningful statement termed a proposition or a unit of meaning" (Martinez & Perez, 2013:201). "The need for a linking phrase to clearly state conceptual relationships makes concept maps (Cmaps) very useful for organizing our own ideas (externalization), as well as, sharing them with other people (elicitation and consensus building)" (Correia, 2012:1985).

During the creation of a concept map, a good way is to commence with a *Focus Question*, that is, "a question that clearly specifies the problem or issue the concept map should help to resolve. Every concept map responds to a focus question, and a good focus question can lead to a much richer concept map" (Novak & Canas, 2008). According to Martizez and Perez (2013:206), as one undergoes the process of creating a concept map, they are forced to vigorously think about how concepts relate thus learning is enhanced.

2.8.4 Knowledge application technologies

Knowledge applications technologies are set to enhance the actual use of knowledge thus play a critical role in the support of knowledge management systems that entail knowledge use, knowledge finding and, knowledge utilisation (Singh & Mishra, 2015:545). According to Becerra-Fernandez and Sabherwal (2015:93), "knowledge application systems are typically enabled by intelligent technologies."

Some technologies have been identified that can facilitate knowledge application. Samoilenko and Nahar (2013:1285) identified artificial intelligence (AI) as one of the technologies and stated that AI has the capability to facilitate knowledge application by codifying knowledge and storing it in repositories in a way that it can be found and applied by users.

Expert systems (ES) are also used to support knowledge application. Expert systems have been defined as "learning based (Knowledge-Based) structures to be utilized as opposed to or together with an individual to settle on decisions in the structure of a specialist undertaking with elucidations for customers" (Fakeeh, 2015:36). Zalis (2004, as cited by Samoilenko & Nahar, 2013:1286) stated that ES has the capacity to capture, integrate, organise and represent knowledge from experts. They further state that ES "improves decision making and problem solving by collecting best practices from different industries (e.g. related to software

engineering), simulating human expert way of thinking (e.g. reasoning such as logical way of human thinking, etc.), defining and analyzing problems as well as giving ready solutions or new decisions that experts may not be aware of."

Becerra-Fernandez and Sabherwal (2015:101) identify some types of knowledge application systems as advisor systems; expert systems and, decision-support systems. Advisor systems are "based on a diagnosis of the activity of a user within an application, an advisor or assistance system compiles some useful advice or explanations and delivers this assistance to a user" (Paquette & Marino, 2012: 213).

Decision support systems (DSS) on the other hand, help to improve the quality of decisions by analysing data, using knowledge-based expert systems through which they compare solutions in existence and apply a variety of options to evaluate potential results (French & Turoff, 2007 as cited by Samoilenko & Nahar, 2013:1287). A well designed DSS supports effective decision-making in support of achieving set objectives through the provision of detailed and tailored specific information that supports specific needs (Hegazy & Ghorab, 2014:149).

DSS are relevant in KM as they facilitate decision-making processes in an organisation which enables informed strategic decision making (Alyoubi, 2015:283). According to Fakeeh (2015:33), a DSS in a higher learning institution ought to bring together information on "each and every educational methodology, offer feedback to their change, and offer decision-making sponsorship with high integration and direct association with all the zones of the issue. Propelled training or higher education executives would have tremendously key data and information at their handle, in a clickable structure, for smart examination and access in certain decisional condition." Fakeeh (2015:36) further states that a DSS for universities may be presented in modules thus, students, teaching and research module with the ability to support a variety of decision making on these aspects.

Acevedo and Marin (2015:1) posit that learner analytics techniques can also be integrated into a DSS and this should help administrators in making informed decisions that are likely to enhance student performance. The NMC Horizon Report (2016:38) describes learning analytics as "an educational application of web analytics aimed at learner profiling, a process of gathering and analyzing details of individual student interactions in online learning activities."

Another emerging technology that supports knowledge application is grid computing which helps to improve on knowledge application and sharing by "offering users' high capacity IT tools performance. It supports decision-making processes by developing advanced solutions with the help of other technologies" (Mancilla-Amaya, Sanin & Szczerbicki, 2010:1287).

2.8.4.1: Artificial intelligence

Artificial Intelligence (AI) refers to the process of qualifying computers to have the ability to perform tasks that are equal to human intelligence (Becerra-Fernandez & Sabherwal, 2015:94). According to Herpch, Voss, Nunes, Jardim and Medina (2014:69), for years, AI has been keen on "methods, techniques, and tools that may be able to represent human knowledge in artificial systems."

Birzniece (2011:5) states that advanced AI tools such as "neural networks, genetic algorithms, and intelligent agents" are equipped with smart tools that are able to analyse and mine text, profile users and, match patterns features that are relevant in KM. Becerra-Fernandez and Sabherwal (2015:95) provide examples of other AI technologies that he posits are referred to as "knowledge-based systems or knowledge application systems" which have the ability to imitate problem-solving skills in particular domains hence intelligently be able to manage knowledge, that is, "to apply, capture, share, and discover it."

AI systems are vital in the management of knowledge in an organisation. Birzniece (2011:5) asserts that these systems aid in the knowledge representation and processing within machines. Citing Carvalho and Ferreira (2011), Birzniece (2011:7) finds that AI systems support KM through "externalization, combination, and internalization" of knowledge. Liebowitz (2001:4) adds that AI systems can be used to codify knowledge in KM systems; intelligent agents "help in the search and retrieval methods of knowledge in the knowledge management systems"; agents help in the combination of knowledge that eventually lead to new knowledge creation; and, data/text mining techniques which are related to AI can support the establishment of relationships and patterns in knowledge repositories hence support the creation of new knowledge. Thus, through these KM processes, AI systems enhance the use of knowledge in an organisation. Vfu (n.d.:2) presented an argument stating that, in comparison with natural language, AI is not creative, has limitations in "the use of sensory devices", and, is unable to apply common sense but he states that these limitations are subject to debate.

2.8.4.2: Expert systems

An Expert System (ES) is an application categorised under AI systems (Vostrovsky, 2006:2; VFU, n.d.:2). "An expert system is a computer program that attempts to mimic human experts by the system's capability to render advice, to teach and execute intelligent tasks" (VFU, n.d:2). An ES is characterised by a knowledge base which is an essential part from which an "inference

engine draws conclusions" (Vostrovsky, 2006:2). The success factors and challenges of expert systems are highlighted by VFU (n.d.:4-5) as presented below:

Critical to the success of ESs include: "Level of knowledge must be sufficiently high; Expertise must be available from at least one expert; The problem to be solved must by fuzzy and narrow in scope; The shell must be of high quality and naturally store and manipulate the knowledge; The user interface must be friendly to novice users; The problem to be solved must be difficult and important enough to justify the development of a system; Knowledgeable developers with good people skills are needed; The impact of the ES must be considered; The impact should be favorable; Management support is needed."

In the case of limitations, the following are presented: "Knowledge is not always readily available; It can be difficult to extract expertise from humans; There are frequently multiple correct assessments; Time pressures; Users have cognitive limits; ES works well only within a narrow domain of knowledge; Most experts do not have an independent means to validate results; Vocabulary is often limited and difficult to understand; Help from knowledge engineers is difficult to obtain and costly; Potential for lack of trust on the part of the end-users; Knowledge transfer is subject to biases." Birzniece (2015:5) added that "ES are unable to respond to vague questions or give vague answers. There are difficulties in the maintenance and updating of the knowledge base and learning from experience."

2.8.4.3: Decision support systems

"Decision support systems are computer-based systems that bring together information from a variety of sources, assist in the organization and analysis of information, and facilitate the evaluation of assumptions underlying the use of specific models. In other words, these systems allow decision makers to access relevant data across the organization as they need it to make choices among alternatives" (Sauter, 2010:2).

Druzdzel and Flynn (2002:3) asserted that Decision Support Systems (DSS) support "human cognitive deficiencies" and this is done through integration of a variety of information sources, DSS enhances access to relevant knowledge and aids in making decisions in an organisation through supporting choices "among well-defined alternatives and build on formal approaches". Druzdzel and Flynn (2002:6) further indicate that DSS support interactions, promote judgment, aid in data storage and retrieval and enhance problem-solving. Through this processes, DSS can enhance decision-making thus increase "productivity, efficiency, and effectiveness" which leads to an enhanced competitive advantage for the organisation.

Critical components of a DSS system as provided by Druzdzel and Flynn (2002:6) include:

i) A Database Management System (DBMS) which stores a vast amount of data required for the various problems it has been designed for. "It should also be capable of informing the user of the types of data that are available and how to gain access to them."

ii) Model-Base Management System (MBMS) – "The purpose of an MBMS is to transform data from the DBMS into information that is useful in decision making. Since many problems that the user of a DSS will cope with may be unstructured, the MBMS should also be capable of assisting the user in model building."

iii) Dialog Generation and Management System (DGMS) also, user interface – "DSSs need to be equipped with intuitive and easy-to-use interfaces." "The primary responsibility of a DGMS is to enhance the ability of the system user to utilize and benefit from the DSS."

2.8.4.4: Grid computing

"The Grid is a distributed computing infrastructure that enables coordinated resource sharing within dynamic organizations consisting of individuals, institutions, and resources" (Talia & Trunfio, 2010:132). Grid supports virtual organisations ("from small corporate departments that are in the same physical location to large groups of people from different organizations that are spread out across the globe") in the sharing of geographically distributed resources in the pursuit of similar goals within the context where a centralised location or control is lacking (Buraga & Alboaie, 2005:2). Grid technology plays a critical role in support of "knowledge acquisition and management" by enabling collaborations and providing "metadata (data about data) about the concepts and relations established between the resources within a given Grid platform" (Buraga & Alboaie, 2005:4). Grids also have the capacity to support various resources such as "supercomputers, storage systems, data sources, specialized devices (e.g., wireless terminals)" so that they are shared among distributed organisations to solve intensive problems (Buraga & Alboaie, 2005:1).

Having identified some technologies in literature that support KM practices, the following section provides a summary of these technologies.

2.8.5 Summary of technologies that support knowledge management practices

The following figure 2.1 provides a summary of the technologies that could possibly support collaborative and distributed learning; knowledge discovery; knowledge mapping and knowledge application as derived from the literature reviewed.

Figure 2.1: Potential technologies derived from literature

2.9 Conclusion

Knowledge is important in organisations but leveraging the actual knowledge assets can be an arduous task. This chapter sought to explain the concepts: collaborative and distributed learning, knowledge discovery, knowledge mapping and actual application of knowledge in organisations. The chapter further identified some broad categories of KM practices in literature and at the MIUC. The final section of the chapter presented some of the technologies that were identified from literature that is likely to support KM practices.

Some salient issues that were realised in the chapter include:

i. While employing technologies in KM practices in education, there is a need to focus on the pedagogical issues so as to meet the students' education needs rather than to focus solely on the technology.
ii. The majority of the tools are designed to support constructivist learning in that the users are actively involved in the learning process.

iii. There is a need for integration of interactive activities while using technology in KM practices so as to engage the users.

iv. Technology offers flexibility in learning in terms of space (learner location), time or distance of which are not as constrained as in the traditional learning environment

v. There is still need for lecturers to be engaged in the learning process by providing guidance and assessment to the learners.

vi. Using technology in learning enhance KM processes such as knowledge creation and sharing.

vii. It is critical that both the lecturer and student familiarise with the technology being employed in order to enhance effective use.

viii. The technologies are geared towards collaboration and ease of access to shared information.

ix. Intelligent systems support the creation and sharing of new knowledge from systems hence enhance knowledge re-use.

The next chapter - chapter three - examines in detail the methodologies that were applied in the data collection process for this study.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

The previous chapter - chapter two, presented a review of the literature on the concepts collaborative and distributed learning, knowledge discovery, knowledge mapping and knowledge application and further unearthed potential technologies that support these KM practices in the context of an academic setting. Some KM practices perceived to be taking place at the MIUC were also discussed and presented. The ultimate purpose of this study was to establish how information technologies can be used innovatively in order to support knowledge management practices at the MIUC.

In order to address the main research question and the sub-questions as presented in chapter one of this study (*see 1.4 Research question and sub-questions*), there was a need to identify appropriate research methods for the study. This chapter serves to highlight the various methods that were applied in carrying out the research in order to respond to the research questions. The chapter is organised into the following sections: research design, research strategy, the selection of research location, target group and sampling methods, data collection methods, application of questions, data analysis and interpretation, validity and reliability of the study, ethical considerations and, a conclusion.

3.2 Research design

A research design refers to a plan that aids in the provision of a logical structure that is relevant in guiding a researcher to address research problems and answer research questions (DeForge, 2010:2). Creswell (2014:4) discusses in detail three major research designs:

i. Qualitative research which focuses on the understanding of meaning attributed to a social or human problem by individuals usually with data collected in their setting and analysed inductively using general themes created by a researcher who makes meaningful interpretations from the data collected.
ii. Quantitative research which refers to the method used to test theories through an examination of the relationship among variables. It involves the use of numbers on data that can be analysed deductively using statistical procedures.
iii. Mixed methods research which combines qualitative and quantitative approaches in a study to provide an enhanced understanding of the research problem as well as aim at strengthening the findings.

A qualitative research design will be adopted for this study. Qualitative research entails a method that involves drawing data from a context in which events occur, with the aim of using an inductive approach (move from detailed empirical observations toward abstract generalisations) to provide in-depth, detailed information that is not necessarily generalisable but explores and clarifies people's behaviours and processes (Gorman & Clayton, 2005:2; Tewksbury, 2009:50).

According to Leedy and Ormrod (2014:141), qualitative researchers believe that it is critical to be able to interpret and make sense of what they see in order to understand any social phenomenon. Leedy and Ormrod (2014:141) further indicate that a case study enables the focus for a qualitative research study to be on phenomena as it occurs in its natural settings. Therefore, a case study enables critical interpretations of the phenomena. Gorman and Clayton (2005:2) also indicated that "the ultimate goal of qualitative research is to understand those being studied from their perspective, from their point of view." Qualitative research data is usually collected in the participants' setting and it allows for inductive analysis of data that is built from specifics to broad themes, while the researcher makes interpretations of the meaning of the data (Creswell, 2014:4).

The qualitative design was, therefore, selected for this study as it permitted the researcher to survey the respondents in their setting in order to determine i) the KM practices at the MIUC and, ii) their technological needs in support of selected KM aspects in an effort to address the first and third sub-questions (*see section 1.4: Research question and sub-questions*). The other advantage of this selection was the ability for the researcher to apply thematic data analysis. Tewksbury (2009:43) finds a limitation of qualitative research by indicating that researchers employing qualitative research are faced with a challenge of finding significant ways to work with data in order to identify patterns and trends. This limitation was overcome in this study through the adoption of KM themes early in the study and further, by framing survey questions within the themes. Thus, data received from the respondents was easy to interpret within each theme and in relation to the specific question.

3.3 Research strategy

This study adopted a case study approach. Gorman and Clayton (2005:47) defined a case study as an in-depth investigation of a distinct entity such as a single setting, subject, collection or event with the assumption that knowledge of a wider phenomenon can be derived by investigating the single case. They further indicated that case studies project "an aura of

containment in space and time" which is appealing especially to first-time investigators but the fact that one concentrates on a single case does not imply that it is an inferior or easier strategy as a rigorous and thorough investigation is expected.

The case study strategy was selected for this study as it tends to provide detailed information on the topic under study as indicated by Flick (2014:122) who stated that, case studies "capture the process under study in a very detailed and exact way." An in-depth investigation on information technologies that are likely to be relevant in support of knowledge management (KM) practices was conducted with the aim of recommending them for the Marist International University College (MIUC) which served as the case study for this research.

According to Oliver (2010:93), a case study ought to have some distinguishing features that make it meaningful to the study. The MIUC is an academic institution. This aspect makes the MIUC significant as the study sought to find out the role of technologies for KM practices in the context of an academic setting. Leedy and Ormrod (2014:143) stated that a case study may be suitable for learning more about little known or poorly understood situations. The strategy, thus, bore some relevance to the study as it set out to explore some current technologies that may be useful in support of KM practices at MIUC.

Oliver (2010:94) further indicated that "a case study should also provide data which in some way reflect the situation in other analogous cases." Flick (2014:123); and Leedy and Ormrod (2014:143) find this to be a limitation of the case study by stating that concentrating on a single case often leads to problems of generalisation. Regardless, the researcher believes that the findings may be useful to other academic contexts.

3.4 Selection of research location

The research was conducted at the Marist International University College (MIUC); a Christian-based academic institution located in Karen, Nairobi – Kenya. In a previous study, Anduvare (2015:172) found that the MIUC had some IT infrastructure but they were not sufficient to support knowledge management practices. Anduvare (2015:9) also indicated that the MIUC has some KM practices related to teaching, learning, and research even though they were not formalised. The need to have appropriate technologies to support these KM practices motivated the choice of this setting.

3.5 Target group and sampling

The population and target group, sampling technique and sample size that were applied in the study are discussed below:

3.5.1 Target group

The group of people who are the focus of a research project is known as the research population (Oliver, 2010:76). Even though not a fixed rule, often times a qualitative research study has a small target group that allows for intensive studying of the units with a possibility to generate a large amount of information from these targeted units (Boeije, 2010:36). This is supported by Emmel (2013:5) who stated that "qualitative samples are invariably small because in collecting rich insight these data will be bulky." According to Patton (2015: 264), a qualitative study can even encompass a single case (n=1) selected for a definite purpose while focusing on in-depth inquiries.

The population for this study was the total number of the full-time academic staff at the MIUC who also served as the target group. A target group is "one to which the study can be realistically generalizable or transferable" and this depends heavily on the nature and characteristics of the selected group (Andres, 2012:93). The target group was derived from a sampling frame. Babbie (2014:216) defines a sampling frame as a "list of elements from which a probability sample is selected." For this study, the total number of the full-time academic staff at the MIUC, which was nine, alongside their titles – lecturers – which indicated that they are academic staff members and, their mode of teaching – full-time, was determined from the payroll list at the MIUC which served as the sampling frame.

3.5.2 Sampling

According to Boeije (2010:35), a sample encompasses units that will be examined and that are selected from a defined research population. He further adds that qualitative research allows for intentional selection of a sample based on the researcher's needs. This study, therefore, settled for purposive sampling.

3.5.2.1 Purposive sampling

Purposive sampling is a form of nonprobability sampling in which the researcher makes the judgement about whom to include in a study (Babbie, 2014:200; Leedy & Ormrod, 2014:215; Andres, 2012:103). Leedy and Ormrod (2014:221) and Punch (2009:358) describe a purposive sample as the sample that has been deliberately derived from a population for a particular purpose or research logic. The deliberately chosen target group for the study was the full-time

academic staff members of the MIUC. The reason for this choice was based on the fact that this study is connected to a previous study and hence the researcher found it appropriate to target the same group that had been previously surveyed (*see* Anduvare, 2015:64). According to Gorman and Clayton (2005:128), purposive sampling is "chosen by the researcher to include representatives from within the population being studied who have a range of characteristics relevant to the research project." This forms another reason for choosing the target group. The researcher believes that this group is capable of providing rich and useful information with regard to technological needs in support of KM practices at the MIUC considering that they actively participate in the KM practices related to teaching, learning and research. Patton (2015:53) indicated that the strength in qualitative purposeful sampling lies in the provision of information-rich cases from which one can attain relevant information that is important to the purpose of the study.

3.5.3 Sample size

All of the nine full-time academic staff members were surveyed. This is justified by Leedy and Ormrod (2014:221) who stated that, for smaller populations, say, N (sample size) = 100 or fewer, there is little point in sampling; survey the entire population.

3.6 Data collection methods

According to Leedy and Ormrod (2014:221), "qualitative researchers identify one or a few variables that they intend to study and then collect data specifically related to those variables. Methods of measuring each variable are identified, developed, and standardized, with considerable attention to the validity and reliability of the measurement instruments." For this study, both primary and secondary methods were used to collect data. Primary data is the data that is not readily available in sources and the researcher has to collect it in order to address a research problem (Bajpai, 2011:126), while secondary data refers to data that has been collected and is, therefore, readily available for use (Bajpai, 2011:127).

Primary data was collected majorly to determine the KM practices at the MIUC and the technological needs of the academic staff in order to support KM practices (*see sub-questions one and three, section 1.4: Research question and sub-questions*). This data was collected via Google forms (*see 3.6.1.2: Online surveys*). Secondary data was relevant to respond to subquestion two (*see 1.4: Research question and sub-questions)* through enabling the researcher to identify the available information technologies as mentioned in the literature that have the potential to support collaborative and distributive learning; knowledge discovery;

knowledge mapping and knowledge application. These data were relevant in aiding the researcher in identifying appropriate technologies in support of KM practices at the MIUC and by so doing, addressed the fourth sub-question (*see 1.4: Research question and sub-questions).* Secondary data sources included printed and electronic books, e-journals and other Internet sources.

3.6.1 Data collection instruments

The research collection instruments for the study included secondary data sources and an online survey as highlighted below:

3.6.1.1 Secondary data sources

Secondary sources refer to publications in which authors describe the works of others. They give a quick overview of studies related to the problem as opposed to primary sources which provide detailed in-depth information on the problem (Oso & Onen, 2009:60). Secondary data sources were critical for this study as they facilitated the discovery of technologies that can support KM practices in an academic setting (*see 2.8: Technologies that support knowledge management in academic institutions*). Secondary data was collected through reviewing available literature as published in online and print books, journals as well as Internet databases.

a) Advantages of secondary data sources

"The sources already exist; therefore, the time spent on the study is considerably less than that on studies that use the primary data collection" (Bajpai, 2011:127). This was crucial to the study considering that the study sought to look at the current technologies hence this was realised through reviewing existing sources. Secondly, because of limited research time, secondary data sources facilitated the provision of relevant information for this study in a shorter period of time as compared to sourcing this particular information through primary data sources.

b) Disadvantages of secondary data sources

Sorensen et al. (1996, as cited by Bajpai, 2011:127) asserted that "the disadvantage of using secondary data is related to the fact that their selection and quality, and the methods of their collection, are not under the control of the researcher and that they are sometimes impossible to validate." This necessitated the researcher to be careful while selecting the sources that were used in order to address the research questions appropriately. Bajpai (2011:127) further expressed this by stating that "the accuracy of secondary data is most of the time questionable

as the researcher is unaware about the pattern of the collection. In addition, the researcher has no control over the data collection pattern. The researcher may try to use the secondary data that are developed for some other purpose in some other time frame in some other circumstances. This poses a great question mark on the currency and relevance of the data in terms of its use in the current problem." For the study, the researcher was keen on using the most current scholarly secondary sources.

3.6.1.2 Online surveys

This study employed an online qualitative survey. A "qualitative survey is the study of diversity (not distribution) in a population" (Jansen, 2010:3). In this case, the diversity lies in the possible technological needs of the academic staff members. According to Robson (2007:41), a survey typically involves seeking answers to a number of standard questions from a carefully selected group of people. Specifically, an online survey was used to collect data. According to Abbott and McKinney (2013:211), the questionnaire used in online surveys is identical to the one used in self-administered surveys.

The researcher used Google forms to create an online survey. After the survey questions were approved by the Faculty of Engineering, Built Environment and Information Technology Committee for Research Ethics and Integrity at the University of Pretoria, they were populated onto Google forms. The process included the creation of an introductory note in which the nature of the study was explained. Respondents were also informed to fill out the survey willingly and that their feedback would be anonymously reported in the mini-dissertation. This was followed by a brief introduction through which the respondents were guided on how to approach the questions. The next sections of the form involved the creation of the survey questions which were presented in six parts: A: Demographic data; B: Major KM practices at the MIUC; C: Collaborative and distributive learning; D: Knowledge discovery; E: Knowledge mapping, and F: Knowledge application. All the questions were set to 'required' prompting users to respond to all the questions in the survey. The survey was automatically saved on the Google drive.

Open-ended questions were formulated for the online survey. According to Kumar (2011:145), open-ended questions can provide a wealth of information as respondents are not conditioned to select answers, but the value of the responses will depend on how comfortable the respondents are to express their opinions. Kumar (2011:154) further indicates that "as open-ended questions allow respondents to express themselves freely, they virtually eliminate the

possibility of investigator bias (investigator bias is introduced through the response pattern presented to respondents."

a) ***Advantages of online surveys***

Online surveys present a variety of advantages as indicated below:

i. The questionnaires can be posted online in a web format hence enabling the respondents to access them via their own computers at a convenient time and location (Abbott & McKinney, 2013:211; Fink, 2012:10).
ii. Online survey software is easily accessible hence they enable a greater geographic access to a large number of people globally (Abbott & McKinney, 2013:211; Fink, 2012:10).
iii. Different respondent groups can be accommodated in online surveys so that appropriate questions can be directed to the specific varied groups (Abbott & McKinney, 2013:211).
iv. Online surveys are less costly and environmentally sound since they are not administered via paper (Abbott & McKinney, 2013:211; Andres, 2012:50; Fink, 2012:10).
v. According to Andres (2012:50), online surveys are most suited for individuals who use the Internet as part of their daily work, otherwise, there is a possibility for limited access to the Internet which may impact on the response rate.
vi. Andres (2012:50) also indicates that it is relatively easy to collect data as non-respondents can be followed up via email.

b) ***Disadvantages of online surveys***

i. "There is a bias toward those with e-mail addresses as there is among respondents of telephone surveys with non-listed numbers." (Abbott & McKinney 2013:212). All the nine MIUC academic staff members had an active email address hence this limitation did not apply.
ii. The survey may easily be lost in the respondents' mail or be delivered to an incorrect email address hence reduce the response rate (Fink, 2012:10). There is, therefore, a need for follow-up. To handle this limitation, the researcher did a follow up by calling the respondents to confirm if they have received the survey and to request them to complete the survey.
iii. Fink (2012:10) also finds that respondents are likely to feel overwhelmed with survey requests or hard to understand questions thus there was a need for careful and considerate designing of the online survey for this study.

3.7 Application of questions to study

The questions asked in the survey aimed at addressing the sub-questions (*see section 1.4: Research question and sub-questions*) with much focus on sub-questions one and three which sought to establish the current KM practices at the MIUC, and to determine the technologies that are currently used to support KM practices and ultimately by answering all the sub-questions, the main research question (*Which information technologies can be used innovatively to support KM practices at the MIUC?*) was met.

The first research sub-question aimed at determining if the KM practices that had been previously established at the MIUC were still apparent. The reason for this was to ensure that the study was in the right direction in the case of recommending technologies to support ongoing KM practices. This was established through section B of the online survey (*see Appendix C: Online survey*).

The second sub-question sought to identify information technologies that can enhance KM practices and this was done through a review of the literature. However, some of the questions presented in sections C-F of the online survey served to determine the current status of the technologies used at the MIUC in support of KM practices (*see Appendix C: Online survey*).

The third research sub-question was addressed by the questions provided in sections C-F in the online survey with four questions in section C focusing on determining technologies that support collaborative and distributive learning technologies; section D has three questions on knowledge discovery technologies; section E has six questions on knowledge mapping and, section F has four questions on knowledge application.

The fourth research sub-question sought to determine how technologies revealed in sub-question two can be used to support KM practices at the MIUC.

3.8 Data analysis and interpretation

"Data analysis is the process in which raw data is ordered and organised, to be used in methods that help to explain the past and predict the future" (Cuesta, 2013). This study utilised secondary data analysis and qualitative data analysis. Secondary analysis is "the re-analysis of previously collected and analysed data" (Punch, 2009:359). Once data had been collected through review of the literature and the online surveys, it was analysed through searching for patterns and themes and then it was synthesised. The specific qualitative data analysis method used was content analysis. According to Leedy and Ormrod (2013:148) and Neuman

(2011:361), content analysis refers to a systematic process of gathering, examining and analysing the contents of a text with the aim of identifying patterns, themes, or biases.

3.8.1 Data analysis and interpretation procedure

The content analysis steps as provided by Leedy and Ormrod (2013:149) were adopted for this study. In the first step, the researcher identified the specific content to be studied. In this case, it was the data gathered from the respondents via the online survey on Google forms. The second step involved the definition of the specific characteristics to be studied. This research adopted some key KM aspects from the onset of the study. These included: collaborative and distributive learning; knowledge discovery; knowledge mapping and knowledge application. These four aspects together with appropriate sub-themes were studied and analysed in the data that was gathered from the respondents.

Thirdly, the data was interpreted. Neuman (2014:112) indicates that interpretation is a "means to assign significance or a coherent meaning to something; in qualitative study, you give meaning by rearranging, examining, and discussing textual or visual data in a manner to remain true to the original understanding of the people being studied." In this stage, therefore, the researcher scrutinised the data for each of the themes (collaborative and distributive learning; knowledge discovery; knowledge mapping and knowledge application) presented in the second step. Themes were identified as the most appropriate data analysis and presentation approach for this study because the research adopted these KM aspects from the onset of the study.

The final step involved the discussion of findings following the themes that informed the investigation and based on the research sub-questions. This was then presented in the form of a discussion in chapter four of this mini-dissertation. The presentation is in the form of a discussion supported with quotations as well as tabulations.

3.9 Validity and reliability

Validity and reliability of research reflect the degree to which an error may occur in measurements (Leedy & Ormrod, 2014:91). While validity of research refers to the extent in which an instrument actually measures what it envisioned to measure (Leedy & Ormrod, 2014:91; Oliver, 2010:73), reliability, on the other hand, refers to the extent to which a measuring instrument produces the same results when the entity remains constant (Leedy & Ormrod, 2014:91).

3.9.1 Validity

Two broad perspectives of validity were highlighted by Kumar (2011:165), namely: whether the research investigation is providing answers to the research questions that it set out to answer and, if so, to what extent are the answers provided using appropriate methods and procedures. He further indicated that "establishing validity through logic implies justification of each question in relation to the objectives of the study" (Kumar, 2011:165). The validity of the data collection instrument to be used in the study was enhanced by the fact that the online survey questions were derived from the objectives of the study. In this case, each question was checked to determine whether it contributes to the first and third objectives of this study.

Validity is further addressed as internal and external validity. Internal validity concerns itself with how sound the investigation was with regard to design and the data it yields in order to achieve accurate conclusions (Leedy & Ormrod, 2014:103). Internal validity for this study was ensured by reviewing studies by other researchers in the same field through literature review. External validity refers to the extent to which the results of a research study can be generalised to other samples or contexts (Leedy & Ormrod, 2014:105). This being a case study, the study is focused on KM practices at the MIUC which is an academic institution. The results of this study may be generalised to other academic contexts that have similar characteristics.

3.9.2 Reliability

A consistent and stable research tool is predictable and accurate hence referred to as being reliable and "the greater the degree of consistency and stability in an instrument, the greater its reliability" (Kumar, 2011:168). Two concepts of reliability are looked at by Kumar (2011:168). This includes: how reliable is an instrument that is, its ability to produce consistent measurements if the information is collected more than once using the instrument and secondly, "how unreliable is the instrument this refers to the differences one is likely to get if the same set of information under the same conditions is collected using an instrument. Kumar (2011:169) states that "the lower the degree of 'error' in an instrument, the higher the reliability." Considering the small sample size, the instrument was not subjected to pilot testing but rather, some of the questions set on the survey were slightly similar so as to countercheck the responses. The responses provided were quite consistent thus, the instrument was found reliable.

3.10 Ethical considerations

Ethics in social research encompasses the act of researchers considering moral accuracies of their research activities whilst relating with other people such as participants and funders along the way as they conduct their studies. Leedy and Ormrod (2014:212) indicate that data collected via the Internet ought to undergo the same vigour with regard to ethical standards just as the data would be subjected to through a face-to-face process. This study, therefore, observed some ethical principles as outlined below:

i. Ethical clearance was sought and granted from the Faculty of Engineering, Built Environment and Information Technology Committee for Research Ethics and Integrity at the University of Pretoria (*see Appendix B: The University of Pretoria ethical clearance*).
ii. The research aimed at providing relevant information that will be valuable to the institution being studied, that is, the MIUC.
iii. Written permission was obtained from the Principal to conduct the study at the MIUC (*see Appendix A: The Marist International University College ethical clearance*).
iv. Respondents were not subjected to any physical or mental injury during the study.
v. Participants were invited via email to participate and were given the link to the survey that was sent via Google forms. Participants were informed that their participation would be voluntary and that their names will not be revealed. Participants had to sign an informed consent form prior to responding to the survey.
vi. Confidentiality of the respondents was ensured by asking them to complete the online survey anonymously.

3.11 Conclusion

This chapter has presented the various research methods that were applied in carrying out the research in order to meet the aim and objectives. This included the case study research strategy in which case, the MIUC was selected as the single case setting being an academic institution, as the research set out to investigate the use of technologies in KM practices in such a unit. A qualitative research approach was selected for the study to enable drawing of detailed, reliable information from units of analysis within the MIUC. The MIUC academic staff members were selected as the target population with the assumption that they have the ability to provide rich information considering that they are more actively involved in the learning, teaching and research activities at the institution. Secondary data analysis was applied in the review of the

literature while an online survey was selected as the data collection instrument. Secondary data analysis enabled reviewing of literature from which some information technologies relevant to support KM practices in an academic institution were identified. Online surveys, on the other hand, were instrumental in collecting data from the academic staff members on the current status of information technology usage in support of KM practices at the MIUC. The validity and reliability of the study and, ethical considerations that were applied were also discussed in this chapter in order to highlight the effort that the researcher took to ensure authenticity for the study. The next chapter, chapter four, presents the data collected from the respondents, its analysis and a discussion of the findings.

CHAPTER FOUR: DATA PRESENTATION, ANALYSIS, AND DISCUSSION OF FINDINGS

4.1 Introduction

The research methodology and data collection methods relevant to the study were covered in the previous chapter – chapter three. This chapter sets out to present and discuss the main issues arising from the findings obtained through an online survey that was administered to nine full-time academic staff members at the MIUC. This target group was selected using purposive sampling in which case, the researcher believed that they were more aware of KM practices and technologies applied in an academic setting and more particularly the MIUC context.

After receiving the University of Pretoria ethical clearance letter, a link to the online survey that had been created using Google forms and consisting of open-ended questions that were divided into six sections (A-F), was sent to the MIUC full-time teaching staff members through e-mail. The questions focused on a) Demographic information of the respondents; b) Major KM practices at the MIUC; c) Collaborative and distributive learning; d) Knowledge discovery; e) Knowledge mapping; and, f) Knowledge application. A number of open-ended questions were presented to the respondents under these sections (*see Appendix C: Online survey questionnaire*). All nine respondents (n=9) provided feedback leading to a hundred percent (100%) response rate. Having set all the online survey questions to 'required' on Google forms, all the questions were addressed hence there were no missing values in the results.

In the presentation and discussion of the findings, the respondents are referred to as 'R' (respondent) followed by a number ranging from 1-9 (number of respondents) in the order that the responses were received. Hence they will appear as R1 – R9 where applicable. This is to ensure anonymity of the respondents as had been indicated in *section 3.10: Ethical considerations, v*.

The literature reviewed in *section 2.8: Technologies that support knowledge management in academic institutions* helped in addressing the second sub-question by revealing technologies relevant in supporting KM practices in academic institutions: The sub-question was:

- ***Sub-question two*:** Which information technologies can enhance collaboration and distributed learning; knowledge discovery; knowledge mapping and knowledge application at the MIUC?

This chapter – chapter four – will mainly focus on addressing three of the sub-questions:

- ***Sub-question one*:** What KM practices are still apparent at the MIUC in view of a previous study by Anduvare (2015)?
- ***Sub-question three*:** What are the technological needs of the MIUC academic staff with regard to collaboration and distributed learning; knowledge discovery; knowledge mapping and knowledge application?
- ***Sub-question four:*** How can the information technologies be used innovatively to support the KM practices at the MIUC?

This chapter has been organised into three major parts: data presentation and analysis; discussion of findings; and discussion of recommendations. Within these main parts, the results and discussion of findings are presented using the main themes identified in the study, thus: collaborative and distributive learning; knowledge discovery; knowledge mapping and knowledge application. The chapter ends with a conclusion.

4.2 Data presentation and analysis

Data analysis reports on how the data collected are organised and analysed in order to present and interpret the findings of the study, and bring meaning to large amounts of data (Bloomberg & Volpe, 2012:109). The data collected was analysed and the findings have been presented below:

4.2.1 Demographic data

The purpose of this section was to serve as background to create a demographic overview of the participating respondents which then serves to confirm that the right target group was surveyed for the study. The study aimed at collecting feedback from the full-time academic staff members at the MIUC. The section had three questions that sought to establish the respondents' highest level of qualification, job title and department.

4.2.1.1 Highest level of qualification

This study targeted to survey the full-time teaching staff at the MIUC. This choice was informed by the researcher believing that this group had the ideal qualifications that would enable them to understand the questions related to the application of technologies in education. The respondents were asked to indicate their highest level of qualification. The study found out that out of the nine respondents surveyed, two had Doctorate degrees and seven had Master's degrees at the time of the study.

4.2.1.2 Job title

The respondents were asked to indicate their job titles. Seven indicated that they were lecturers, one was a senior lecturer and the other one was a tutor. The findings confirmed that the right target group had been surveyed. This was easily established as their job titles indicate that they are teaching staff members at the MIUC.

4.2.1.3 Department

The majority of the respondents, five in total were from the Education department, followed by three from the Business department and one from Social Science totaling to nine respondents. It should be noted that this study sought to establish technologies that can aid in KM practices within an academic setting. The technologies that were uncovered in this study through a review of the literature especially in relation to KM practices related to teaching and learning are applicable to all the departments as found in this study, thus Business, Education and Social Sciences. The study has not sought to establish as to whether some technologies are better placed in subject units within a department compared to the others.

4.2.2 Section B: Major knowledge management practices at the MIUC

This section served to address the first sub-question:

> *What KM practices are still apparent at the MIUC in view of a previous study by Anduvare (2015)?*

The KM practices apparent at the MIUC as had been established from a previous study (Anduvare, 2015) were restated as a summary *section 2.7: Knowledge management practices at the MIUC*. The essence of sub-question one was to confirm what had been revealed in the previous study which indicated that the MIUC had some KM practices in place even though they had not been formally instituted. The section had nine questions for the respondents (*see appendix C: Online survey questionnaire*) which addressed various facets of KM practices derived from chapter two (*see Table 2.3: The MIUC KM practices categorised under: collaboration and distributed learning; knowledge discovery; knowledge mapping and, knowledge application).*

The section is presented using the four major KM aspects as stated in Table 2.3 and further the findings and discussions are discussed using some themes created from the questions posed to the respondents. The results are presented and thereafter, a discussion of the findings under each of these themes is addressed.

4.2.2.1 KM practices related to collaboration and distributed learning

An academic institution such as the MIUC is engaged in KM practices that support collaboration and distributed learning. Thus, this section presents the results of some of these practices that had been found to be in existence at the MIUC.

a) Academic workshops

The respondents were asked if the MIUC organises academic workshops that provided them with a chance for continuous training for employees. The results indicated that the majority of the respondents (eight) agreed that the MIUC does organise for academic workshops but this is not done frequently. The frequency was indicated with phrases provided by the respondents such as: "Very few" (R2); "Not so frequently, once in three years" (R4); "Yes it does though not that much" (R6); "Rarely" (R7) and "Occasionally" (R9). One respondent stated "No" (R1) indicating that the MIUC does not organise for any academic workshops.

b) Knowledge creation

Participants were required to indicate as to whether they contribute to the creation of knowledge at the MIUC through research and contribution of ideas. The majority, eight respondents stated that research is conducted by the academic staff but they voiced that the output was not at a very large scale and additionally, most of the research is done at individual levels thus does not necessarily contribute significantly to organisational knowledge. This is expressed by some of the staff as follows: "To date I have not seen any joint research by faculty […]" (R2); "This is done at an individual level, teaching [workload] is too high to allow one to do research" (R4), and, "Yes they [the staff] do lots of research in their fields of interest and competence" (R6).

c) Knowledge transfer

The participants were requested to indicate if there was an ongoing transfer of knowledge among employees through consultations and collaborations. A significant number of the respondents (seven) indicated that there was a minimal level of knowledge being transferred among employees and this happens through research collaborations and consultations. One of the respondents expressed the status by saying that "while there is some knowledge transfer it cannot be said that it is satisfactory" (R3).

d) Knowledge sharing

The respondents were asked to note if the most shared knowledge at the MIUC was through teaching and learning activities. All the nine respondents affirmed that the most shared knowledge was through teaching and learning activities with some providing reasons such as: "Most knowledge passed is about innovation in teaching and learning" (R3), "Yes with

students, different departments do not share due to different interests" (R4), "Yes since MIUC is a teaching and learning oriented institution" (R6).

4.2.2.2 KM practices related to knowledge discovery

This section addresses the ability of the MIUC to discover and put to use best practices and knowledge in repositories.

a) Best practices

The respondents were asked if best practices were being recorded and shared at the MIUC. Four of the respondents indicated that best practices are not recorded while the remaining five noted that best practices are shared even though three of these respondents stated that it does not happen as often. These results suggest that even though some best practices are recorded and shared, it is not an extensive practice.

b) Central repository

When asked if they had contributed their own created work into the institutional repository, four of the respondents indicated not to have shared their research in the repository. Three respondents indicated yes but one provided an explanation that indicated a lack of awareness of the existence of a central repository, that is, "yes, through the teaching and information sharing" (R6). This assumption is further proved by another respondent who claimed that "I have shared knowledge but there is no formal institutional repository" (R3). The last respondent indicated that he/she was in the progress of contributing to the institutional repository.

4.2.2.3 KM practices related to knowledge mapping

This section presents results on the ability of the MIUC to map knowledge

a) Identification of expertise

When the respondents were questioned as to whether it was easy for them to identify experts and to capture their knowledge at the MIUC, seven of the respondents indicated "yes" but some provided comments such as "identification of experts is not so widely practiced" (R3), "MIUC lacks resources to help/facilitate the process" (R4) and "it is easy especially when the talent is identified at departmental level" (R6). Two of the respondents leaned to the negative by stating that it was not easy. The rationale was to establish if MIUC had known experts and if so, to find out how easy they are to be accessed.

b) Access to organisational knowledge

The respondents were asked to state if they found it easy to access organisational knowledge that is created at the MIUC. The reason for this question was to check if there was a general

understanding of what organisational knowledge meant and if so, what measures are used to access it. Six of the respondents stated that it was easy while three noted that it was not easy.

4.2.2.4 KM practices related to knowledge application

This section addresses the actual use of knowledge created at the MIUC.

a) Knowledge application

Respondents were asked if they applied knowledge that is created at the MIUC. The idea was to find out if the staff members take advantage of the knowledge created at the MIUC to improve their work and/or research. Five of the respondents stated that they did use knowledge created at the MIUC, two of the respondents commented in a way to suggest that they used their own knowledge, that is, "not quite, I am self-driven" (R2), "only that knowledge that I have created or have somehow informally got to know of its creation" (R3). One respondent indicated that they did not apply the knowledge while the last one stated that knowledge was rarely applied. The results indicate that there is a general lack of awareness of knowledge available at the MIUC or lack of commitment in taking advantage of knowledge created at the MIUC.

The next sections C-F were created to address the following sub-question:

> **Sub-question three:** *What are the technological needs of the MIUC academic staff with regard to collaboration and distributed learning; knowledge discovery; knowledge mapping and knowledge application?*

Rationale: The main purpose of this sub-question was to identify the technologies currently applied at the MIUC and to find out in what ways they were applied with regard to KM practices related to teaching, learning and research. Consequently, the findings helped in the identification of gaps in terms of adoption of available educational technologies especially with regard to those technologies that this study has identified through the literature review (*see section 2.8: Technologies that support knowledge management in academic institutions*). By doing this, the researcher was better placed to recommend appropriate technologies for the MIUC. The findings are presented in the following sections.

4.2.3 Section C: Collaborative and distributive learning

This section investigates technologies that support KM practices at the MIUC in relation to CL and DL practices as categorised in *Table 2.3: The MIUC KM practices categorised under: collaboration and distributed learning; knowledge discovery; knowledge mapping and, knowledge application.*

4.2.3.1 Technologies in support of workshops at the MIUC

The respondents were asked to highlight ways in which technology has been integrated into academic workshops. The responses that have emerged in the findings showed that the level of technology integration into workshops has not been majorly adopted. Five respondents indicated PowerPoint as the key technology being used during workshops and further indicated that the workshop content is shared using WiFi, emails and social media. Two of the respondents stated that the application of technology to academic workshops is on a very limited extent. One of the respondents pointed out that "so far none has taken place" to mean that technology has not been integrated into workshops. One other respondent expressed that the adoption "has not taken the level and magnitude of workshops so far."

4.2.3.2 IT supporting creation and contribution of knowledge at the MIUC

The respondents were requested to provide a list of information technologies that have facilitated their creation of knowledge and/or contributions of ideas at the MIUC and to briefly explain how each of the identified technologies was applied. This question sought to find out if technologies have been adopted to facilitate the creation of knowledge at the MIUC. One of the respondents (R2) indicated that there was no technology used in the creation of knowledge at the MIUC. A number of technologies was provided by the other respondents with explanations on how the technologies are applied as indicated in Table 4.1 below:

Table 4.1: Technologies supporting knowledge creation at the MIUC

Technology	Respondent	Explanation on usage
Powerpoint	R1	- Teaching.
Email list	R3	- Supports collaborations to a small extent.
Handheld calculators	R4	- Facilitates integration of teaching to enhance student understanding of concepts.
E-books and E-journals E-Resources	R5 R7	- No explanation provided. - Used to upgrade teaching materials.
Internet	R6	- Supports research and explorations, and, sharing of knowledge via modern technologies.
LCD projectors and laptops Computers	R8 R9	- Delivery and research work - Research.

These results indicate that basic technologies that include computers, Internet and projectors are used in support of knowledge creation at the MIUC.

4.2.3.3 IT for collaborations among staff at the MIUC

Upon being asked to provide a list and a brief explanation of the technologies used to support collaborations and sharing of knowledge among themselves, the academic staff provided some

technologies as presented in table 4.2. One respondent, however, indicated that there was "non-existent space for collaboration" (R2).

Table 4.2: Technologies used to facilitate collaborations and knowledge sharing among academic staff

Technologies	Respondent	Application
E-mail	R1, R5, R7 & R8	- No explanations provided.
Moodle (e-learning platforms)	R3 R4	- No explanation. - Interacting with students.
Smart board	R4	- Teaching and creating notes.
Facebook	R5	- No explanation.
Wi-fi	R5	- No explanation.
E-journals	R5	- No explanation.
Mobile phones	R9	- Facilitates constant communication and knowledge sharing.

The results in Table 4.2 suggest that the email technology is the most popular tool for collaborations among the MIUC staff members.

4.2.3.4 Activities carried out using technologies

The study further sought to establish what sort of specific teaching, learning and/or research activities are carried out at the MIUC using technologies. The results are presented in Table 4.3.

Table 4.3: Activities carried out using technologies at the MIUC

Activities using technology	Respondent	Application area
Discussion chats	R1	Teaching & learning
Downloading useful materials and uploading notes	R1, R7	Teaching & learning
Access to e-resources	R1, R4, R5	Teaching, learning & research
Access to academic sites	R2	Research
Online surveys	R3	Research
Academic writing	R6	Research
Research activities	R8	Research
Data analysis (statistics)	R9	Research

The result suggests that accessing electronic resources is the most popular activity followed by downloading and uploading of relevant resources. It is also evident that the activities carried out by the academic staff using technologies are inclined towards supporting research activities.

4.2.4 Section D: Knowledge discovery

This section presents results related to technologies used to support knowledge discovery at the MIUC.

4.2.4.1 Knowledge discovery at the MIUC

The respondents were asked to indicate the ways that they use to discover relevant knowledge to be reused at the MIUC. A number of ways were reported by the respondents that included:

i. Through extensive searches on the library catalogue (R1, R4)
ii. Through the use of e-resources (R1, R5)
iii. Through informal sharing (R3)
iv. Use of the library (R2)
v. Knowledge can be discovered through "testing the usefulness of the knowledge that has been gathered and see how it has changed the lives of both the students and staff" (R6)
vi. Through various websites (R7)
vii. Through "documenting procedures and processes" (R8)
viii. Through research (R9)
ix. Through the MIUC repository (R9)

Judging from the responses provided, it can be said that the respondents pointed out the possible sources of relevant knowledge, that is, where it can be found but failed to indicate how the knowledge can be discovered.

4.2.4.2 Finding knowledge in databases

The respondents were further asked to indicate how easy it was for them to find new and useful knowledge from the databases and repositories. Seven of the respondents stated that it was easy for them and indicated ways they use such as "searching the library website" (R1), and, "logging onto the system and retrieving relevant information" (R6). Some of the respondents said that even though it was easy, they experienced some challenges such as "databases not being widespread" (R3), and, "need for help from an expert" (R4). One respondent pointed out that sometimes it was easy while other times it was difficult (R8) thus, highlighted a challenge of inconsistencies with the methods applied to find knowledge.

4.2.4.3 Potential technologies that can aid in knowledge discovery

On being asked to explain which technologies they thought would aid them in discovering useful knowledge from the MIUC institutional repository (IR), a variety of technologies were provided as indicated in Table 4.4 below:

Table 4.4: Proposed technologies to aid in knowledge discovery at the MIUC IR

Technologies	**Respondent**
E-resources	R1
Audio tapes	R2
DVDs	R2
Social communication tools	R3
Networking tools	R3
Collaborative tools such as Yammer	R3
Library technologies	R4
WiFi	R5
Facebook	R5
Search engines	R6
Cataloguing technologies	R6
Internet	R7, R8
Computers	R9

The results provided in Table 4.4 suggest that a wide range of technologies are perceived to have the ability to aid in knowledge discovery from the IR. It also appears as though there is some level of lack of awareness as to what knowledge discovery is and/or what an IR is.

4.2.5 Section E: Knowledge mapping

This section sought to establish technologies in aid of knowledge mapping at the MIUC.

4.2.5.1 Knowledge flow at the MIUC

The respondents were asked to indicate if they thought that knowledge flows easily at the MIUC. Two respondents stated that it does flow easily; three respondents indicated that knowledge does flow easily but infrequently; two of the respondents indicated "yes" but provided the conditions under which knowledge flows easily, that is, "at my departmental level" (R2) and "it does flow easily if the lecturers and the students are committed to sharing information and knowledge" (R6). Finally, the other two respondents said that it does not flow easily with one saying that "with the current trends in technology MIUC is still very [much] behind" (R4). These results suggest that there is some level of knowledge flow at the MIUC but there is a need for improvement.

4.2.5.2 Identification of knowledge sources

Respondents were asked to state how they are able to identify relevant knowledge resources contained in databases or experts available at the MIUC. Four respondents indicated that they can easily identify knowledge sources through the use of websites. One respondent indicated that they can easily get relevant knowledge sources when aided by the library or computer

laboratory staff (R2). One noted that they get knowledge from experts and database (R3). Through the use of references one can identify knowledge sources (R7), and, through "interactive research and consultation" (R8). R4 pointed out that there is a lack of time to go through any sources and there are no experts to provide assistance. From these results, it is evident that there is a lack of a knowledge map to aid the academic staff in the identification of knowledge sources. Most of them indicated the sources of knowledge but failed to indicate how they identify knowledge sources.

4.2.5.3 Access to experts

The respondents were asked how quickly they were able to access an expert in a particular knowledge domain within the MIUC when they needed their help. The majority, eight of the respondents indicated that it was very fast with some highlighting that they easily use the supportive library staff (R1); "fellow faculty" (R2); "informal networks" (R3) and, "dialing up a number or emailing an expert" (R6). Only one respondent indicated that there was no expert at the MIUC in their specialisation. These results suggest that the experts at the MIUC are easily accessible but they seem to be limited to only the experts that are known to the individuals.

4.2.5.4 Technologies that facilitate access to knowledge

The respondents were asked to list and explain any technologies that they were aware of that facilitate access to organisational knowledge at the MIUC. The essence of this question was to find out if the respondents had any specific technologies that directed them to knowledge sources at the MIUC. Two respondents indicated the library databases (e-resources), a further two indicated the use of social media, one suggested the use of Moodle (e-learning platform), one stated the Internet, two stated that there are no technologies supporting this process and, one respondent indicated not to have understood the question. These results indicate that there is a general lack of awareness as to technologies that can facilitate access to organisational knowledge and there is also a possibility of lack of understanding as to what organisational knowledge entails.

4.2.5.5 Ease in exploiting knowledge in databases

The respondents were questioned if they found it easy to access and exploit knowledge in databases at the MIUC. Five of the respondents stated that it was easy and attributed this to aspects such as availability of websites and Wi-Fi (R5, R7) and, easy authentication requirements (R6). Two of the respondents said that it was not easy to access knowledge in the

databases. One indicated that there were no databases to access while another indicated not to have understood. These results suggest that the majority of the academic staff pretty much have an idea on how to easily access the MIUC databases but there is still need for knowledge maps and awareness to enhance access for all the staff.

4.2.5.6 Application of concept maps

The academic staff members were asked to indicate if and how they have applied any form of knowledge or concept maps in teaching and/or research. This question was posed precisely to establish if there was any awareness about knowledge or concept maps. The respondents provided a variety of responses such as "guiding students on how and where to find relevant materials in the library" (R1); "the knowledge I have is from outside MIUC" (R4); "publishing online" (R5); "yes the knowledge in my area of competence has been applied in my teaching and learning processes" (R6); "comparing the knowledge and its relevance in today's world" (R7); and, "many times in teaching, referring to authorities in a discipline (established authors – who have published their work online)" (R8). These results indicate that the majority of the respondents addressed the question with regard to the knowledge they have acquired and how it is applied. The study can, therefore, establish that concept maps technologies are not yet introduced in the teaching and learning at the MIUC.

4.2.6 Section F: Knowledge application

In this section, the study tries to establish technologies in use to support knowledge application at the MIUC.

4.2.6.1 Technologies for knowledge application

The respondents were required to indicate the technologies that have facilitated their effective application of knowledge at the MIUC. The question sought to find out if the MIUC academic staff integrated the use of technologies in knowledge application. A list of technologies that were provided is indicated in Table 4.5 below.

Table 4.5: Technologies in support of knowledge application

Technology	**Respondent**
Computers	R1, R7
PowerPoint	R1
Google search engine	R2
Databases	R3
None at the MIUC	R4
Shared websites	R5
Wi-fi	R5
Whatsapp	R5
Internet	R6, R8, R9
Social networks	R9

A variety of technologies has been provided with the Internet appearing to be more favourable in support of knowledge application. Some of the technologies provided such as Google search engine and databases seem to be sources of knowledge rather than technologies facilitating knowledge application. From the results, it can be assumed that it is not very clear as to what technologies the MIUC academic staff can adopt to facilitate knowledge application.

4.2.6.2 Knowledge application at the MIUC

The respondents were asked to indicate ways in which they have applied knowledge that has been captured at the MIUC. Six respondents pointed out that they have applied their knowledge in teaching. Research activities were also highlighted by six of the respondents whereby some mentioned both teaching and research. Another different opinion was that the respondent used the knowledge to share with others and, another respondent indicated that he or she has not applied any knowledge captured from the MIUC. These results indicate that most of the knowledge produced at the MIUC aids in teaching and research activities as far as the academic staff members are concerned.

4.2.6.3 Knowledge needed by the MIUC staff

The respondents were asked to state if there is specific knowledge that they would like to have access to at the MIUC in order to work more effectively. This question sought to establish if there could be gaps in terms of knowledge access that could be of potential value to the academic staff members. The respondents indicated the following:

i. Knowledge specific to my subject area in terms of books and journals (R1, R4)
ii. New journals (R2)
iii. Expert knowledge (R3)
iv. Cutting edge innovation (R3)

v. Collaborative knowledge (R3)
vi. Electronic resources (R5, R8)
vii. Specialised knowledge such as "medieval concepts developed in biblical studies" (R6)
viii. Institution-supported research (R7)
ix. Academic knowledge (R8)

The results indicate a wide range of codified knowledge is required especially geared towards supporting teaching and research. There seems to be less emphasis on tacit knowledge which is likely to even enhance effective working. Possibly there is a gap in the awareness of tacit knowledge sharing and application.

4.2.6.4 Innovation and knowledge flow

The respondents were asked to explain if they thought innovation can be enhanced in the case of easy flow of knowledge at the MIUC. All the nine respondents agreed that innovation will be enhanced once knowledge flows easily at the MIUC. The reasons provided for this include:

i. Information will be available for research and knowledge creation thus enhancing the quality of research (R1).
ii. "Innovation is hampered [by] the lack of a formal policy for knowledge creation and dissemination" (R3).
iii. With the availability of resources a great deal can be done (R4).
iv. Innovation can be enhanced with effective online knowledge sharing (R5).
v. Innovation can be enhanced through "a conscious collaboration between the staff and students" (R6).
vi. Innovation can be enhanced through research as more knowledge is discovered and shared (R7).
vii. Knowledge gathered can be easily disseminated and implemented (R9).

The results indicate that all the respondents are aware of the importance of knowledge flow at the MIUC and the impact it can have on innovation.

4.3 Discussion of findings

This section discusses the findings presented in section *4.2: Data presentation and analysis* of this study in relation to the literature reviewed. The discussion is based on the four KM themes: collaborative and distributive learning; knowledge discovery; knowledge mapping and, knowledge application. Within each theme, the findings related to KM practices at the MIUC and the technologies that support these practices are discussed.

4.3.1 Collaborative and distributive learning at the MIUC

The following is a discussion based on the results of the KM practices and technologies related to collaborative and distributive learning. The KM practices address academic workshops which were recognised by Pinto as a KM practice in academic institutions (*see Table 2.1: KM practices in academic institutions adopted from Pinto (2014)*) and, knowledge creation, transfer and sharing which are critical knowledge processes integrated into collaborative and distributive learning activities.

4.3.1.1 KM practices at the MIUC related to CL and DL

Sharing of knowledge is enabled by bringing people together through collaboration (Kumaraswamy & Chitale, 2011:310 as cited by Anduvare, 2015:137). One of the ways of providing this chance in an academic institution would be through the provision of workshops to facilitate collaborations among the teaching staff members. Findings of this study (*see 4.2.2.1a: Academic workshops*) indicate that the opportunity for meeting in academic workshops is rarely presented to the MIUC academic staff members and this confirms what had been previously found by Anduvare (2015:86) when a respondent stated that "academic workshops are organised once in a while that enhances knowledge sharing". Therefore, the MIUC does organise for academic workshops but the frequency is not satisfactory.

Knowledge creation as a KM practice was investigated at the MIUC by finding out if the participants did contribute to this. The results (*see 4.2.2.1b: Knowledge creation*) indicated that the majority of the academic staff members do participate in knowledge creation through conducting research but this is mainly done at individual levels. In a previous study, 79% of the respondents had agreed that knowledge creation is an ongoing process at the MIUC (Anduvare, 2015:82). The result in this study, therefore, confirms that knowledge is created at the MIUC by the academic staff members through research activities.

The majority of academicians and/or organisations place more emphasis in knowledge production and not necessarily on the transfer of the knowledge created despite the relevance of knowledge transfer in facilitating sharing of ideas (Anduvare, 2015:135-136). The current situation of KM transfer was investigated at the MIUC. The result (*see 4.2.2.1c: Knowledge transfer*) suggests that knowledge created at the MIUC through research is transferred albeit there is not much effort put into this practice. It appears like there continues to be a lack of awareness as to the relevance of knowledge transfer among employees as these results reflect what had been found in the previous study (Anduvare, 2015:84) which had indicated only 31%

percent of the employees had agreed that knowledge was being transferred at the institution. Nevertheless, some knowledge is transferred and this can be improved.

Previously in Anduvare (2015:86), respondents had commented that there is limited knowledge sharing within departments but the most shared knowledge at the MIUC was with the students. The result in this study (*see 4.2.2.1d: Knowledge sharing*) thus confirm that the situation is still the same as it is through the teaching and learning and interactions with students that knowledge sharing majorly takes place at the MIUC.

4.3.1.2 CL and DL technologies at the MIUC

Academic workshops can play a significant role in facilitating knowledge sharing as discussed in section *4.3.1.1: KM practices at the MIUC related to CL and DL* above. In chapter two (*section 2.3: Collaborative and distributed learning)* of this study, Long, *et al.* (2012:616) asserted that the CL has a great potential to support knowledge transfer which involves the delivery of knowledge among individuals and the conversion of knowledge from tacit to explicit or vice versa. The results in this study (*see 4.2.2.1a: Academic workshops*) suggest that there is limited adoption of technology to facilitate collaborations during workshops at the MIUC with the majority of the respondents highlighting PowerPoint presentations as the key technology that has been adopted. Wi-fi, emails and social media technologies were also mentioned to have facilitated workshop content sharing at the MIUC but their adoption is very limited.

CL also supports the creation of new knowledge through collaborations (Long, *et al*., 2012:616). With regard to technologies supporting knowledge creation at the MIUC, the study found out that the MIUC had adopted some basic technologies to facilitate knowledge creation through teaching and research as indicated in *Table 4.2*: *Technologies supporting knowledge creation at the MIUC.* The technologies mentioned included PowerPoint, email, handheld calculators, e-resources, Internet, LCD projectors, and computers. It is unclear as to how some of these technologies such as e-resources directly support the knowledge creation process which could raise the question as to the level of understanding of knowledge creation as a KM aspect and the role of technologies in facilitating this.

The respondents were also asked to indicate some of the technologies that facilitate collaborations among the academic staff members at the MIUC. The study established that the MIUC staff members majorly used email in collaborations. Other technologies mentioned included Moodle, Smart board, Facebook, wi-fi, e-journals and mobile phones (see *Table 4.3:*

Technologies used to facilitate collaborations and knowledge sharing among academic staff). Despite the question asking for explanation on how the technologies facilitate collaborations among academic staff, it was interesting to note that some of the explanations are still geared towards interactions with students and not with fellow staff members hence there is a possibility of limited collaborations among staff members when it comes to the use of the provided technologies. The Moodle platform had also been previously underutilised at the MIUC as indicated in Anduvare (2015:120). The technology appears to have gained more acceptance as presented in the results even though it is unclear how it supports collaborations among the staff members having been mentioned in this case.

In trying to establish the kind of specific teaching, learning and research activities that are carried out using technologies, it was evident that most of the activities were research-related such as academic writing, access to e-resources and use in data analysis. There were fewer activities geared towards supporting teaching and learning using technologies (*see Table 4.4: Activities carried out using technologies at the MIUC).* This is interesting as much of the discussion in literature in chapter two with regard to technologies in support of CL and DL is geared towards teaching and learning activities as opposed to collaborative activities of researchers (*see section 2.3: Collaborative and distributed learning*).

In chapter two of this study, a number of technologies were discovered that can aid CL and DL in academic institutions. *Diagram 2.1*: *Potential technologies derived from literature* highlights a summary of these technologies as podcasts, clickers, wikis, multimedia technologies, game-based learning, blogs and microblogs, social bookmarking tools, media sharing tools, brainstorming tools and, document creation tools. A critical analysis of the findings of this study as presented in section *4.2.3 Section C: Collaborative and distributive learning,* indicate that not much of these newer ITs have been adopted to support collaborative and distributive learning at the MIUC. This study has, therefore, made an attempt to recommend to the MIUC other technologies that can support CL and DL and this is presented in section *4.4.1: Recommendations for CL and DL technologies for the MIUC.* The next section discusses the findings of KM practices and technologies related to knowledge discovery at the MIUC.

4.3.2 Knowledge discovery at the MIUC

Knowledge discovery aims at discovering useful knowledge from data (Soundararajan, *et al*. 2005:142). In this section, a discussion of findings based on the results of the KM practices and technologies related to knowledge discovery is presented. The KM practices address knowledge discovery in relation to best practices and the central repository at the MIUC. The technology part discusses technologies that the MIUC is currently using to facilitate knowledge discovery.

4.3.2.1 KM practices at the MIUC related to knowledge discovery

The relevance of recording and sharing best practices is to enable the members of the MIUC to learn from previous practices that led to efficient courses of action while at the same time to deter duplication of tasks. According to Pinto (2014:2), best practices are to be identified and incorporated into tasks in an academic institution. The MIUC seems to have some level of best practices identified but not all the respondents were aware of this practice as the results in section *4.2.2.2a:Best practices* suggests.

The IR plays a critical role in an academic institution as it facilitates knowledge storage which is a key KM process. The findings of this study confirmed that the majority of the academic staff members were not aware of the IR (*see 4.2.2.2b*: *Central repository*). In the previous study, it had been established that the MIUC had an IR in place but similarly, there was a high level of unawareness about the existence of the repository (Anduvare, 2015:140). This could explain why the majority of the academic staff members are not contributing their work to the repository.

The relevance of understanding where knowledge silos are in academic institutions is to aid in facilitating knowledge discovery from existing databases and repositories. As discussed in section *2.4: Knowledge discovery*, it is not enough to have repositories of data in an institution but further, there need to be measures to discover patterns and useful knowledge from these copious amounts of data. Thus, the MIUC has a challenge of not only enhancing knowledge storage generated at the institution but also finding ways of discovering useful knowledge that can aid in decision making, improving work practices and innovation.

4.3.2.2 Knowledge discovery technologies at the MIUC

This study sought to find out ways in which the academic staff members discovered relevant knowledge for reuse. The results as were presented in section *4.2.4.1: Knowledge discovery at the MIUC* indicated a general lack of awareness of the idea of knowledge discovery as the

majority of the respondents pointed out sources of knowledge rather than ways of discovering the knowledge in the sources. These findings prove what was highlighted in chapter two (*see 2.4: Knowledge discovery*) by Pechenizkiy, Tsymbal and Puuronen (2010:1), who indicated that academic institutions are highly capable of collecting and storing a lot of data while exceeding the ability to "analyze, summarize and extract knowledge from this data."

The respondents were further provided with specific knowledge sources, that is, databases and repositories and were asked to indicate how easy it was to discover relevant knowledge from these sources. The results as presented in section *4.2.4.2: Finding knowledge in databases* indicated a variety of challenges faced by the academic staff in trying to find useful knowledge from databases and it generally came out that assistance was needed in this area. In chapter two (*see 2.4: Knowledge discovery*), Maimon and Rokach (2005:1) suggested the use of data mining techniques which is a core process in knowledge discovery that facilitates the recognition of relevant patterns that enhance discovery of new knowledge in databases.

With regard to technologies that aid in knowledge discovery in the IR, the MIUC academic staff members pointed out a variety of technologies (*see Table 4.4: Proposed technologies to aid in knowledge discovery at the MIUC IR*) of which the findings indicated that they reflected a lack of awareness of knowledge discovery and/or institutional repositories. These results back up what was found and discussed in section *4.3.2: KM practices at the MIUC related to knowledge discovery* in which it occurred that the IR is not popularly known despite its existence at the MIUC.

This study had established some technologies relevant in knowledge discovery as crowdsourcing technologies and recommender systems *(see 2.8.2: Knowledge discovery technologies).* Given that the findings of this study indicate a lack of awareness of such technologies, the study has endeavoured to suggest how they can be adopted as presented in the recommendation section (*see 4.4.2: Recommendations for knowledge discovery for the MIUC).*

4.3.3 Knowledge mapping at the MIUC

In this section, findings on KM practices alongside technologies that support knowledge mapping are discussed.

4.3.3.1 KM practices at the MIUC related to knowledge mapping

The results in chapter four (*section 4.2.2.3a: Identification of expertise)* indicated that the MIUC has some known experts but there seems to be a lack of formal mechanisms to facilitate access to these experts. The relevance of accessing knowledge experts in academic institutions would be to facilitate the sharing of tacit knowledge which can be helpful in solving problems and enhancing innovation.

The findings about how easy it was for the respondents to access organisational knowledge revealed that the MIUC has some organisational knowledge in place but possibly not all the staff members were aware of what organisational knowledge means hence the varied responses (*section 4.2.2.3b: Access to organisational knowledge).* In Anduvare (2015:137), similar results had been established that accessing expertise was a challenge to some of the staff members and this was stated to likely hinder the use of relevant tacit knowledge embedded in the minds of experts thus possibly leading to duplication of tasks and lack of growth of organisational knowledge base.

The challenge of accessing experts and organisational knowledge can be solved through the use of knowledge mapping. The relevance of knowledge mapping was established in chapter two of this study (*see 2.5: Knowledge mapping*) as enabling quick access to relevant knowledge in the midst of vast knowledge bases (Lee & Fink, 2013:15) and, to act as a guide in the identification of knowledge sources and flows within an organisation (Lee & Fink, 2013:17; Jalalimanesh & Homayounvala, 2011:2). Knowledge mapping will, therefore, be an ideal KM practice for the MIUC setting as knowledge sources need to be easily and quickly identified by all the academic staff members.

4.3.3.2 Knowledge mapping technologies at the MIUC

Knowledge flow at the MIUC was found to be inconsistent (*see 4.2.5.1: Knowledge flow at the MIUC*) with an academic staff pointing out that the MIUC has not done much in adopting new trends and technologies to facilitate knowledge flow. Further, the results as presented in chapter four *(see 4.2.5: Identification of knowledge sources*) clearly indicate that the MIUC lacks knowledge maps to aid the members in the identification of knowledge sources, thus, the respondents pointed out some familiar knowledge sources but did not indicate guides available at the MIUC that would quickly direct people to knowledge sources. This challenge was highlighted in chapter two by Lee and Fink (2013:16) who stated that most organisations in the

current day have knowledge bases thus they do not majorly suffer from lack of access to knowledge but rather the means to access and exploit it.

Another challenge that was established was with regard to accessing experts. It occurred that the respondents could easily locate experts but this was limited to the ones known to them as individuals (*see 4.2.5.3: Access to experts*). There is a need to have a proper mechanism to enable the MIUC staff members to be able to clearly know all the available experts and how they can be easily accessed. By doing this, experts can be useful across all departments and also duplication of tasks can be reduced. This point is supported in literature (*see 2.5: Knowledge mapping*) by Bautista-Frista, Romero-Gonzalez and Morgan-Beltran (2012:48) who highlighted that a knowledge map contains "key processes and activities, information and the strategic knowledge necessary to carry these out; who the people, clients and associated internal and external users are and who the information and knowledge suppliers are; and how the people use the information and knowledge." Thus, with all these aspects included in a knowledge map, the MIUC staff members can easily identify and access knowledge sources.

One of the ways of dealing with these challenges is by having knowledge maps in place. The creation of knowledge maps can be facilitated by the use of technologies. In trying to establish if the MIUC had any technologies in place that facilitate access to knowledge sources, the respondents were asked to indicate technologies that enable them to easily access and exploit knowledge. The findings as presented in section (*4.2.5.4: Technologies that facilitate access to knowledge and 4.2.5.1: Ease in exploiting knowledge in databases)* indicate a general lack of awareness of knowledge maps and in the same breath, a lack of these at the MIUC. Besides being used as a guide to knowledge sources, this study also established that knowledge and concept maps can be used to facilitate teaching and learning *(2.5: Knowledge mapping).* The respondents indicated not to be aware of the use of these maps in teaching and learning contexts *(see 4.2.5.6: Application of concept maps).*

Evidently, there is a need for the MIUC to be introduced to technologies that can aid in the facilitation of access to knowledge sources and enhanced learning through the use of concept maps. A review of the literature in this study identified two mapping software applications that can aid in the creation of knowledge and concept maps as Bubbl.us and Cmap tool (*see 2.8.3: Knowledge mapping technologies*). This study has made an effort to propose how these technologies can be adopted at the MIUC. This is presented as recommendations *(see: 4.4.3: Recommendations for knowledge mapping technologies for the MIUC).*

4.3.4 Knowledge application at the MIUC

In this section, findings on KM practices alongside technologies that support knowledge application at the MIUC are discussed.

4.3.4.1 KM practices at the MIUC related to knowledge application

The actual use of knowledge created at an institution is essential in KM. In chapter two (*see 2.6: Knowledge application*), Dhamdhere (2015:176) suggested that the lack of knowledge application in an organisation renders the other KM practices of gathering, storage, creation and sharing in vain. It is essential, therefore, that an organisation puts mechanisms in place to encourage knowledge application or reuse. In this study, it was established that not all the respondents that were surveyed were applying the knowledge that is available at the MIUC (*see 4.2.2.4a: Knowledge application*). This may be attributed to a lack of formal measures to make them aware of the knowledge available to them and how it can be accessed for reuse.

4.3.4.2 Knowledge application technologies at the MIUC

According to the respondents, knowledge created at the MIUC is majorly used in teaching and learning activities (*see 4.2.6.2: Knowledge application at the MIUC*). This was majorly attributed to codified knowledge such as from e-resources and books. The results from the survey as presented in this chapter (*section 4.2.6.3: Knowledge needed by the MIUC staff*) suggest a general lack of emphasis on tacit knowledge as being vital. On the other hand, the respondents were in complete agreement that knowledge flow at the MIUC would be critical in enhancing innovation (*see 4.2.6.4: Innovation and knowledge flow*). The need for knowledge and to facilitate its reuse should, therefore, be facilitated. Technologies may come in handy to support this process.

In the second chapter (*see 2.8.4: Knowledge application technologies*), Becerra-Fernandez and Sabherwal (2015:93) found that it is typical for knowledge application to be supported by intelligent systems. These technologies included: artificial intelligence, expert systems, decision support systems and grid computing of which have been discussed in detail in the same section. A review of the results presented by the respondents when they were asked to indicate the technologies that support knowledge application indicated that it was not very clear to the respondents as to which technologies can effectively facilitate knowledge application. None of the technologies reviewed in chapter two of this study was mentioned. A recommendation of these intelligent systems and how they can facilitate knowledge application

at the MIUC is thus presented (*see 4.4.1.4 Recommendations for knowledge application technologies for the MIUC*).

4.4 Technologies that have the potential to support the KM practices at the MIUC

Following the findings presented in this chapter (*see 4.2: Data presentation and analysis and, 4.3: Discussion of findings*) that indicate a limited adoption of information technologies to support KM practices at the MIUC, this section presents suggestions of technologies that can be used at the MIUC. The study set out to uncover technologies that can be used innovatively to support KM practices. The following sub-question was formulated to aid in this venture: ***Sub-question Four:*** *How can the information technologies be used innovatively to support the KM practices at the MIUC?*

This sub-question has been responded to in the form of suggestions, whereby, the researcher has attempted to identify relevant technologies from the ones identified in the literature review (*see 2.8: Technologies that support knowledge management in academic institutions*) and has pointed out to which KM practices identified at the MIUC as presented in this chapter (*see 4.3: Discussion of findings*) these technologies can support.

These recommendations are presented in the form of the major KM themes: Collaboration and distributed learning; Knowledge discovery; Knowledge mapping and Knowledge application. Cmap tools have been used to create concept maps diagrams for each of these themes so as to aid in visually presenting the technologies that can potentially support KM practices at the MIUC.

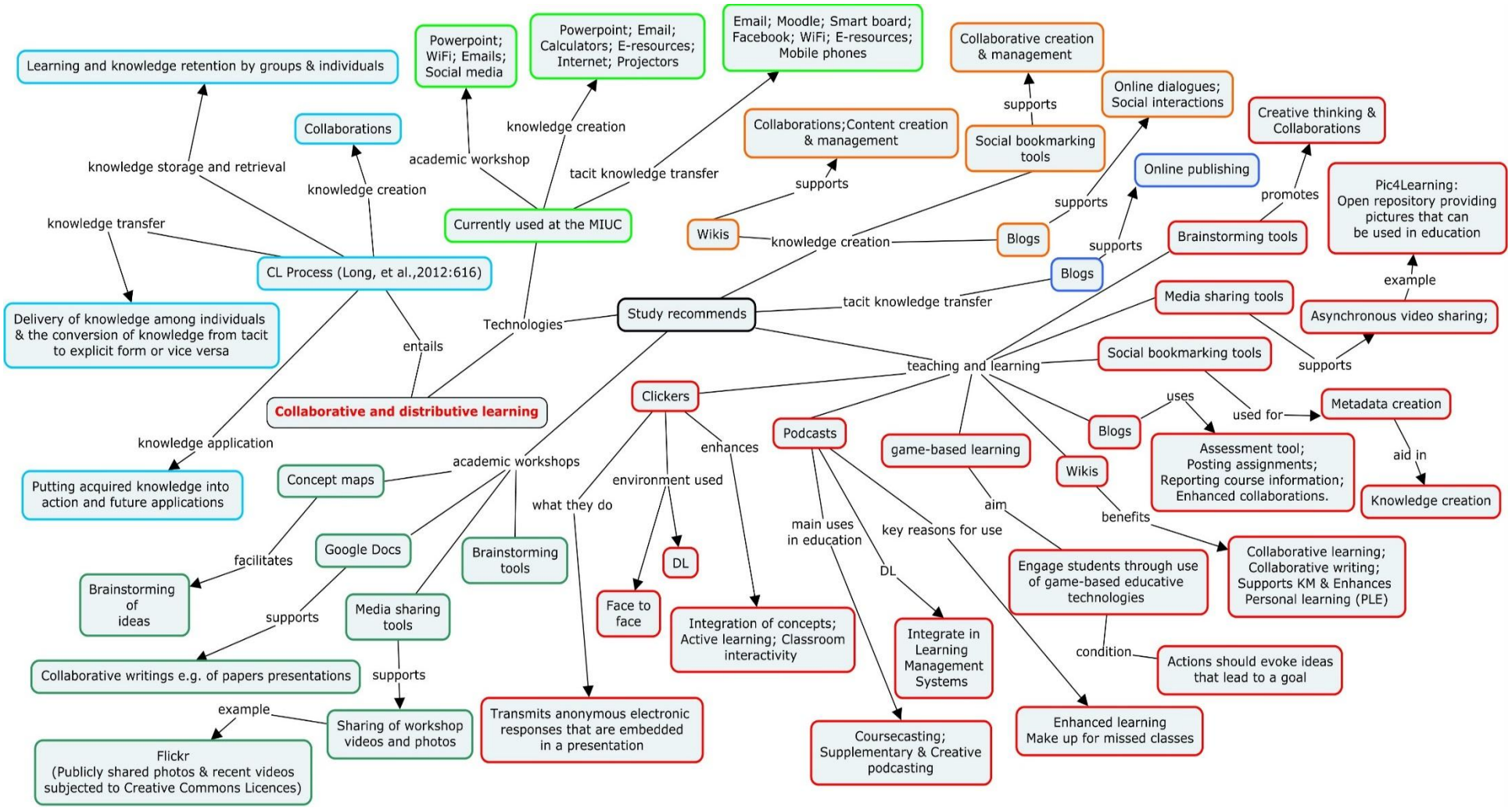
4.4.1 Recommendations for CL and DL technologies for the MIUC

In this study, it was established that the MIUC has some KM practices such as training through academic workshops, knowledge creation, knowledge transfer and knowledge sharing despite the fact that these practices are practised ad hoc (*4.3.1.1: KM practices at the MIUC related to CL and DL*). The study further found that the MIUC employed PowerPoint, use of wi-fi, email, social media, handheld calculators, use of e-resources, Internet, projectors, Moodle, smart board and mobile phones (*4.3.1.2: CL and DL technologies at the MIUC*) to facilitate KM practices related to CL and DL. This study has found these technologies to be inadequate and has sought to propose others derived from literature (*2.8.1: Collaboration and distributed learning technologies*).

In the case of academic workshop training, the study recommends the use of concept maps to enhance brainstorming of ideas; Google docs to facilitate collaborative writing; and, media sharing tools to enhance sharing of videos and photos. To increase knowledge creation, the study proposes the use of wikis for collaborations and content creation and management; social bookmarking tools such as Delicious to support collaborative creation and management of web documents; and blogs in support of online academic dialogues and social interactions. The study suggests the adoption of blogs to enhance the transfer of tacit knowledge through collaborative online publishing. Finally, to aid in teaching and learning, the study found that brainstorming tools can promote creative thinking and collaborations; media sharing tools such as Pic4Learning promote asynchronous video sharing; social bookmarking tools enhance metadata creation (tags) that enhances knowledge creation; blogs which aid in assessing student content, posting assignments, reporting course information and enhancing online collaborations; wikis support collaborative learning and writing, and enhance personal learning; game-based learning in aid of student engagement; podcasts that support the sharing of audio and video educational content; and, clickers which enhance classroom interactions. These technologies and their uses are presented in Figure 4.1.

Figure 4.1 illustrates two main aspects: collaborative learning processes as highlighted by Long *et al.* (2012:616) which highlights some of the key KM processes that are contained in collaborative learning. The second aspect includes technologies and is further divided into two: i. the technologies that the study found to be currently applied at the MIUC in support of academic workshop; knowledge creation; and knowledge transfer; and, ii. technologies that the study recommends to the MIUC in support of knowledge creation; knowledge transfer; teaching and learning; and, academic workshop training. The functions that these recommended technologies can support have also been highlighted.

Figure 4.1: Potential technologies for collaborative and distributive learning at the MIUC



Key: CL Process; Technologies: Currently at the MIUC; Knowledge creation; Knowledge transfer; Teaching & learning; Academic workshop

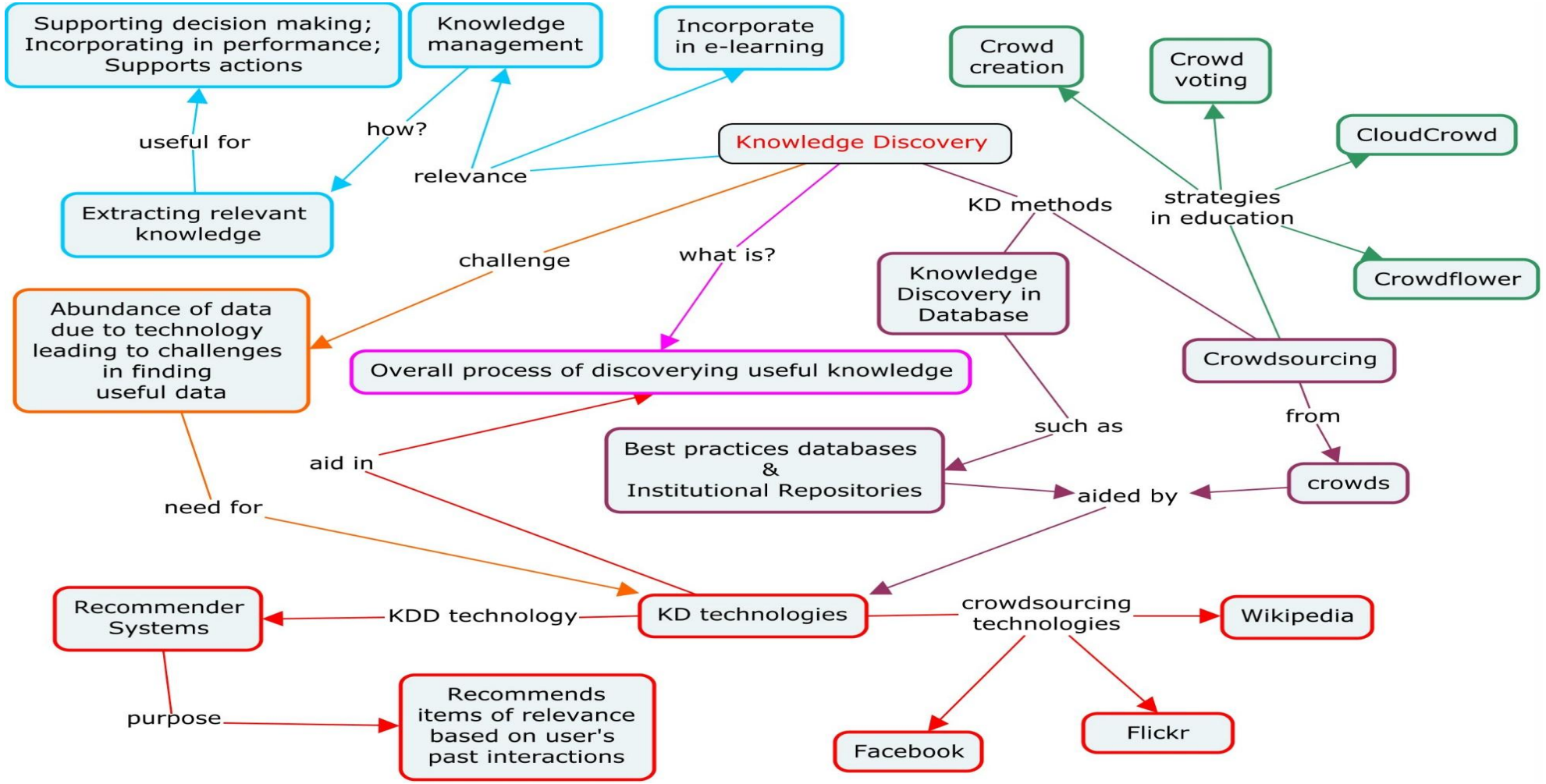
4.4.2 Recommendations for knowledge discovery technologies for the MIUC

Despite the MIUC having some level of stored best practices and content in the institutional repositories, this study ascertained that the majority were not aware of this content, were not accessing and contributing to it and consequently, were not using it (*see 4.3.2.1: KM practices at the MIUC related to knowledge discovery*). This can be attributed to the lack of formal ways to aid in knowledge discovery. This study has discovered a variety of technologies that can aid the MIUC in knowledge discovery (*see 2.8.2: Knowledge discovery technologies*).

This study established that crowdsourcing technologies and recommender systems can come in handy to facilitate the discovery of knowledge at the MIUC. The study proposes crowdsourcing technologies such as Facebook; Flickr and Wikipedia for the discovery and sourcing of knowledge from 'crowds'. On the other hand, knowledge such as best practices in databases and content in institutional repositories can be discovered by the use of recommender systems which trace a person's past interactions and recommends sources based on these previous searches. Figure 4.2 illustrates these recommendations.

Figure 4.2 illustrates what knowledge discovery is about; the relevance of knowledge discovery in education and knowledge management; the challenges that have led to the need for knowledge discovery; and finally, proposes technologies that aid in knowledge discovery based on the findings of this study. Two technologies are indicated: i. Knowledge Discovery in Databases (KDD) which is supported by recommender systems and aid in the discovery of knowledge in databases such as best practice databases and institutional repositories, ii. The study realised that knowledge can be sourced from crowds and hence, found crowdsourcing technologies such as Facebook, Flickr and Wikipedia to come in handy in this context.

Figure 4.2: Potential technologies for knowledge discovery at the MIUC



Key: KD definition; KD Relevance; KD Challenges; KD Methods; KD Technologies; Crowdsourcing strategies

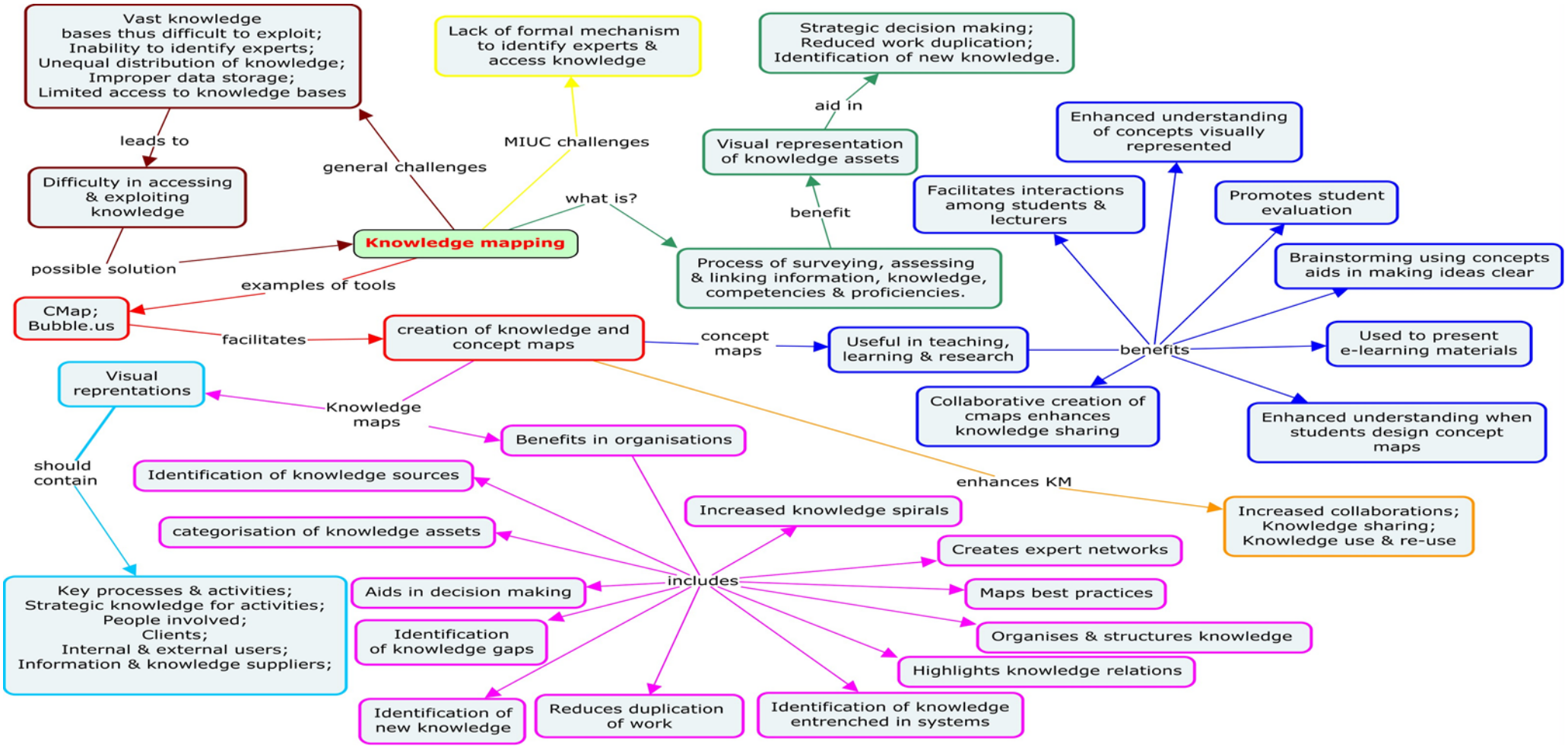
4.4.3 Recommendations for knowledge mapping technologies for the MIUC

The inconsistent flow of knowledge at the MIUC, caused by a lack of a formal mechanism to aid in the identification of experts and access to critical knowledge (*see 4.3.3.2: Knowledge mapping technologies at the MIUC*) calls for the use of technologies. IT offers a range of benefits when it comes to aiding an organisation to identify its knowledge sources as discussed in the literature (*see 2.8.3: Knowledge mapping technologies*).

The results as presented in this chapter (*see 4.2.5: Section E: Knowledge mapping*) indicated a general lack of awareness of information technologies that are available that can enhance the identification of knowledge sources. This study finds that knowledge mapping is a useful technique to aid in this. Knowledge mapping is designed by the use of knowledge mapping technologies such as Cmap and Bubble.us (*see 2.8.3: Knowledge mapping technologies*). These technologies are useful in the creation of knowledge and concept maps. Knowledge maps are more geared towards visually presenting knowledge sources in organisations hence making it easy for staff members to identify knowledge sources. Concept maps, on the other hand, are vital especially in teaching, learning and research as they present an opportunity for the users to highlight and share concepts visually, thus enhancing knowledge sharing and consequently, identification of experts in particular domains based on created concepts. Figure 4.3 illustrates the use of these technologies in academic contexts.

The figure highlights the meaning and benefits of knowledge mapping; the challenges faced by the MIUC in mapping knowledge; the general challenges associated with mapping knowledge as found in literature; and, the two technologies (Cmap and Bubble.us) that the study found to be relevant in the creation of knowledge and concept maps alongside the benefits of these maps.

Figure 4.3: Potential technologies for knowledge mapping at the MIUC



Key: Definition; MIUC challenges; K Mapping challenges; Mapping tools; KM contents; K Maps; Concept Maps; Mapping in KM

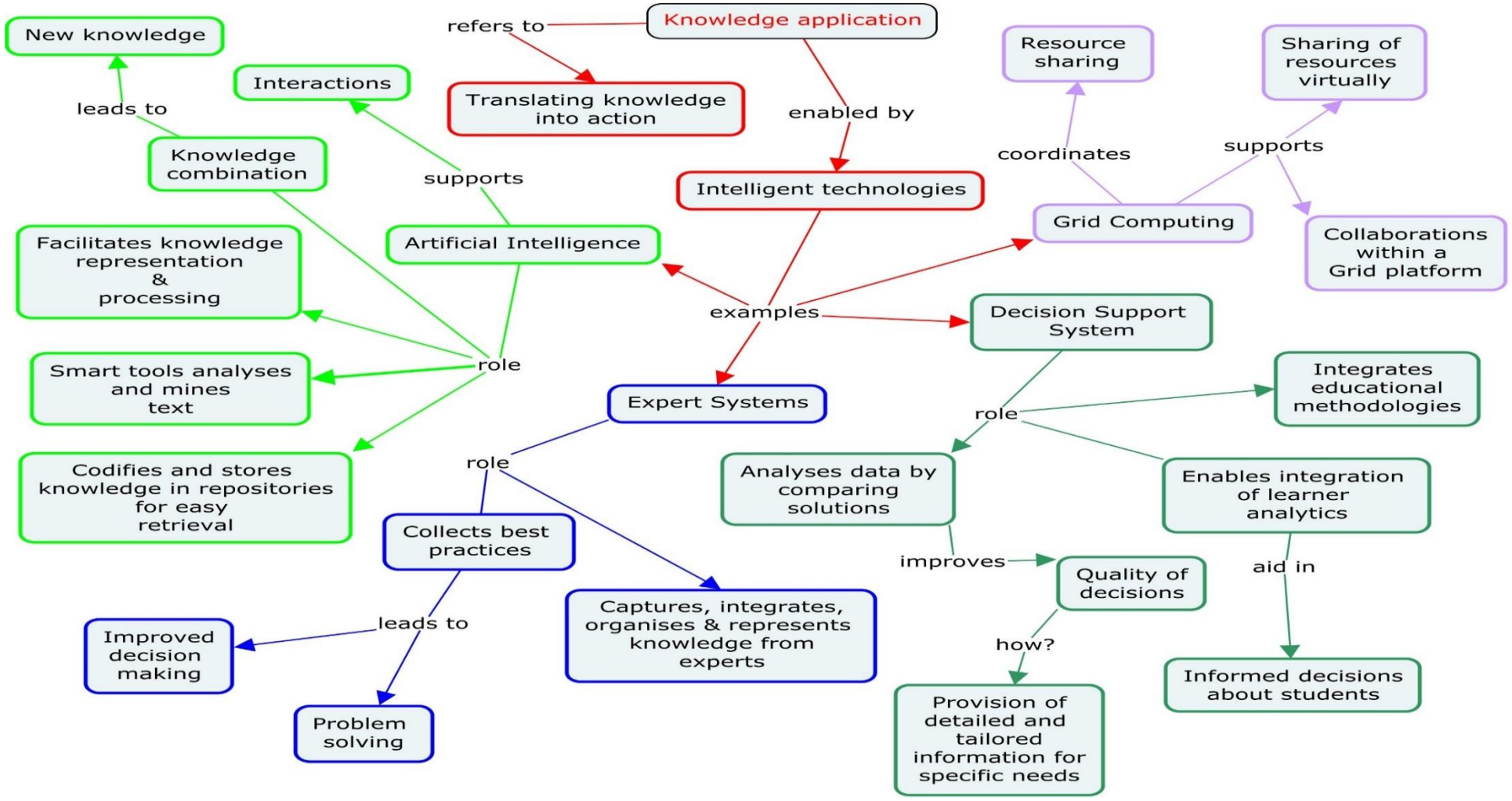
4.4.4 Recommendations for knowledge application technologies for the MIUC

Knowledge application is a critical KM process without which the other KM practices are rendered invalid (Dhamdhere, 2015:176). In trying to assess the knowledge application status at the MIUC, this study established that knowledge is majorly applied in teaching, learning and research activities (*see 4.2.6.2: Knowledge application at the MIUC*). This would be expected considering that it is an academic institution. However, when it comes to technologies that enhance knowledge application, the study found that the majority of the technologies that were indicated facilitated the application of explicit knowledge while there were limited technologies in aid of tacit knowledge (*see 4.3.4.2: Knowledge application technologies at the MIUC*).

To enhance innovation and the flow of knowledge at the MIUC, there is a need for both explicit and tacit knowledge to flow and thus, aid in knowledge reuse. The flow of knowledge can be facilitated by the use of technologies. Knowledge application is majorly enabled by intelligent technologies as indicated by Becerra-Fernandez and Sabherwal (2015:93) discussed in chapter two (*see 2.8.4: Knowledge application technologies*). These technologies include: Artificial intelligence systems; Expert systems; Decision support systems and Grid computing (*see 2.8.4: Knowledge application technologies*).

Intelligent systems are developed to aid in the integration of relevant knowledge from a variety of sources, thus this facilitates access to knowledge enhancing applications. Therefore, the MIUC can adopt intelligent systems to enhance access to relevant knowledge. Figure 4.4 illustrates four examples of intelligent technologies that support knowledge application and further, their role in enhancing knowledge application has been presented.

Figure 4.4: Potential technologies for knowledge application at the MIUC



Key: Definition; Artificial intelligence; Expert systems; Decision Support System; Grid Computing

4.5 Conclusion

This chapter sought to address three major areas of the study: i) the determination of the existence of KM practices at the MIUC; ii) the technological needs of the MIUC academic staff members in support of KM; and, iii) technologies that can support the MIUC KM practices. This was done through the presentation, discussion of findings and proposals for appropriate technologies. The findings were presented according to research sub-questions under different themes.

In this chapter, it was established that the KM practices such as academic workshops to enhance collaborations among academic staff members; knowledge creation through research and contributions of ideas; knowledge transfer through consultations and collaborations and knowledge sharing through teaching and learning are ongoing KM practices at the MIUC even though it occurred that these practices are not as substantial as they should be. With regard to knowledge discovery, the findings indicated that best practices are not exhaustively recorded and shared, thus it becomes difficult to access this knowledge. On the other hand, there was a general indication that the majority of the respondents were not aware of the institutional repository and, thus did not contribute their work and neither did they use the existing knowledge in the repositories. The study also established a challenge with knowledge mapping as not all experts are known and accessible to all the respondents. On the other hand, not all academic staff members were aware of the availability of organisational knowledge, thus, could not state if it was easily accessible. With regard to knowledge application, it came out that not all the respondents were aware of knowledge that is available for their use thus the majority used their own generated knowledge.

The study also sought to establish which technologies can support KM practices at the MIUC. The study found that there were limited technologies at the MIUC to support CL and DL, knowledge discovery, knowledge mapping and knowledge application. Due to these findings, the study attempted to provide recommendations of technologies that can support KM practices at the MIUC as presented in the final part of this chapter. The next chapter – chapter – five provides a summary, conclusion and brief recommendations of the study.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This final chapter of the mini-dissertation presents the summary, conclusion and recommendations for the study. The chapter aims at reflecting on the research questions as stated in chapter one in relation to the literature review presented in chapter two and the research findings presented in chapter four.

In the first chapter, this study commenced with an introduction to KM and related concepts in order to provide background information on their relation to technology and the academic context. The study further provided a summary of a previous study conducted by Anduvare (2015) with emphasis on the findings that suggested that the MIUC had not majorly adopted technologies to support KM practices. It was based on this realisation that this study was undertaken – to investigate technologies that can support KM practices at the MIUC.

The aim of the study was to investigate information technologies that can be used innovatively to support KM practices at the MIUC. Four research sub-questions as stated in chapter one (*section 1.4: Research question and sub-questions*) were formulated to aid in meeting the aims and objectives of the study.

The study adopted a qualitative research design to collect data from nine full-time academic staff members at the MIUC which was the case setting for this study. An online survey consisting of open-ended questions formulated using Google forms was employed as the instrument to collect the data electronically. Both primary and secondary data was adopted for the study. Primary data was collected using the online surveys to determine the KM practices at the MIUC and the technological needs of the academic staff members. On the other hand, secondary data on technologies that can support KM practices was sourced from literature. Content analysis was used to analyse the data that had been collected from the respondents which was then analysed, presented and discussed in chapter four of this study.

5.2 Summary of the major findings

This section presents a summary of the major findings based on the objectives and research sub-questions formulated for the study.

5.2.1 KM practices at the MIUC

Sub-question one: *What KM practices are still apparent at the MIUC in view of a previous study by Anduvare (2015)?*

The study sought to find out if the KM practices that had been revealed in a previous study were still in existence at the MIUC. To achieve this, the researcher surveyed the full-time academic staff members through an online survey. The study established the following:

i. That even though academic workshops are vital in aiding collaboration among the staff members, the number of workshops conducted at the MIUC were inadequate. The study further established that there is insufficient technology to support academic workshop training with the majority indicating PowerPoint as the key technology in use.
ii. That knowledge is created at the MIUC through research activities. Some basic technologies such as PowerPoint, projectors and computers were indicated to facilitate this process. These technologies were found not adequate to support knowledge creation.
iii. Regarding knowledge transfer, the study established that the process existed but is not significantly practised. E-mail was listed as the major technology applied at the MIUC to facilitate knowledge transfer.
iv. That knowledge sharing is greatly witnessed through teaching and learning activities as opposed to other collaboration such as among staff members. There is limited use of technologies to facilitate teaching and learning at the MIUC.

5.2.2 Information technologies in literature that can support KM practices at the MIUC.

Sub-question two: *Which information technologies can enhance collaboration and distributed learning; knowledge discovery; knowledge mapping and knowledge application at MIUC?*

To respond to this sub-question, the researcher reviewed academic sources accessed through Google Scholar and ranging from the years 2012 – 2016 with a specific focus on technologies used in academic institutions. The study established the following:

i. Collaborative and distributive learning can be facilitated using the following technologies: podcasts, clickers, wikis, multimedia technologies, game-based learning, blogs and

microblogs, social bookmarking tools, media sharing tools, brainstorming tools and, document creation tools.

ii. Knowledge discovery can be enhanced by the use of crowdsourcing technologies and recommender systems.

iii. Knowledge mapping enhances identification of knowledge sources including tacit knowledge from expertise and can be facilitated by the use of knowledge and concept maps. These maps can be created using technologies such as Cmap tool and Bubbl.us.

iv. The ultimate aspect of knowledge management lies in the application of knowledge. To enhance knowledge use, the study established the need to employ intelligent systems such as artificial intelligence, expert systems, decision support systems and grid computing. These systems aid in integrating knowledge entrenched in systems to enhance access and use.

5.2.3 Technological needs of the MIUC academic staff members in relation to KM practices

Sub-question three: *What are the technological needs of the MIUC academic staff with regard to collaboration and distributed learning; knowledge discovery; knowledge mapping and knowledge application*

This question sought to find out what technologies were currently applied at the MIUC and onto which practices, with the aim of identifying gaps in terms of technology adoption in order to recommend some where applicable. The study found out that the MIUC had not extensively adopted adequate technologies to facilitate KM practices hence there was a need for recommendations. A summary of these recommendations is presented in the next section.

5.2.4 Information technologies capable of supporting the KM practices at the MIUC

Sub-question four*: How can the information technologies be used innovatively to support the KM practices at the MIUC?*

The study set out to uncover technologies that can be used innovatively to support KM practices at the MIUC. This sub-question has been responded to in the form of recommendations where by the researcher has attempted to identify relevant technologies from the ones identified in the literature review (*see 2.8 Technologies that support knowledge management in academic institutions*) and has pointed out which KM practices identified at the MIUC (see *Table 2.3: The MIUC KM practices categorised under: collaboration and distributed learning; knowledge discovery;*

knowledge mapping and, knowledge application) the technologies can support. The Table 5.1 below illustrates a summary of the technologies that the MIUC can adopt to facilitate KM practices at the MIUC.

Table 5.1: Potential technologies to support the MIUC KM practices

KM Aspect	Specific practice	Suggested technology	Purpose
Collaborative and distributive learning	Academic workshop training	Concept maps	Brainstorming
		Google Docs	Collaborative writing
		Media sharing tools	Video and photo sharing
	Knowledge creation	Wikis	Collaboration and content creation and management
		Social bookmarking tools	Collaborative and content creation and management
		Blogs	Online dialogues
	Knowledge transfer	Blogs	Online publishing
	Teaching and learning	Clickers	Classroom interactions and active learning
		Podcasts	Sharing of recorded audio/video lessons
		Game-based learning	Educating through games purposed to teach
		Wikis	Collaborative learning and writing, enhanced PLE
		Blogs	Assessment tool, posting assignment, enhanced collaborations.
		Social bookmarking tools	Metadata creation
		Media sharing tools	Asynchronous video sharing
		Brainstorming tools	Creative thinking and collaboration
Knowledge discovery	Databases	Recommender systems	Recommends items of relevance
	Crowds	Crowdsourcing technologies such as Facebook, Flickr, Wikipedia	Acquisition of new knowledge through engaging a crowd(s) in interactions.
Knowledge mapping	Creation of knowledge and concept maps	Cmap and Bubble.us	Visually map knowledge sources.
Knowledge application	Knowledge reuse	Artificial intelligence; expert systems; decision support system and grid computing.	Systems facilitate access to relevant knowledge thus enhance knowledge reuse.

5.2 Conclusion

This final chapter of the mini-dissertation has presented a summary of the major findings, a conclusion and recommendations. The study aimed at investigating the IT that can be used innovatively to support KM practices at the MIUC. In order to meet this objective, it was necessary to identify the major KM practices and the current technologies in use at the MIUC and this was done through an online survey presented to the MIUC full-time academic staff members. The study also found it necessary to unravel the most recently used educational technologies from literature. This was necessary so as to understand how the technologies work in order to make recommendations for the MIUC. The study further merged the technologies revealed with specific KM practices at the MIUC that they are likely to support. By doing this, the aim of the study was met. The 'innovate use' of technology aspect has been met in that, firstly, all the technologies recommended in this study are not currently in use at the MIUC hence they are novel ideas. Secondly and lastly, the study made an attempt to identify specific technologies for all the KM practices identified at the MIUC. Innovation at the MIUC can, therefore, be further enhanced through the practical adoption of the technologies recommended in this study.

5.3 Recommendations of the study

Based on the findings and conclusion, the researcher makes the following recommendations.

5.3.1 Recommendations for the MIUC

In chapter four of this study (*section 4.4: Technologies that have the potential to support the KM practices at the MIUC*), recommendations have been proposed in terms of the technologies that can support the various KM practices identified at the MIUC. This study established that the majority of the technologies presented are freely available for use and thus, the MIUC needs to make an effort to adopt some or all of the technologies to facilitate teaching, learning and research activities. The proposals given in this study in terms of the technologies are not fixed but serve as a guideline to enthuse innovative thinking in terms of IT adoption in the academic setting.

5.3.2 Recommendations for further studies

i. This study identified a wide range of educational technologies and attempted to identify KM practices that can be supported by these. Further studies could be undertaken to

investigate, in detail, how the individual technologies would impact services in an academic setting.

ii. Further studies can also be carried out to investigate how these technologies can impact the administrative KM aspects of academic settings as this study majorly focused on the academic component.

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Appendix A: The Marist International University College ethical clearance

MARIST INTERNATIONAL UNIVERSITY COLLEGE
Constituent College of The Catholic University of Eastern Africa
Langata Road, P.O. Box 24450 – 00502 Karen, Nairobi
Phone: 254 – 20- 2012787, 2012797; Fax 254 – 20- 2389939;
Mobile: 0724987101, 0736518024

Date: 08th August, 2016

To whom it may concern

I, Br. Dr. Cyprian Gandeebo, as delegated authority of The Marist International University College hereby give permission to the primary researcher, Ms. Everlyn M. Anduvare, of the School of IT, Department of Information Science at the University of Pretoria the following:

1. To engage survey with the employees of the above mentioned company. I have reviewed the questionnaire given to me by the researcher. I hereby give my approval for using the questionnaire by the researcher.

2. To collect and publish information about the above mentioned company that is publicly not available for the research project titled: Innovative use of information technology to enhance knowledge management practices at the Marist International University College, Nairobi – Kenya.

This authorization is based on a mutual understanding that the above mentioned company's name can be mentioned in his/her project.

The information provided by the employees or any other means (such as company's archived documents or reports) of the above mentioned company is purely for academic purposes and cannot be used for any other purpose.

Regards,

Signature:  Date: 5th August, 2016

Name & Surname: Br Dr. Cyprian **Gandeebo**

Position/Delegation of Authority: (e.g. CEO, Director) **Principal**

Tel/Email address: +254 734017060, cypriangandy@gmail.com

Appendix B: The University of Pretoria ethical clearance

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Enquiries : Dr Marlene Holmner
Tel. nr. : +27 (0)12 420-5215
Fax nr. : +27 (0)12 362-5181
E-mail : marlene.holmner@up.ac.za
Office : IT 6-43

Faculty of Engineering, Built Environment and Information Technology

School of Information Technology

2016-09-25

ETHICAL CLEARANCE FOR EVERLYN ANDUVARE

Dissertation Title: ***Innovative use of Information Technology to enhance knowledge management practices at Marist International University College, Nairobi - Kenya***

To whom it may concern:

This is to confirm that the Research Committee of the Department of Information Science approved the application by Everlyn Anduvare for ethical clearance. Ms Anduvare complied with the standard requirements for ethical clearance as set out by the University of Pretoria's Faculty of Engineering, Built Environment and Information Technology (EBIT), as follows:

- She signed and submitted all the application forms required for ethical clearance;
- She submitted her data collection instruments for vetting by both the Research and Ethics Committees; and
- She implemented all corrections recommended by the above-mentioned committees.

The Research Committee of the Department of Information Science therefore requests permission for Ms Anduvare to collect the data she needs in order to complete and submit her mini-dissertation for examination. The Committee further appreciates any effort by appropriate authorities to expedite this process, and expresses its gratitude in anticipation.

Yours sincerely

Dr Marlene Holmner

Dr Marlene Holmner
Academic Coordinator: Carnegie MIT
Department of Information Science
E-mail: marlene.holmner@up.ac.za

Appendix C: Online survey

Dear respondent,

I am a Master of Information Technology (M.IT) student at The University of Pretoria collecting data that will assist me to complete my mini-dissertation on the topic – ***innovative use of information technology to enhance knowledge management practices at the Marist International University College, Nairobi – Kenya.*** The research aims at identifying information technologies that can be used innovatively to support KM practices at the Marist International University College. Knowledge management practices in a university basically include activities in teaching, learning, and research that mainly involve the creation, sharing and use of knowledge.

Your responses will be kept strictly confidential and data from this research will be anonymously reported in the mini-dissertation.

Thank you very much for your time and support.

Ms. Everlyn M. Anduvare,

P.O. Box 13019 – 00400 Nairobi, Kenya,

Mobile: +254733758162

Email: varelynn@gmail.com

Research sub-question: *What are the technological needs of the MIUC academic staff with regard to collaboration and distributed learning; knowledge discovery; knowledge mapping and knowledge application at the MIUC?*

Instruction:

The following questionnaire has been divided into six sections (Sections A-F) with a definition or explanation provided in each section to help you to have an understanding of the main aspects being surveyed. Kindly read the definition or explanation then proceed to provide answers for each of the questions provided in each section, by listing and/or briefly explaining where applicable.

Section A: Demographic information

The purpose of this section is essentially to determine that the correct target group has been involved in the study. Please provide the following information:

1. Highest level of qualification
2. Job title
3. Department

Section B: Major knowledge management practices at the MIUC

In a previous study on knowledge management at the MIUC, some KM practices were identified to be present though they had not been formally instituted. To what extent are the under listed KM practices still in existent at the MIUC?

1. The MIUC organises academic workshops that provide a chance for continuous training for employees.
2. The academic staffs contribute in the creation of knowledge at the MIUC through research and contribution of ideas.
3. There is ongoing transfer of knowledge among employees through consultations and collaborations.
4. The most shared knowledge at the MIUC is through teaching and learning activities.
5. Best practices (efficient cause of action) in the organisation are recorded and shared.
6. I have contributed my own created work to the institutional repository (central knowledge storage).

7. It is easy to identify experts and to capture their knowledge at the MIUC.
8. There is easy access to organisational knowledge created at the MIUC.
9. I put into application knowledge created at the MIUC.

Section C: Collaborative and distributive learning

Definition: "Distributed learning and collaborative learning apply computer and communication technologies to allow students and instructors to participate in learning activities anytime and anywhere" (Li, *et al*.; 2008:2).

1. In what ways has technology been integrated into academic workshop training at the MIUC?
2. List any specific information technologies that have facilitated your creation of knowledge and/or contribution of ideas at the MIUC and briefly explain how each of the technology was applied.
3. List and briefly explain any technology or (technologies) that you use to collaborate and share knowledge with other academic staff members.
4. What specific teaching, learning and/or research activities have you carried out using information technology?

Section D: Knowledge discovery

Definition: "Knowledge discovery refers to the overall process of discovering useful knowledge from data […]" (Soundararajan, *et al*., 2005:142).

1. In what ways can you discover relevant knowledge at the MIUC that can be reused?
2. How easy is it for you to find new and useful knowledge from databases or repositories?
3. Explain briefly which technologies you think can aid you to discover useful knowledge from the MIUC institutional repository.

Section E: Knowledge mapping

Definition: The availability of vast knowledge bases has brought a challenge for organisations to identify critical knowledge sources hence the need to map it. Knowledge mapping is a useful way of guiding and identifying relevant, available knowledge sources and enables a better understanding of how it flows within an organisation thus enabling members to be able to quickly

locate needed knowledge and experts (Lee & Fink, 2013:17; Jalalimanesh & Homayounvala, 2011:2).

1. In your opinion, does knowledge flow easily at the MIUC?
2. How do you identify relevant knowledge sources (e.g. in databases or experts) at the MIUC?
3. How quickly are you able to access an expert in a particular knowledge domain within the MIUC when you need some help?
4. Please list and briefly explain any technologies that you are aware of that facilitate access to organisational knowledge at the MIUC.
5. Please explain how easy it is for you to access and exploit knowledge in databases at the MIUC.
6. Briefly, indicate if and how you have applied any form of knowledge or concept map in teaching and/or research.

Section F: Knowledge application

Definition: Knowledge application refers to the actual use of knowledge with the aim of benefitting an organisation or individual hence knowledge found and mapped in an organisation is translated into action (Jovović & Draskovic, 2008).

1. Which technologies enable you to effectively apply knowledge that is created at the MIUC?
2. In what ways have you applied any form of knowledge that you have captured from the MIUC?
3. What kind of knowledge would you like to have access to at the MIUC in order to work effectively?
4. Briefly, explain if you think innovation can be enhanced if knowledge can easily flow at the MIUC?