Elimu 2.0 – Investigating the Use of Web 2.0 Tools for Facilitating Collaboration in Higher Education

Bajuna R. Salehe

A dissertation submitted in partial fulfilment of the requirements of
Dublin Institute of Technology for the degree of
M.Sc. in Computing (Knowledge Management)

September 2008

I certify that this dissertation which I now submit for examination for the award of MSc in Computing (Knowledge Management), is entirely my own work and has not been taken from the work of others save and to the extent that such work has been cited and acknowledged within the test of my work.

This dissertation was prepared according to the regulations for postgraduate study of the Dublin Institute of Technology and has not been submitted in whole or part for an award in any other Institute or University.

The work reported on in this dissertation conforms to the principles and requirements of the Institute's guidelines for ethics in research.

Signed: _____

Date: *08 September 2008*

1   ABSTRACT

The latest web innovations and technologies which has made the Web into a 'Platform', are become increasingly applied in the higher education arena. Tools such as *Google docs*, *Google groups*, *Wikis*, *Blogs*, *RSS* and *Podcasting* are gradually becoming more popular within higher education in teaching and learning. Yet their huge potentials have not been fully explored. Collaboration and knowledge sharing are common terms in higher education, and in the corporate world of the today's knowledge economy. However better infrastructure and facilities that enable these important issues are yet to be set and fully utilised in higher education. In the higher education complex ideas of Computer Science subjects are still crucial in today's technology-driven world. Hence teaching expertise of various Computer Science subjects need to be visible, accessible, and shared within. The purpose of this research is to investigate the usefulness of the latest web technologies and tools conventionally known as Web 2.0 in supporting the sharing of computer science teaching expertise within higher education.

A survey was conducted to analyse and examine the type and usage of Web 2.0 tools within computer science education and examine how useful they could be in supporting the sharing of computing teaching expertise. The survey findings revealed that some Web 2.0 tools have potential in enhancing the sharing of teaching knowledge. A framework for knowledge sharing incorporating Web 2.0 tools was then developed. A working prototype that demonstrated some Web 2.0 features of this framework which enables sharing of piloted computer science teaching knowledge was designed and evaluated by computer science teaching experts. The results showed that the proposed framework and prototype are workable in the current higher education environment.

Key words: *Knowledge Management, Web 2.0, Higher Education, Computer Science, Knowledge Sharing, Wiki, Blog, Podcasting, RSS. Teaching, Learning*

ACKNOWLEDGEMENTS

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

1. INTRODUCTION

1.1 *Background*

Knowledge management focuses on optimising organisations' business processes by utilising efficiently and effectively their knowledge resources which include articulated and actionable information and artefacts as well as experiences, perceptions, and insights of individual employees within organisations. Among organisations that need to incorporate knowledge management are higher education organisations. The focus of this research is to develop mechanisms for the sharing of teaching experiences, techniques and methods in undergraduate computer science education.

In this research I hypothesised that some Web 2.0 tools could have potential in providing mechanisms for the sharing of teaching skills and approaches used by computer science lecturers in undergraduate education. Web 2.0 tools can offer the opportunity for powerful knowledge sharing and collaboration in higher education due to their ease to use and rapidity of deployment, which can reduce the complexity of teaching computing concepts in undergraduate education.

Web 2.0 is an umbrella term which describes several new web technologies and tools. Its foundation encompasses a number of web-based services and applications which ideally are not technologies themselves and most of them are being used in education. Examples of Web 2.0 technologies are blogs wikis, multimedia sharing services, content syndication, podcasting and content tagging (Anderson, 2007).

In this research project a framework for knowledge sharing that incorporates Web 2.0 tools is proposed. The knowledge to be shared is both explicit and implicit computer science knowledge. This knowledge could be further improved through the use of the proposed tools. The targeted computer science lecturers used and evaluated the working prototype system that demonstrated the framework and the results were reviewed to evaluate its applicability.

1.2 Project Description

Computer science lectures have different techniques in teaching and assessing students. This research seeks to providing mechanisms for sharing of teaching techniques and approaches. This knowledge could be tacit or explicit used by individual lectures. The focus of this research is on those methods used in teaching undergraduate computer science education. The motivation of doing this project was on the fact that key ideas of computing concepts are very complex (Gordon, 2007). And lecturers use different teaching techniques and approaches in conveying these ideas. Sharing of best practices in teaching and assessing computer science students is an effective way to enhance the teaching process.

This research proposes a framework for knowledge sharing enhanced with Web 2.0 tools to facilitate sharing of best practices in teaching and assessing undergraduate computer science students. The main advantage is to enhance collaboration within faculty lecturers and hence expertise within higher education could be retained (Milam Jr, 2001). Hence Web 2.0 has potential for knowledge management in higher education.

Web 2.0 tools have increasingly become more common in corporate environment and in education as well (Anderson, 2007). University of Arizona's Learning technologies Centre introduced wikis to help remotely enrolled students across the USA on information studies course. These students worked together to build a wiki-based glossary of technical terms they learned while on the course (Glogoff, 2006). The ubiquitous learning through the use of iPods and podcasting has been also implemented in Duke University (Ractham & Zhang, 2006). The podcasting in combination with RSS feeds facilitate sharing of tacit knowledge such as teaching experiences and insight. Blogs also might well support sharing of reflection on teaching experiences as well as personal professional challenges and teaching tips to other academics (Duffy & Bruns, 2006).

1.3 Research Problem

This project focuses on providing mechanisms using Web 2.0 tools to facilitate the sharing of the techniques, experiences and methods used for teaching computer science

students in higher learning organisation. The pilot was a specific module which was a computer programming module.

An extensive literature review was undertaken to determine the existing teaching approaches that are used to teach in higher education and particularly computer science undergraduate education. Moreover interviews were conducted to obtain insights of the lecturers' experiences and implicit techniques used in teaching undergraduate computer science as well as obtaining their views on the potentials of Web 2.0 tools in their lecturing domain.

Thereafter several Web 2.0 tools were explored to determine their application in teaching and supporting knowledge management processes. The focus was to determine the tools that would be most suitable in sharing of individual computer science lecturer's explicit and implicit teaching approaches and techniques.

Both questionnaires and interviews were deployed to understand how and which tools are used generally by teachers and also assessing which are useful in sharing of teaching knowledge. Basing on the findings from the literature and research surveys a set of Web 2.0 tools that seemed to be useful in facilitating tacit and explicit knowledge sharing within faculty lecturers were proposed. The framework for knowledge sharing incorporating Web 2.0 tools was then developed and the working prototype that demonstrated some Web 2.0 features of this framework was implemented. The pilot was targeted at computer science lecturers in Institute of Finance Management (IFM) and Dublin Institute of Technology (DIT) who reviewed the framework and used the prototype and assessed it.

1.4 Project Aims and Objectives

The aim of this project is to investigate the usefulness of web 2.0 tools in enhancing sharing of teaching techniques used by computer science lecturers in teaching particular undergraduate students focusing on programming.

As it could be observed from research literature most Web 2.0 tools primarily were used in higher learning education to assist lecturers in teaching students and for

simplifying the learning process from the student perspective. The focus of this project is to investigate whether these tools have potential for capturing and specifically for sharing both explicit and implicit knowledge that is possessed by computer science lecturers in undergraduate education.

To achieve the aim the following objectives had to be achieved:

1. To investigate teaching and learning approaches used in undergraduate computer science degree in higher education particularly in DIT and IFM

2. To examine the role of technologies in teaching and learning in higher education

3. To explore different best practices and experiences in which computer science lecturers use to teach students particular subject in one third level institute (IFM, DIT)

4. The potential uses of web 2.0 tools in higher learning education were explored.

5. A framework for knowledge sharing incorporating web 2.0 tools was devised to be used to share lecturers' tacit and explicit knowledge on a wider-basis based of the findings.

6. A set of Web 2.0 tools were proposed for enhancing the sharing of computer teaching programming knowledge.

7. The usefulness of these tools in sharing of knowledge related to teaching was evaluated by allowing lecturers to use them.

The results showed that the proposed framework was an ideal solution for sharing of teaching knowledge in computer science lecturers' community and could improve individuals' teaching knowledge.

1.5 Research Methodology and Project Outputs

- Quantitative and qualitative research methods were used, and data was collected and analysed through the use of interview and questionnaire surveys.

- A complete literature review that explore different teaching approaches used in higher education and particularly computer science education

and various technologies and web 2.0 tools in particular that are used in teaching in higher education was produced.

- Similarly an Interview & Survey Material (Questionnaire) that used during data collection were provided.
- The framework for enhancing sharing of computer science explicit and implicit teaching knowledge incorporating Web 2.0 tools was generated.
- The prototype was developed to test whether proposed Web 2.0 tools were useful in sharing of teaching knowledge.
- The devised framework and developed prototypes were evaluated through targeted computer science lecturers available in DIT who used the prototype.
- The results were reviewed and assessed to know the effectiveness and applicability of the framework and prototype.

1.6 Organisation of the Dissertation

This dissertation is divided into 6 chapters. Chapter Two examines in detail literature review to obtain general understanding on three major issues of this project which are Education, Web 2.0 and Knowledge Management.

Chapter Three will deal with the research conducted involving questionnaires that were deployed and interviews that were undertaken.

Chapter Four will discuss the design of the framework for sharing computer science teaching knowledge incorporating Web 2.0 tools and discusses the prototype.

Chapter Five will evaluate the framework and prototype that was developed to determine if it enhances sharing of teaching knowledge.

Chapter Six will be a summary and conclusion of the project. In this chapter the summary of the entire project will be discussed and the future work as well.

2 EDUCATION, WEB 2.0 AND KNOWLEDGE MANAGEMENT

2.1 Introduction

This chapter discusses three crucial issues regarding this dissertation. These are *Education* in which there are number of things associated with education will be discussed. As far as this dissertation is concerned education and higher education in particular has to be discussed since it is a domain of my focus of this dissertation. In this case the history of education will be examined as well as two important issues related to education which are teaching and learning.

Then *Web 2.0* will be discussed exploring various tools, their applications and uses. Afterward there will be discussion on how these tools are applied for educational purposes.

Finally *Knowledge Management* will be discussed and determining how can be applied and practiced in higher education environment. Moreover a special consideration will be given to Web 2.0 technologies and how they can be applied to enhance knowledge management practices in the context of higher education.

2.2 Education

2.2.1 Introduction

This section of chapter two, aims to discuss various concepts and theories related to education. It endeavours to explore various approaches to teaching which are applied in higher education particularly computer science. Firstly, a general understanding of teaching and learning is discussed. Then, a discussion of history of education will be done in which an Irish and Tanzanian context will be examined. The next section will discuss different theories of teaching and the last two sections discuss approaches used

for teaching in higher education and in particular those that are used for teaching computer science in higher education.

2.2.2 History of Education

2.2.2.1 Africa/Tanzania

Formal Western-type education was introduced into what became Tanganyika (currently Tanzania) by missionary organisations of different denominations which had established themselves in the territory since 1840s (Buchert, 1994). It supplemented traditional forms of education, through which knowledge about the prevailing norms and practices of the indigenous societies was passed on by elders to new generations. The purpose of the tradition educational activities was to transmit a common culture and the prevailing gender based division of labour. Thus education fulfilled a cultural cohesive and a socio-economically differentiated role (Buchert, 1994).

The educational activities undertaken by the missionary organisations introduced competing values into the indigenous societies as the primary objective was to westernise and Christianised the 'heathen' populations. The missionary activities expanded geographically under the protection of the formal German administration in the 1890s (Buchert, 1994).

The secular orientation become more important after 1900 when the German administration became involved in the formulation of educational policy for the area and began to support mission schools financially. The German administration's interest in education derived from its growing needs for middle layers of administrative personnel that could provide a level of communication, and for technical personnel that could secure economic development in the area (Buchert 1994).

In 1913, the German administration listed nine government main schools (in the cities and mission stations) with 2, 394 pupils, 89 government branch schools (in the surrounding African communities) with 3,706 pupils and six government artisans'

schools with 166 pupils (Buchert, 1994). The total number of pupils in missionary schools was indicated as 108, 551.

However most of this foundation was terribly damaged as a consequence of the First World War. Fortunately it was restored as the British were given the mandate of the territory and mission societies resumed their activities and as both the British administration and the native authorities began to participate in the provision of the education for the local communities (Buchert, 1994).

In contrast to the German, the devised objectives of education in the British period urged both political and economic goals for the educational system, which led to the higher degree of intervention in the local circumstances (Buchert, 1994). Most of the African education provided was at the elementary level and only 3 per cent of all students participated in education beyond the primary level during 1931-46.

After the Second World War, the British administration in Tanganyika distinguished between ultimate and immediate objectives in its educational policy. Until the mid 1950s the primary aim was to ensure that as large a proportion as possible of the child population of school age would become literate, which implied a vast expansion of the school system at the primary level (Buchert, 1994).

The final objective from mid-1950s was concentrated on middle level schooling, which provided agricultural and other practical skills determined by the local area, along with a planned increase in the number of pupils who accomplished secondary course in order to secure a constant supply of well-educated Africans with special technical and academic training (Buchert, 1994).

In this period the education structure of Tanzania (the then Tanganyika) was fully formalised at the end of British period into four years of primary, four years of middle, and four or six years of secondary education (O and A level, respectively). And the only University college at the time in East Africa was Makerere University in Uganda in which Form VI students from Tanganyika were given access to study there (Buchert, 1994).

After the independence between 1962 and 1981 the government made the reforms in education compared with the time before independence. After 1968 formal education consisted of seven years of primary, four years of 'ordinary' secondary and two years of 'advanced' secondary education (Buchert, 1994). The examination and certification points introduced by the British were maintained after standard VII (the Primary School Leaving Certificate), form IV (the Certificate of Secondary Education) and form VI (the Advanced Certificate of Secondary Education). Students were able to enter higher education only after they had completed one year of national service, and between 1974 and 1984, two years of work experience were also required as a criterion to enter higher education (Buchert, 1994). Since the higher education also obtained public funds therefore university students were obliged to work for five years in the country stationed by the government as recompense.

2.2.2.2 Europe/Ireland

Ireland's education and particularly higher education movements can be traced back to the monastic period during sixth century where people from all over the Ireland started to come to Kevin's community to learn what the monks was teaching. Kevin was a hermit who lived in Glendalough; he gradually started allowing some monastic community to be formed around him (Cahill, 1996).

The monks in this monastic community built what would become a university city to which came thousands of hopeful students first from all over Ireland, then Britain and at last from Europe. The Irish monastic universities accepted commoners as well as noble men and those who wished for learning and they played the central role in maintaining European culture during the dark ages of Europe (Cahill, 1996).

Nevertheless Ireland did not benefit from the outgrowing Universities which many other European countries experienced in the Middle Ages (Coolahan, 1981). Several initiatives aimed to establish formal university failed in this period and Ireland had to wait until in 1591 for the establishment of the University of Dublin which received its royal charter 1592. This remained the Ireland's only University until the mid-nineteenth century (Coolahan, 1981).

University education was closely entwined with denominational and political considerations. Various nineteenth-century initiatives failed to establish an overall university structure to the satisfaction of the main interests involved and it was only with the Irish University Act 1908 that an acceptable compromise solution was evolved. In the early days, the Trinity College (the University of Dublin) was closely linked to the Church of Ireland interests and had the advantages of long tradition and good endowment (Coolahan, 1981).

In 1908 two new universities were established. These were old Queen's College in Belfast which were raised to the status of full university and a federal National University which was non-denominational, and which would embrace the colleges at Cork and Galway and an expanded University College of Dublin and it had the right to grant 'recognised' status to other colleges such as Maynooth College in 1910 (Coolahan, 1981).

The achievement of political independence in 1922 catapulted little change in Irish universities and the state did not interfere with their internal affairs, though Irish studies were promoted more in the colleges of National University (Coolahan, 1981). And by 1960 the government established a commission on higher education to meet the need of many for formal reappraisal of Irish university and higher education (Coolahan, 1981).

Factors in modern Irish history such as the colonial past, the religious affiliations of the population, the cultural traditions of the people, the economic structure and the goals set for education have all shaped the unusual, interesting and complex structure of the current Irish educational system (Coolahan, 1981). The entire Irish educational tradition is deeply-rooted in its past and the respect displayed by the people for education, even at periods of great political and economic difficulty is a wonderful feature of her history. However as Ireland has passed the twentieth century, she faces the potential challenges in providing the range and standard of educational facilities appropriate to the needs of contemporary society (Coolahan, 1981).

That is why Ireland has signed the Bologna agreement in which she is now part of a wider educational group. The Bologna accord is the voluntary agreement that was

signed by 40 countries (Peters & Ashridge, 2005) in Europe. This agreement aimed at forming more uniformity in higher education systems and quality assurance within signatory countries (Peters & Ashridge, 2005). The agreement enforces three cycles in which undergraduate level will lead to Bachelor degree, graduate level will lead to master degree, and postgraduate level will lead to doctorate award. In this case there will be two basic formats; in which either the bachelor degree will constitute three years with two years master degree followed by three years of doctorate or it will constitute four years with one year master degree followed by three years of doctorate.

The fact that the current economy is becoming knowledge economy and the society is shifting toward knowledge society, therefore amongst the objectives of this accord is to establish uniform system of credits known as ECTS system as an appropriate method of encouraging widespread student mobility (Lorenz, 2006) as well as the teachers and researchers mobility which in effect could increase the international competitiveness of the European 'higher educational space' (Lorenz, 2006).

2.2.3 Teaching and Learning

Teaching can be defined as a matter of changing the learner's perspective, the way the learners sees the world and on how learners represent knowledge (Prosser & Trigwell, 1998)

There is no consensus agreement about exact definition of learning, since there is no single theory of learning which embraces all activities that are done by humans during the learning process (Brockbank & Mc Gill, 1998). This led to various definitions of learning, for example, the behavioural psychologists usually identify learning in the changed behaviour of their subject, while cognitive psychologists seek for change in the learner as evidence that learning has occurred (Brockbank & Mc Gill, 1998).

A survey that was conducted to know how adults view learning produced various responses as claimed by (Säljö, 1982), and (Brockbank & Mc Gill, 1998) defined learning in six categories as such as a quantitative increase in knowledge, memorising, acquisition of facts, methods, etc. which can be retained and used when necessary, the

abstraction of meaning, an interpretation process aimed at understanding reality, and (Marton, Dall'Alba & Beaty, 1993) added meaning which is developing as a person as (Brockbank & Mc Gill, 1998) explained.

Brockbank & Mc Gill (1998) claim that the first, second , and third categories imply cognitive learning which can be measured in terms of recall and retention, and categories 4, 5, and 6 propose more holistic descriptions of learning and correspond with the learning outcomes as adopted by teachers in higher education (Brockbank & Mc Gill, 1998).

As far as learning styles are concerned learners can be divided into two groups as suggested by John S. Daniel (1975). The first learning group is *serialists,* who learn step by step, creating new hypotheses as they go and who may be 'unable to see the wood for trees' (Daniel, 1995: p85). And the second group is *holists* who are global learners with appreciation of complexity and 'the whole picture', and who may be tempted to 'overgeneralise' (ibid: p 85)

2.2.4 Theories of Education

This section discusses the main theories related to education.

2.2.4.1 Behaviourism

Behaviourism is one of theories of teaching which is related to passive learning (Fumero, 2006a, 2006b) where a student is treated as an empty vessel to be filled with knowledge. This mode is characterised with a one way unidirectional (verbal) communication where a lecturer is verbalising information to students who takes notes. And on exams students repeat what the instructor tells them.[1] Similarly Ertmer & Newby (1993) describes it as "learning with changes in either the form or frequency of observable". Others have described it as "a theory of learning which suggests the only proper concern of the teacher is that of behaviour modification" (Winch & Gingell, 1999).

---

[1] http://lpc1.clpccd.cc.ca.us/lpc/hanna/learning/activevspassive.htm#tpe Retrieved on 03/07/2008

Behaviourism can be traced back to the work of John B. Watson who claimed that psychology was mainly concerned with behaviour instead of human mind or consciousness. His claim based on a famous scientific experiment called *Pavlov experiment*. The Pavlov experiment was done by a Russian scientist Ivan Pavlov who was investigating animal behaviour. In this experiment he rang a bell as he fed dogs. The dogs became familiar with the ring when they were fed, and he termed this as *conditioning* (Pavlov, 2003).

Through behaviourism, learning is achieved by conditioning which involves alterations of predecessors and consequences of behaviour. The alterations are continuously done until the exact response is observed. The key elements of behaviourism are the stimulus, the response and the relationship between the two. The major concern is how the response is made, how it is strengthened, and how it is maintained (Ertmer & Newby, 1993).

Behaviourists regard both learner and environment as important factors. Before giving instructions the behaviourist will asses the learner to determine the most effective instruction for that learner. Nevertheless it is widely accepted that behaviourism cannot explain how the higher level skills is acquired which essentially need analysis and processing (Ertmer & Newby, 1993).

2.2.4.2 Cognitivism

The trend of learning theory started to shift during 1950's from the approach focusing more on behaviour towards the cognitive approach. Scientists were emphasising more complex cognitive processes such as thinking, problem solving, language, concept formation and information (Ertmer & Newby, 1993).

According to cognitive theorists more focus should be put on how knowledge is communicated and transferred to a learner. It is considered more appropriate for the dissemination of complex forms of learning, i.e. reasoning, problem solving, and information processing. There are two techniques that are used to accomplish this which are *simplification* and *standardisation*. These are analysing and decomposing knowledge into simplified building blocks. If information is inappropriate then is deleted from a learning artefact. The information is learned and broken apart since

cognitivism theory requires that the learner consume information efficiently if it is in a more simplified form. Behaviourists will focus more on the design of the environment in which the learner exists which is in contrast with the cognitivists who prefer to concentrate on how the learner receives information (Ertmer & Newby, 1993).

Cognitivism is related to active learning (Fumero, 2006a, 2006b) where a lecturing instructor endeavours to create an environment for learning in which the students can learn to restructure new information and their prior knowledge into new knowledge about the content. Students develop skills in constructing and using knowledge with the instructor's guidance (McManus, 2001).

Cognitive theories put emphasis on making knowledge more meaningful and assist learners to associate new knowledge with existing knowledge. Analogies and metaphors allow learners to apply meaning to knowledge (Ertmer & Newby, 1993).

2.2.4.3 Constructivism

Constructivism emphasises that the learners construct knowledge with their own activities, build on what they already know. In constructivism teaching is not necessarily stressing on transmitting but on engaging student in active learning, building their knowledge in terms of what they already know (Biggs, 1999).This means that the constructivist should engage students to use active learning techniques such as experiments, and real-world problem solving to create more knowledge and then to reflect on and talk about what they are doing and how their understanding is changing. Constructivist teachers guide and encourage students to constantly asses how the activity is helping the gain understanding and they become expert learners through questioning themselves and use their strategies to keep learning.[2]

Some have described constructivism as a process in which the individual is constantly building representations of reality based on their experiences. This internal representation is continuously changing as each experience open out; hence in order to understand learning that has taken place the actual experience also has to be examined (Bednar *et al.,* 1992). Ertmer & Newby (1993) explained that the goal of instruction

---

[2] http://www.thirteen.org/edonline/concept2class/constructivism/index.html, Retrieved on 22/07/2008

"is not to ensure that individual knows particular facts but rather that they elaborate on and interpret information". There are three crucial factors for successful constructivist learning environment: these are the activity, the concept, and the environment (Brown *et al.,* 1989).

Constructivism may be looked as a spiral because as students continue to reflect on their own experiences, they find their ideas gaining in complexity and power, and they gradually develop strong abilities to integrate new information. The figure below illustrates this concept.
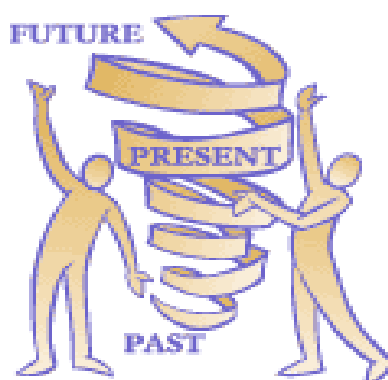
Figure 2.1 Constructivism ([3])

In constructivist environments new knowledge is constructed from previously formulated ideas, opinions, and experience through active participation of learners (students).[4]

Some have criticised constructivism by saying that not all learning is active as could be claimed by constructivists. They criticise that the theory may not cover all forms of learning. Secondly the idea that the world and truth is a person's own creation can lead to rejection of ethics (Winch & Gingell, 1999; Ben-Ari, 1998).

2.2.5 Approaches to Teaching in Higher Education

A common situation facing teachers is to understand what to teach students (learners) and the exact means and approaches that can be used to teach them. In a traditional way lecturers give students lectures, experiments, assignments and consultations, and

---

[3] http://www.thirteen.org/edonline/concept2class/constructivism/index.html Accessed July 2008

eventually examination in a closed-book form (Yingliang, 2005). In fact there are different teaching methods for different people. But what is required for lecturers is to provide some knowledge and appropriate methods for students to learn, and provide opportunities for students to enhance their abilities for the future (Yingliang, 2005). Lecturers may be guided by what is the best for the students which conceptually could be recognised as student-centred teaching. In this situation making decisions regarding content organisation and teaching approaches to a great extent is determined by the students' needs. In this type of learning the students are the centre and the teacher acts as a coach or a facilitator. Essentially this type of teaching is the development of students' cognitive abilities (Lara, 2005). Student-centred teaching might lead to better retention, better transfer of knowledge to other situations, better motivation for further learning, and better problem solving abilities. (Lara, 2005)

Within this framework of student-centred teaching there are several teaching approaches for lecturers to adopt such as case study, concept mapping and problem based learning (Yingliang, 2005).

2.2.5.1 Case Studies Approach

Case studies are an approach in which students are told about the way scientific problems are being solved at present or have not yet been solved in the past such as AIDS, or the Mars probes in the form of story. Then the lecturer asks some specific questions related to the curriculum (Yingliang, 2005). The case studies is analogous to the way children like hearing a story and learning experience becomes more interesting when lecturers use a story. Also a story makes students enthusiastic and motivated. Real stories help to make students aware of the real world and know how the real world operates (Yingliang, 2005).

Case studies shift students away from passive absorption to the active construction and through questions students could be stimulated to think more deeply and hence shifting them from surface to deep learning. This approach can promote skills such as analytical, classification, application, summarising, scientific judgement, and critical thinking skills (Yingliang, 2005).

---

[4] http://www.thirteen.org/edonline/concept2class/constructivism/index.html, Retrieved on 22/07/2008

2.2.5.2 Concept Mapping

Concept mapping is a method of representing particular knowledge in a graphical manner. It consists of *nodes* and *links* in which nodes represent related concepts within a topic and links represent the relationships between the concepts (King, 2004).

Research in the cognitive aspects of science learning has provided evidence that professional scientists and successful students develop elaborate, well-differentiated and highly interconnected frameworks of related concepts (Chi *et al.,* 1981; Mintzes *et al.,* 1998; Glaser & Bassok 1989). This means that as an expertise in a domain grows through learning training, and experience, the elements of knowledge become increasingly interconnected (Chi *et al.,* 1981) which makes a concept maps a more concise approach for capturing this knowledge (Ruiz-Primo & Shavelson, 1996). The figure below illustrates the model of a concept map.
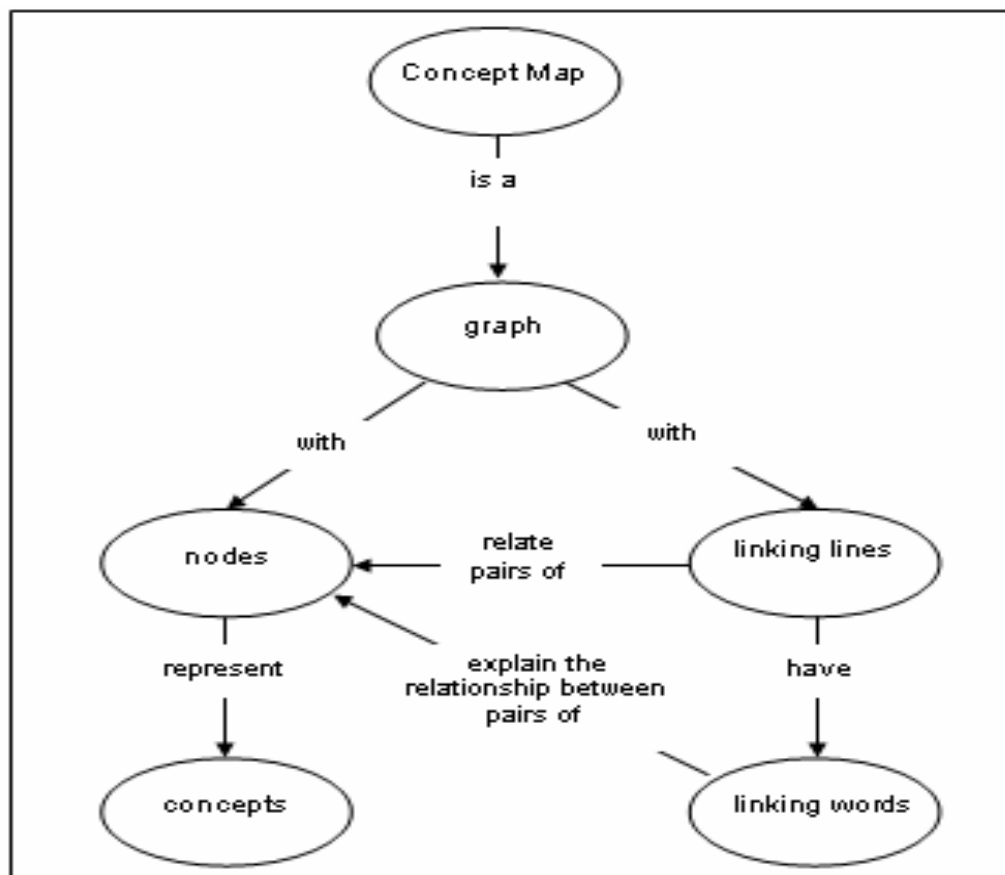
Figure 2.2 A Concept map what is a concept map (Ruiz-Primo, 2000)

Through using concept mapping a complex concept can be constructed in stepwise manner from simple to complex in which students are allowed to think freely about the topic. Also they can see concepts and their relationships. Concept maps can help student to elucidate what they understand and what they do not understand (Yingliang, 2005).

2.2.5.3 Problem Based Learning (PBL)

Problem based learning is an instructional method that challenges students to "learn to learn" (Duch, 2004). A fundamental component of problem based learning is that content is introduced in the context of complex real world problems (White, 1996). In other words *problem comes first* (Boud & Feletti, 1997).

In PBL the teacher provides the problem which is not well formulated and tries to help students to analyse the knowledge they should have to solve the problem. Students must work in small groups when they solve the problem (Yingliang, 2005). They must identify what they know, and more importantly what they do not know for the problem. Furthermore they must go beyond the textbook and classroom activities to pursue knowledge and information from other resources (Yingliang, 2005). Also they must make a plan for finding a solution to the problem, assign tasks to members of the group, collect information and data, and analyse the data. Communication and discussion are essential to the students before coming to the solution of the problem (Yingliang, 2005).

The important point to note about PBL is that it is not just a single method or technique rather it consists of a variety of problem-based approaches, from lecture-based teaching to pure problem-based learning without any teaching or assessment by the teachers (Boud, 1985; Barrows, 1986). Boud (1985) had mentioned typical characteristics that are related to PBL courses. Some are; acknowledgement of learners' experience, emphasis on students taking responsibility of their own learning, and changing staff role from instructor to facilitator as claimed by Hamalainen (2004).

In general during the process of solving a problem with PBL students not only catch a 'fish' but also learn how to fish. And it is a good way to foster the abilities of survival and lifelong learning (Yingliang, 2005).

2.2.5.4 Other Teaching Approaches

Apart from the discussed teaching methods in higher education there are also other methods such as student-oriented approaches to curriculum design and teaching, deep learning approaches, aligned and appropriate assessment, and action research and scholarship of teaching[5]

2.2.6 Approaches to Teaching Computer Science Subjects

Many students find the study of computer science extremely difficulty and there are some empirical results that show the depth of the difficulty (Ben-Ari, 1998). For instance Sleeman *et al.,* (1988) found that the concept of variables is very difficult to understand. There are many approaches that are used to ease the process of teaching computer science.

2.2.6.1 Constructivist Approach

Many phenomena of computer science education can be explained by constructivism (Ben-Ari, 1998). For instance the Graphical User Interface (GUI) paradox requires a design that is 'intuitive' and 'user-friendly' although many users still have the problem in learning to do this. However this concept can be easily taught using constructivist approach. From the constructivist point of view an icon is just a representation; and it is useful only to the extent that user can *construct* a mental model of the object being represented. In that case an icon of a 'running man' can represent the action of 'running a program' (Ben-Ari, 1998). Moreover WYSIWYG (What You See Is What You Get) is another idea that could benefit from a constructivist teaching mode (Ben-Ari, 1998).

2.2.6.2 Inverted Classroom

An inverted classroom is one of the teaching methods in which it combines the use of technology and hand-on activities. In inverted classroom, usual in-class lecture time is replaced with laboratory and in-class activities. Outside class time lectures are delivered over some other medium such as video on demand (Gannod *et al.*, 2008). For example in a three credit hour course, contact hours are spent having students

---

[5] http://cs.anu.edu.au/~Peter.Strazdins/seminars/BestPracticeCS.pdf Accessed on July 2008.

actively engaged in learning activities. Outside of class, students are focused on viewing 3-6 hours of lectures per week. And additional time outside of class is spent completing in-class activities (Gannod *et al.*, 2008).

Past uses of the inverted classroom have included the use of video tape, DVD players and downloadable media files (Lage *et al.*, 2000). New technologies such as iPods have been introduced, and new broadcasting method such podcasting have made multimedia data more accessible and ubiquitous (Gannod *et al.*, 2008). Examples of course that have been effectively taught using this method is software engineering (Gannod *et al.*, 2008).

2.2.6.3 Little Man Computer (LMC) Paradigm

The Little Man Computer paradigm is a conceptual device designed at MIT during 1960s to simulate the Von Neumann computer architecture (Yurcik & Osborne, 2001). The Von Neumann architecture emphasises that computers execute programs by accessing both instructions and data in the same storage device. The LMC paradigm is used to teach computer architecture (Gordon, 2007)

The LMC consists of a room with a 'Little Man' who simulates the operations of a computer. The room contains an array of locations that store information and instructions, an input and output tray, and a calculator. This approach allows students to easily understand the fundamentals of computer architecture; however the analogy between LMC and real computer is not ideal (Gordon, 2007).

2.2.6.4 Other Approaches

There are numerous other approaches used to teach computer science subjects. Examples of these approaches are: formative assessment, use of buzz groups in large group teaching, assignment design to foster student engagement and ownership, and community of practice in student projects.[6] Another common approach used to teach programming is a problem solving approach which could be used to teach programming as suggested by Webb *et al.*, (1986).

---

[6] http://cs.anu.edu.au/~Peter.Strazdins/seminars/BestPracticeCS.pdf Accessed on July 2008

The Faculty of Computing and Information Technology at Monash University introduced an approach called "teaching community approach" which put major emphasis on improving existing teaching approaches (MacDonald, 2001). Fundamentally the teaching community model was based on collaborative groups whereby academic staff particularly those who teach programming subjects formed different groups aimed at improving experience, skills and teaching knowledge of the novice and less experienced teachers in programming subjects. Each group contains 15-20 members of a particular programming subject and they had a regular meeting and discussion about finding appropriate ways of teaching it, with all members sharing their knowledge to reach a consensus on the approach to be used. All members of the group were in a steep learning curve (MacDonald, 2001). One of the most interesting aspects was the opportunity to give participating staff to work through considerable and very sudden changes occurring in the university system. By participating in collaborative groups, in which student learning was the most important priority, staff were able to resolve and manage problems they faced, and recommit to the core objective of quality teaching (MacDonald, 2001).

2.2.7 Conclusion

This section has discussed in a wide range of aspects related to education and higher education in particular. The history of education particularly higher education in both Ireland and Tanzania was discussed. The aim was to look at gradual processes and mechanisms in which it was improved from period to period and oversee potential challenges facing the current situation of higher education as well as envisaging its adaptive ability in the dynamic environment.

The concepts of teaching and learning were then discussed. This is important because it will provide a clear picture of how technology could fit in that context. Then different theories of education were discussed. Here three important concepts related to teaching and learning was discussed. These are behaviourism, cognitivism and constructivism. The fundamental importance of these concepts is that they are largely used in teaching and learning aspects in higher education. So discussing these issues

was necessary to check how technologies and specifically Web 2.0 technologies could fit as well as how they might be utilised to improve these core aspects.

The discussion of various teaching approaches used in higher education was next. The main purpose was to understand whether technology could be used to enhance these approaches and how knowledge management activities are practiced directly or indirectly. For instance the concept mapping approach could entail into knowledge discovery/acquisition in both teaching and learning perspectives. Then the discussion about various approaches used to teach computer science was done. The main importance was to understand in what ways knowledge management activities are performed through these approaches and entailing technology that could potentially be used to enhance them. For instance as it will be seen later that Web 2.0 tools such as Wikis might well be applied to the constructivist approach which conceptually emphasises more collaboration.

2.3 Web 2.0

2.3.1 Introduction

This section of the second chapter analyses the meaning and general understanding of the term Web 2.0. It is divided into three main subparts which are Web 1.0, Web 2.0, and Web 2.0 in education.

2.3.2 Web 1.0

There is loosely boundary definition of the term Web 1.0 but this term emerged when the Web 2.0 term was introduced. Web 1.0 refers to all web applications before arising of Web 2.0 (Klamma *et al.*, n.d.). These include personal websites as well as static and some dynamic web sites existed between 1994 and 2004.

2.3.3 Web 2.0

The term Web 2.0 does not have an exact meaning; however some people see it as a marketing buzzword for financial profit. The term Web 2.0 was first coined in a

brainstorming session conference between O'Reilly and MediaLive International (O'Reilly, 2005) in which they attempted to set out the core principles and practices underpinning the entire web and its services after the dot-com bubble.

The figure below shows a "meme map" of Web 2.0 that was developed during the conference at O'Reilly Media. It shows many ideas around the Web 2.0 core.
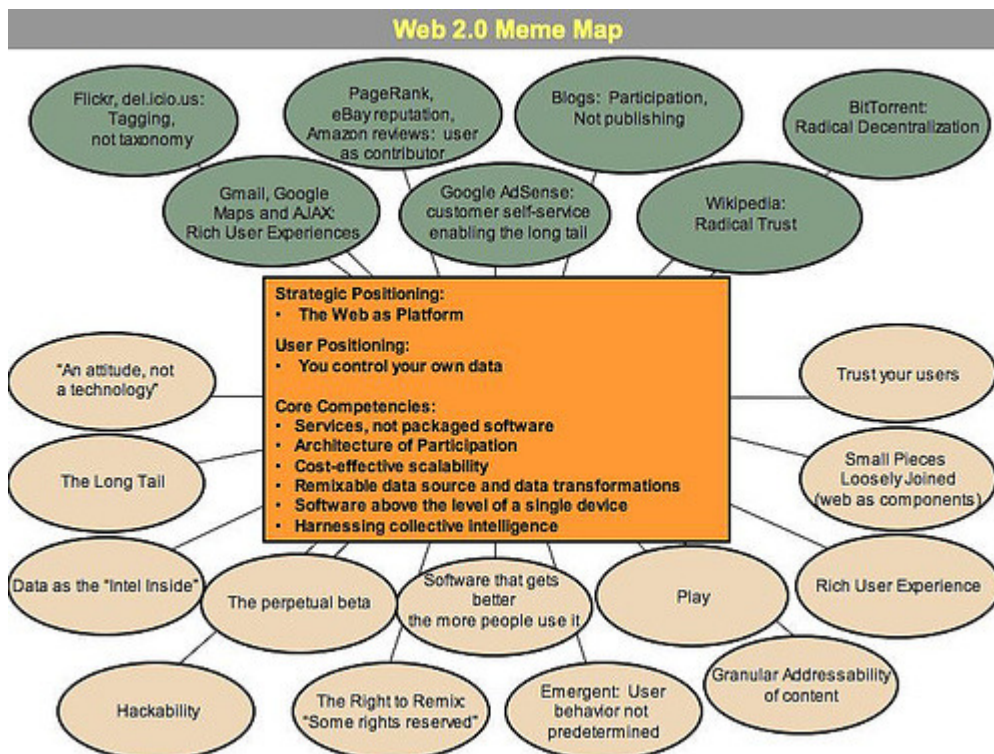
Figure 2.3 Web 2.0 Meme map (O'Reilly, 2005)

However numerous people have attempted to define Web 2.0. Tim O'Reilly after releasing his first paper describing Web 2.0 ideas attempted to come up with a more compact definition from his company's blog (O'Reilly, 2005):

"Web 2.0 is the network as platform, spanning all connected devices; Web 2.0 applications are those that make the most of the intrinsic advantages of that platform: delivering software as a continually-updated service that gets better the more people use it, consuming and remixing data from multiple sources, including individual users, while providing their own data and services in a form that allows remixing by others, creating network effects through an "architecture of participation," and going beyond the page metaphor of Web 1.0 to deliver rich user experiences."

23

Another interesting definition is from Kingsley Idehen[7] who defined Web 2.0 as a point of presence on the Web for exposing or invoking Web services and/or Syndicating or Subscribing to XML based content.

Richad MacManus[8] defined Web 2.0 as "The Web as Platform" depending on individual perspective; that is for marketers, the Web is a platform for communications, for journalists the Web is a platform for new media, for corporate people the Web is a platform for business, for geeks the Web is a platform for software development, etc.

The core principles around the Web 2.0 concept were outlined as result of the conference. These are the Web as platform, harness collective intelligence, data is the next 'Intel inside', end of software release cycle, lightweight programming models, software above the level of single device, and rich user experiences (O'Reilly, 2005). However Anderson (2007) laid down the modified Web 2.0 ideas basing on some of the above principles into a more social perspective rather than technological and a global information space perspective. These are Individual production and user generated content; harness the power of the crowd, data on epic scale, architecture of participation, network effects and openness.

Participation controls every aspect of Web 2.0. The transition to Web 2.0 was due to the emergence of platforms such as blogging, social networks, and free image and video uploading that collectively allowed easy content creation and sharing by everyone.[9]

The following subparts of this section discuss the underlying web applications and services which are the foundations of Web 2.0 concepts. In reality these are not technologies themselves, nevertheless they are built using the technologies and open standards that bear the Internet and the Web (Anderson, 2007). These are wikis, blogs,

---

[7] http://www.openlinksw.com/blog/~kidehen/index.vspx?id=373 Accessed July 2008

[8] http://www.readwriteweb.com/archives/web_20_definiti.php

[9] http://www.futureexploration.net/images/Web2_Framework_E2EF.pdf Accessed 10/08/2008

podcasting, social networking, Really Simple Syndication (RSS), mashups and tagging.

2.3.2.1 Wikis

The word Wiki originates from a Hawaiian term which means "quick" or "Super fast". As popularly known a wiki refers to a web site that anybody can edit (Long, 2006). The first wiki was launched by Howard G Cunningham whose wiki site was named as WikiWikiWeb on March 25, 1996. The most popular wiki site is Wikipedia (http://www.wikipedia.org). Other examples of wiki sites are http://www.twiki.org, and http://pbwiki.com. The main distinctive feature of any wiki site is that anyone can edit it. The underlying concept of a wiki is the fact that it acts as a collaborative tool and henceforth facilitates more effectively the production of a group work.

The figure below displays a wiki site.

Figure 2.4 A Wiki Site (Wikipedia.org)

Uses of Wiki

The most uses of wiki obtained from the survey done by Majchrzak *et al.*, (2006) are as follows;

- Wikis are used in e-learning including web design, requirement descriptions, testing, and assignments to training.
- Wiki is used in software development processes such as technical documentation, client approval, issues tracking, internal workflow, quality &

process management, software design, reference information, application maintenance and operations.

- Wiki is used in project management for creating deliverables, meeting agendas, status reports, standards and practices.
- Wikis is used for Community of Practice and user groups, and collaboration.
- Wiki is also used to provide technology support including best practices, and customer support information-sharing

Other wiki uses include tracking interesting marketing trends, collecting data, logging daily lead counts, information on partnerships, notifying users of new features, marketing materials, with some opening up their wikis to selected customers, also it is used in Research and Development (R&D) for product requirements, product information, & commercialization in which everything relating to R&D is tracked through the wiki (Majchrzak *et al.*, 2006).

2.3.2.2 Blogs

The term blog originally come from the phrase "web-log", which refers to a simple webpage containing paragraphs of opinion, information, personal diary entries, or links arranged in a chronological order with the most recent entry first in the style of an online journal (Doctorow, 2002). The process of blogging is characterised with posting and commenting blog contents done by blog visitors in which there is an exchange of views between the blog author and contributors who visit the blog and comment on blog contents in conversational manner. (Anderson, 2007). Blog entries may include video and other rich media depending on the blogging software or service that is used (Kennedy *et al.,* 2007)

Examples of commonly known blog sites are http://radar.oreilly.com/ and http://www.techrinch.com/ which are education-based blogs, http://wordpress.org/ and http://www.blogger.com/start which are software blogs, and http://technorati.com/ and http://blogsearch.google.com/ which are blog search services.

The picture below displays a sample of blog site:

Figure 2.5 A Blog Site (radar.oreilly.com)

Uses of Blogs

In education recently there are a considerable number of blogs that have been created for education purposes such as learning and teaching. For instance teachers use blogs to replace the standard class Web pages. Instructors post class times and rules, assignment notifications, suggested readings, and exercises. Aside from the ordering of material by date, students would find nothing unusual in this use of the blog. The instructor, however, finds that the use of blogging software makes this previously difficult chore much simpler.[10]

In marketing, blogging has also great advantages in business organisations. For instance blogs can be used to promote products and services which can reduce advertising and marketing costs (Haugen & Claire, 2006).

In knowledge management blogs can be used for knowledge works in the sense that blog is useful in articulating ideas, experiences, opinions through writing which lead to create new knowledge. (Klamma *et al.*, n.d.)

---

[10] http://www.pembinatrails.ca/program/technology/uses_of_blogs_in_education.htm, Retrieved on 30/06/2008

2.3.2.3 Podcasting

Podcasts are audio recording, usually in the form of talks, interview, and lectures which can be played either on a desktop computer or on MP3 devices (Anderson, 2007). Originally podcasts were called audio blogs and were the beginning efforts of adding audio streams to early blogs (Felix & Stolarz, 2006). Podcast listeners normally subscribe to RSS feeds so as to receive new information about new podcasts when they are available.

Common example of podcasting sites are: http://btpodshow.com/, and http://odeo.com/, http://connect.educause.edu/
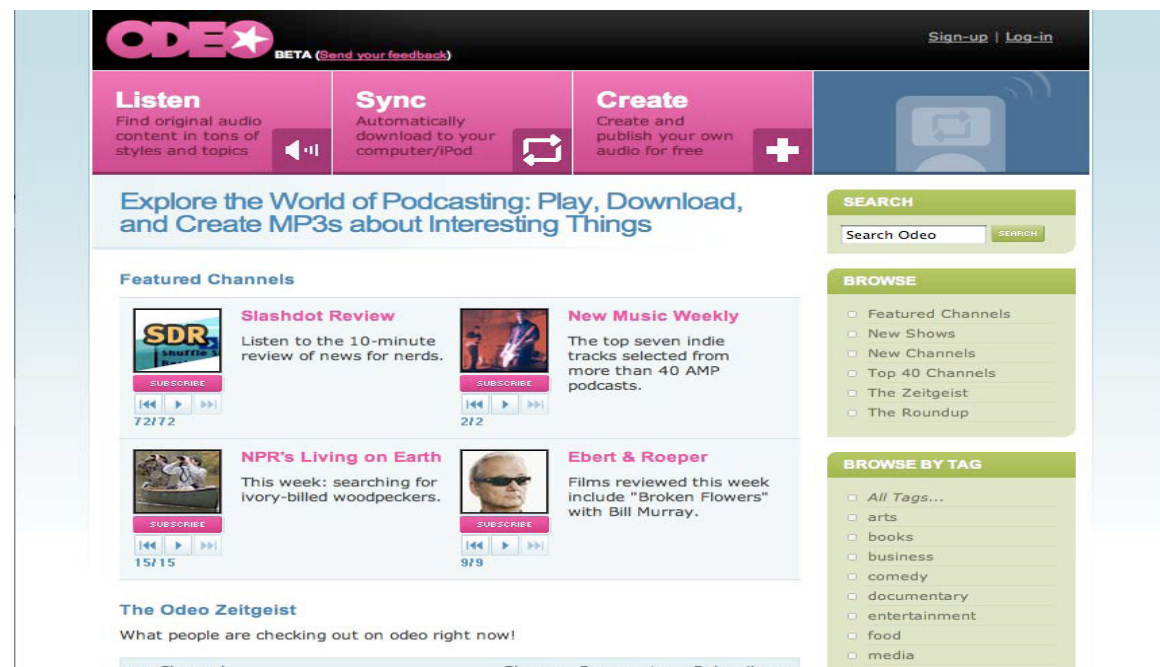
Figure 2.6 A Podcasting Site (Odeo.com)

Uses of Podcasts

Podcasting is increasingly applied in education (Brittain *et al.,* 2006). For instance podcasts are used for recording lectures in the University of Washington (Aldrich *et al.*, 2006).

Within an enterprise environment, a podcast can be used for briefings, recordings of conference calls, training, new product updates, leadership messages, and anything that

would benefit from verbal and/or video communication to the employees (Davidson, 2006).

Podcasts and video podcasts in particular can be helpful when a message needs to be delivered rapidly and consistently. Video podcasting is a recent added feature to podcasting which technically can be described as a combination of video files available for download. Each video files publisher creates a unique Really Simple Syndication (RSS) file. The main objective of RSS in this case is to describe the video and presenting the most current video content available.[11] Video podcasts can also be used when teaching a topic that involves psychomotor skills or many visuals (Moore, 2006a).

2.3.2.4 RSS

RSS (Really Simple Syndication) is a technology which has brought about a significant advance in the fundamental architecture of the web (O'Reilly, 2005). RSS is an XML format which allows users to know about the content of RSS-enabled websites, blogs, or podcasts without necessarily visiting its actual site (Anderson, 2007). The information from the site is collected within a feed (which has RSS format) and "piped" to the user in a process known as syndication.

In order to use a feed a user must have a software tool commonly known as a *feed reader* on their computer and then decide which RSS feed they want to receive by subscribing to them. A picture below represents example of one of the RSS feed aggregation blog site;

---

[11] http://ezinearticles.com/?Video-Podcasting&id=59972 Accessed on 11/08/2008

Figure 2.7 An RSS feed (http:taliessinthroughlogres.blogspot.com)
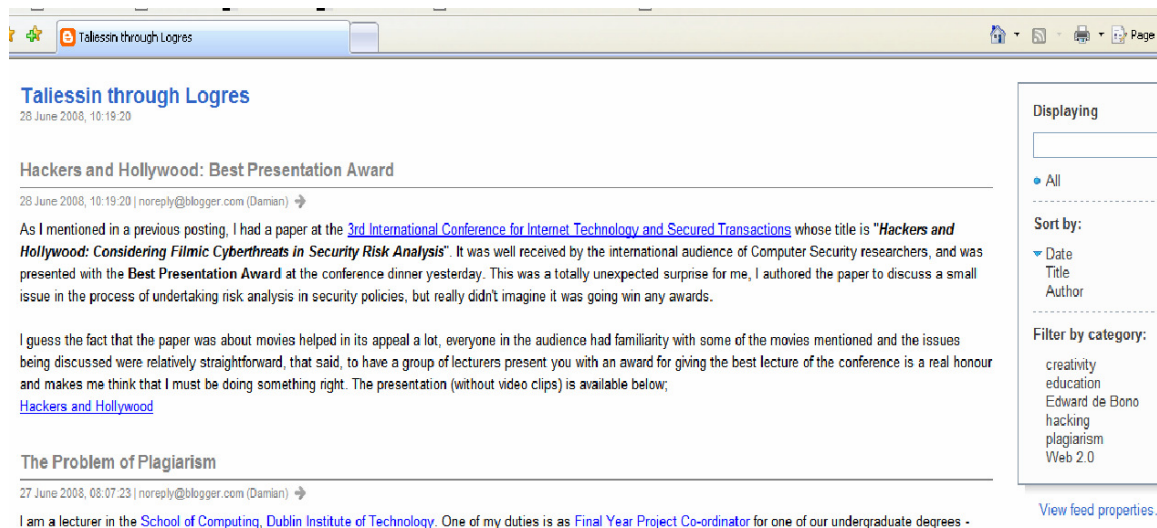
Uses of RSS

RSS is an intermediary tool which supports other Web 2.0 tools like blog and wiki, or any website. For instance, in educational blogs RSS feed can be used by educators and trainers from other blogs to alert them about the latest developments in their field of interest on a regular basis (Brandon, 2003).

RSS is a better solution than an email list subscription, as it does not require users to give out their email addresses, avoiding the potential for spammers to obtain their email details (Duffy & Bruns, 2006).

2.3.2.5 Mashups

A mashup is a term used to refer to a website or webpage that combines data and services from various sources on the Web (Murugesan, 2007). Mashups can be divided into seven categories: mapping, search, mobile, messaging, sports, shopping, and movies. More than fourty percent of mashups are mapping mashups (van der Vlist, 2006).

HousingMaps (http://www.housingmaps.com) is one of mashup application which pulls sales and rental information from the classified advertisement Web site Craigslist (http://www.craigslist. com) and displays the listings on interactive maps pulled from Google (Murugesan, 2007).

30
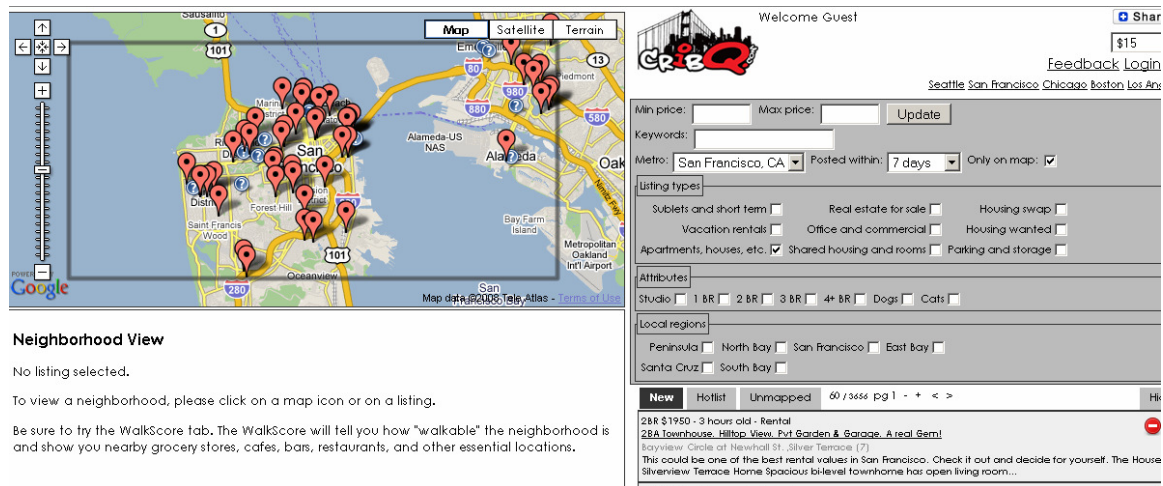
Figure 2.8 A Mashup Site (http://sfbay.cribq.com)

Uses of Mashups

Mashups have a potential uses such as enabling individuals to find a place to live as housingmaps application is used by many people for that purpose, and helping people to purchase goods locally (John & Urs, 2007).

2.3.2.6 Tagging and Social Bookmarking

Tagging is the association of particular keywords with related content (website, picture or video), such as photo tagging on photo sharing sites or link tagging on collaborative news site (Options & Latest, 2007). A tag is a keyword which describes a website, picture or video. The basic principle of tagging is that the end users have the power to create their own indices instead of experts only and the assigned tags are immediately available on the web (Voss, 2007).

'Social bookmarking' is the trend which was first motivated by the popularity of tagging sites such as del.icio.us (Anderson, 2007). Social bookmarking systems share similar features (Millen *et al.*, 2006) that allow users to create lists of 'bookmarks' or 'favourites' that are stored on a remote central server (Anderson, 2007).

Folksonomy is a term related to tagging concept which refers to the collection of tags created by an individual for personal use. And it is described as a result of tagging practice (Anderson, 2007). Social tagging was seen as a useful way to get a reliable

content classification out of a large number of people (Avram, 2006). Examples of common tagging services are: http://del.icio.us/, http://www.digg.com and http://www.librarything.com/
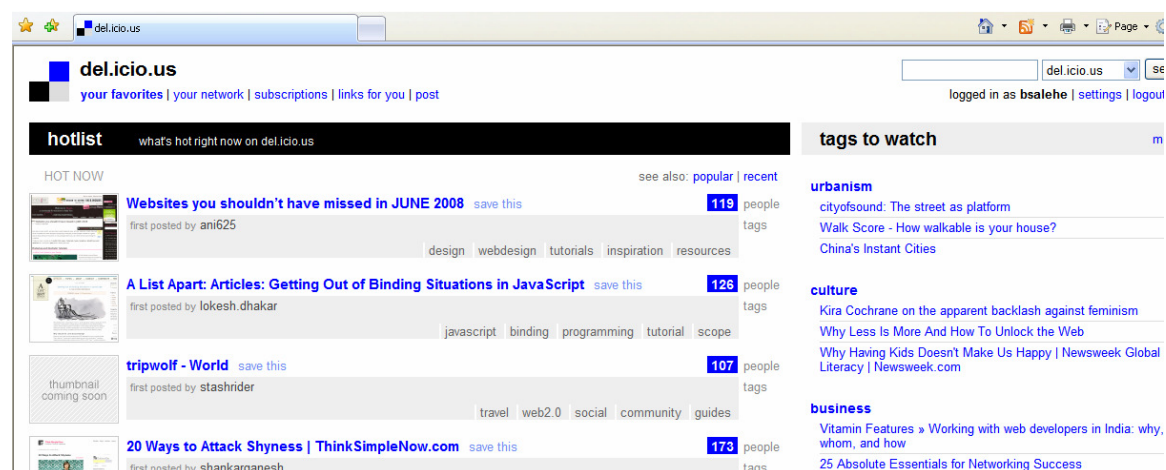
Figure 2.9 A Tagging Site (http://del.icio.us)

Uses of Tagging

Tagging has become recently a popular approach for sharing information and collaboration. Common examples of applications that apply tags are photos sharing, web pages, and email applications (Muller *et al.*, 2006)

Collaborative tagging is used in the enterprise for connecting expertise within the enterprise and can enhance communication through social networks of tags or topics (John & Seligmann, 2006).

2.3.4 Web 2.0 in Education

This section of dissertation discusses the applications of some of Web 2.0 tools in education It has now been recognised that Web 2.0 tend to complement, enhance, and add new collaborative dimensions to the classroom (Parker & Chao, 2007). Therefore the main focus of this section will be on how these tools are used in teaching and learning in higher education. As this dissertation is essentially based on examining the usefulness of the tools to enhance the knowledge sharing process then understanding their ubiquity in higher education pave new ways to think about how there could be

potential for knowledge sharing among academics in higher education and hence improving knowledge creation as well as innovation in the academic universe of discourse.

2.3.4.1 Wikis

Wikis are largely used in education for both teaching and learning. Wikis can be used in the classroom to support many learning approaches. Learning approaches that could most be supported by wikis are collaborative learning and the constructivist learning paradigms (Parker & Chao, 2007).

Collaborative learning is a learning process in which students work together in different mixed groups to support the learning of their individual members (Parker & Chao, 2007). The collaborative features of wikis may be used to support a collaborative learning environment (Schaffert *et al.,* 2006). Wikis can be used to facilitate the computer - supported collaborative learning process to enhance education and research (Augar *et al.*, 2004).

In constructivism knowledge is constructed instead of being given to students by engaging students in meaningful learning. In this case the learning process should be constructive and reflective to allow students to integrate new ideas with prior knowledge to get new knowledge and enable learning through reflection (Miers, 2004). Wikis have a significant role in students' reflective learning, and improve students' experience (Chen *et al.,* 2005).

Wikis also offer opportunities for constructive learning more extensively in an educational environment due to their low technological barriers and their flexible functionality (McMullin, 2005). Similarly Parker & Chao (2007) suggest that the most common learning paradigm that can be well supported by wikis is constructivism.

2.3.4.2 Blogs

 Blogs have a large range of potential use in higher education and research suggests that their growing popularity might help students to accomplish some of their learning activities more effectively (Duffy & Bruns, 2006). The structure of a blog facilitates the students' ability to demonstrate critical thinking, and make sophisticated use of

language and design elements. This enables students to acquire creative, critical, communicative, and collaborative skills that may be useful to them in both scholarly and professional contexts Duffy & Bruns, 2006).

Duffy & Bruns (2006) discuss the potential educational uses of blogs first in a personal academic perspective where a blog can support reflection on teaching experiences, classified descriptions of resources and methodologies, ramblings regarding professional challenges and teaching tips for other academics, and illustration of particular technology issues to other colleagues.

Blog also can support a common online presence for unit-related information such as calendars, events, assignments, and resources. Similarly they can support an online area for students to post contact details and queries relating to assignments (Duffy & Bruns, 2006)

Within a pedagogical perspective a blog can support comments based on literature readings and student responses as well as to provide a collaborative space for students to act as reviewers for course-related materials (Duffy & Bruns, 2006).

2.3.4.3 Podcasting

Podcasting is becoming a new learning paradigm in the academic environment in which material such as a course lectures can be recorded into audio and video files and delivered to subscribing users automatically (Ractham & Zhang, 2006). In University of Sydney podcasting was used to support postgraduate students in the Faculty of Economics and Business (Clark, *et al.,* 2007).

Podcasting has been used in Duke University primarily for disseminating recorded lectures and discussions (Flanagan & Calandra, 2005). Video podcast can also be used when teaching a topic that involves psychomotor skills or many visuals (Moore 2006a)

2.3.4.4 RSS

(Duffy & Bruns (2006) suggest a significant number of different ways in which RSS feeds can be useful in an educational context that was specified by Harrsch (2003). For

instance students and lecturers may get an updates from wikis, blogs and research sites that are relevant to their course topics.

Also Duffy & Bruns (2006) state that RSS feed allows teachers to obtain any updates of new content added to students' blogs without visiting their sites, also students can subscribe to the feeds of their friends, peers and teachers. Furthermore lecturers and students can set up RSS feeds for assignment topics and areas of research interests.

2.3.4.5 Mashups

Most of the research that is reported appears to suggest that mashups are not being widely used in education. And there are little findings regarding application of mashups in education although they seem to have potential uses like other Web 2.0 tools. For instance it has been indicated that in cartographic higher education mashups are built to help the mapmaking process[12].

Moreover there are also suggestions that mashups applications like Google Earth might have potential uses in education. For example they can provide educators with a means to assess and reinforce the students' visual literacy. Also it can help them develop a context for spatial and cultural differences around the world.[13]

2.3.5 Conclusion

In general the importance and usefulness of Web 2.0 tools, services and applications to the community of people using of that technology relies on the fact that the technology is meaningful, essential, applicable and perpetual.

Chris Hughes the co-founder of the popular social networking site, FaceBook in commenting on importance of community to the existence of social networking applications was quoted saying[14]:

---

[12] http://lazarus.elte.hu/puff/icc-2007/4-05-1-zentai.doc, Retrieved on 05/07/2008

[13] http://net.educause.edu/ir/library/pdf/ELI7019.pdf, Accessed on 05/07/2008.

[14] http://www.msnbc.msn.com/id/25560815/page/3/, accessed on 07/07/2008

"You can have the best technology in the world, but if you don't have a community who wants to use it and who are excited about it, then it has no purpose."

Therefore in applying these technologies in the higher education arena it is very important to ensure that people around the academic environment including both lecturers and students are aware of them and are enthusiastic about the use of them.

The next section will be focusing on knowledge management in which several concepts of knowledge management will be discussed. And we will see how Web 2.0 technologies have potential to this area and some possibilities that exist in the application of these tools to manage knowledge around organisations particularly the higher education environment.

2.4 Knowledge Management

2.4.1 Introduction

This section of chapter two discusses various concepts relating to knowledge management. The basis of this dissertation is to investigate the usefulness of the underlying technologies of Web 2.0 in sharing of teaching know-how within the context of higher education. Therefore discussing the core issues of knowledge management is of significant importance to explore the key ideas of this dissertation.

Ideally knowledge management encompasses all processes that identify and locate intellectual assets, create new knowledge for competitive advantage, organising, distributing, and maintaining knowledge within the organisation as well as intra and extra – organisation sharing of best practices and technology that enhances all of the above.

According to research findings (Rao, 2003) there are significant benefits from knowledge management initiatives that are undertaken within companies. These range from better decisions, more flexibility, increased profits, reduced workloads, improved

productivity, new business opportunities, reduced costs, best practice exchange, higher market shares, higher stocks prices, improved motivation and retention of employees.

In this section several issues regarding knowledge management will be discussed. The discussion will centre on the history of knowledge management, followed by an understanding of knowledge processes, then looking at knowledge types which will give us views on different types of knowledge in general and main type that this dissertation focuses. Community of practice (CoP) will then be discussed since this project examines how useful the Web 2.0 tools can be to enhance collaboration in higher education therefore it is important to know about CoP.Afterward the scope of knowledge management in higher education will be explored and how Web 2.0 tools have potential to enhance knowledge management activities.

2.4.2 History of Knowledge Management

The historical perspective of current knowledge management shows that it is an old paradigm where knowledge and reasoning had a philosophical grasp from both Western and Eastern philosophers (Wiig, 2000). Much of the earlier efforts were directed toward theoretical and practical understanding of what knowledge is about.

Understanding the historic roots of knowledge management and other aspects of knowledge is essential part while people are trying to develop more skills in practising knowledge management. These efforts must be built with a close look at developments in technology and people-centric areas like cognitive sciences (Wiig, 2000). That is why this research endeavours to investigate the next generation of Web which is Web 2.0 to see its potentiality to the knowledge management practice in the context of higher education.

The milestone of practical knowledge management began from a conference held in Boston in 1993 which was devoted to knowledge management (Prusak, 2001). In this conference attendees endeavoured to find the meaning of knowledge but were not able to come with an exact meaning of knowledge.

However the management theorists have also helped with great contributions to the evolution of knowledge management. For instance Leonardo Barton produced a case study of *Chaparral Steel* which is a company that had an effective knowledge management strategy since mid-1970s (Leonard-Barton, 1995).

Organisations started recognising the importance of organisational knowledge after their concerns in the increasing of amount of available knowledge and increasingly complex products and processes which led to look at computer technology as part of a solution. For example in 1978 an early hypertext/groupware application capable of interfacing with other applications and systems was introduced as well as a Knowledge Management System (KMS) which was an open distributed hypermedia tool (Barclay & Murray, 2000).

The 1980s also saw the development of systems for managing knowledge. The systems mainly were empowered by the work of artificial intelligence (AI) and expert systems that gave rise to the concepts such as "knowledge acquisition", "knowledge engineering", "knowledge-based systems and computer-based ontologies" (Barclay & Murray, 2000).

From 1989 term 'knowledge management' started appearing in articles in journals as the phrase "knowledge management" got more serious attention and had a place within dictionaries. Similarly a consortium of U.S companies started initiatives for Managing Knowledge Assets to provide technological bases for managing knowledge and the first books on organisational learning and knowledge management such as Senge's *The Fifth Discipline* and Sakaiya's *The Knowledge Value Revolution* were published (Barclay & Murray, 2000).

The culmination of the published books was the popular and widely read book by Japanese business experts (and Knowledge Management gurus) Ikujiro Nonaka and Hirotaka Takeuchi *The Knowledge Creating Company: How Japanese Companies Create the Dynamics of Innovation* (1995).

The evolution of Internet and Intranet technology and the advancement of Web technologies brought about significance changes in the ways of managing knowledge.

As will be discussed later a number of knowledge management initiatives which introduced these technologies were started.

2.4.3 Knowledge Processes

Understanding knowledge processes is the key thing to know, apply and practicing knowledge management. Any knowledge management strategy in one way or another must incorporate at least one knowledge process. Therefore this section endeavours to discuss various knowledge processes. But before diving into this discussion the first thing to understand (which calls for attention in many disciplines, and had great debates among epistemologists) is knowledge.

There is no clear cut definition of knowledge, however many people have attempted to define knowledge. Nonaka and Takeuchi define knowledge in the organisational perspective as a basic unit of analysis to explain firm behaviour (Nonaka & Takeuchi, 1995). According to Alavi & Leidner (1999) knowledge is a justified personal belief that increases an individual's capacity to take effective action. Action can be described in terms of physical skills and competencies, cognitive/intellectual activity or both.

Davenport also states that knowledge is a fluid mix of relevant experience, values, contextual information, and expert insights that provide a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers (Davenport & Prusak, 2000a, 200b). In this research the knowledge that is mainly concerned with is related to experience, personal belief and values which from Nonaka's point of view is hardly to be captured.

As far as knowledge management is concerned there are different knowledge processes. In the organisational context by knowledge processes we mean all processes within an appropriate organisational culture that capture, organise, target, transfer and maintain knowledge. Similarly knowledge creation, knowledge sharing, and knowledge utilisation are essential processes in knowledge management.

The diagram below shows of knowledge management processes as described by (Bouthillier & Shearer, 2002).
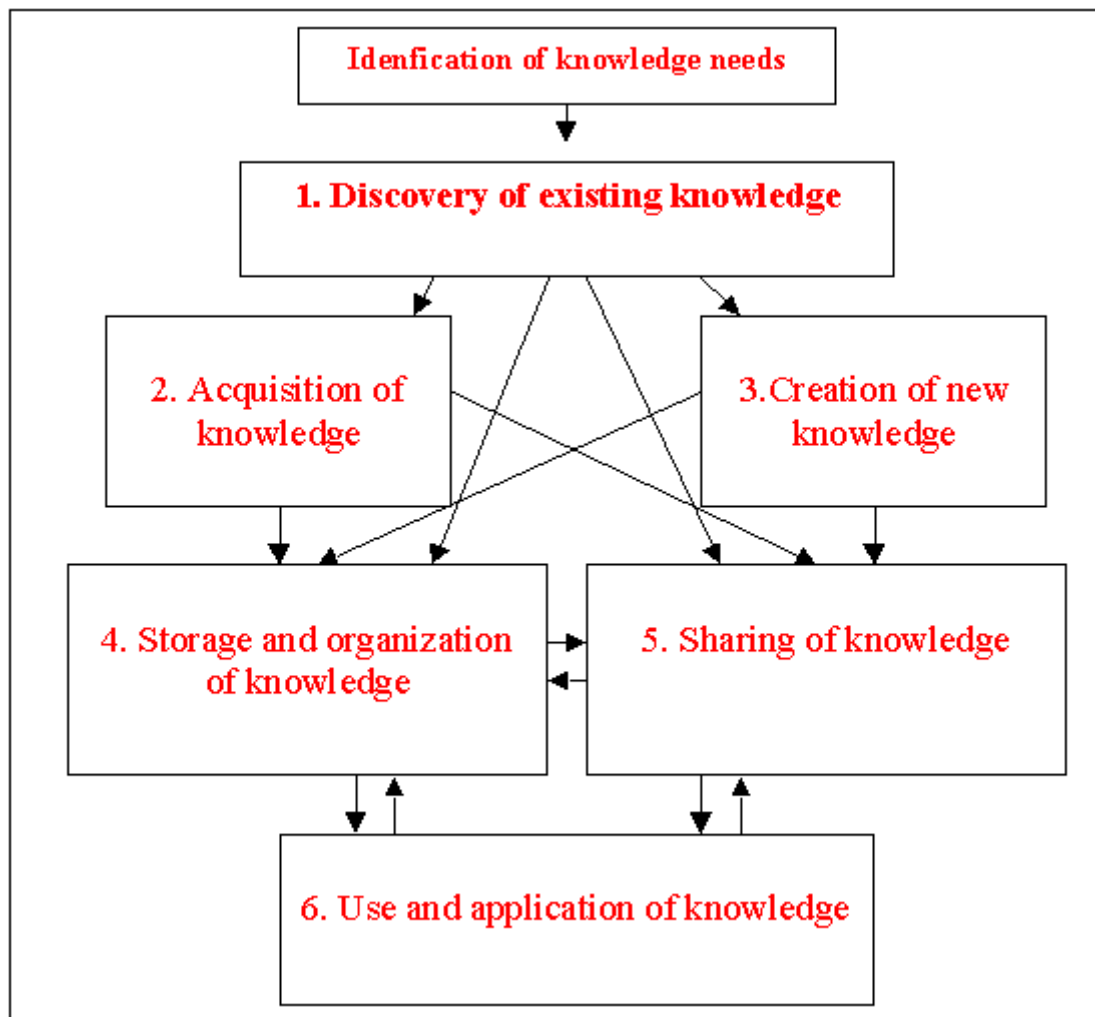
Figure 2.10 Conceptual framework of Knowledge Management Process (Bouthillier & Shearer 2002)

Knowledge discovery – This involves locating or identifying the existing or internal knowledge within an organisation. In this case the organisation may be unaware of its own knowledge assets especially if the organisation is geographically dispersed.

Knowledge acquisition – This involves bringing knowledge from outside to the organisation.

Knowledge creation – Knowledge can be created by integrating the existing internal knowledge, and experiences, or by analysing existing information. Some have argued that in this stage technology is important since it can facilitate the creation of new

knowledge through the synthesis of data and information that have been captured from different sources (Oluic-Vukovic, 2001).

Knowledge organisation and storage – In this case knowledge is gathered and stored in a convenient way and appropriate place or repository. The objective is to make it useful for present and future use.

Knowledge sharing – Knowledge after being gathered and stored must be shared and accessed by people. This involves the transfer of knowledge from one (or more) to another person(s). It is important for organisations to implement different methods that support sharing of different types of knowledge (Snowden, 1999). The focus of most knowledge management is on the sharing of knowledge which seems to be crucial when one employee leaves an organisation and other comes in. The process of knowledge sharing occurs naturally in a mutually dependent community.

Knowledge use or application (knowledge utilisation) – The knowledge management practice comes to an end when stored and shared knowledge is utilised for the organisational benefit. The knowledge management does not have any value if knowledge created and stored is not utilised to its potential. More knowledge is created as knowledge is applied and utilised.[15]

The key knowledge process that is the focus of this research is knowledge sharing in undergraduate computer science education. Moreover the project attempted to examine how this process can be furthered facilitated using Web 2.0 technologies.

2.4.4 Knowledge Types

Knowledge can be categorised into several types. From the literature it has been observed that authors differ in their views in types or categories of knowledge. However from the Nonaka & Takeuchi (1995) point of view there are two categories of knowledge.

Explicit Knowledge

The first type is explicit knowledge, which can be expressed in words and numbers and shared in the form of data, scientific formulae, product specifications, manuals,

---

[15] http://kmlearning.blogspot.com/2007/07/knowledge-management-process.html, Accessed on 10/07/2008

universal principles, etc. This kind of knowledge can be transmitted across individuals formally and systematically. This has been the dominant form of knowledge in the West. Nevertheless the Japanese see this form as just the tip of the iceberg. They view knowledge as more tacit, something not easily visible and expressible (Nonaka & Takeuchi, 1995).

Tacit Knowledge

The second type is tacit knowledge which is highly personal and hard to formalise, making it difficult to communicate or share with others. Typical tacit knowledge examples are subjective insights, personal belief, intuitions and hunches fall into this category of knowledge. Furthermore, tacit knowledge is deeply rooted in an individual's action and experience.

In more precise ways tacit knowledge itself can be put into two dimensions. The first is the "technical" dimension, which encompasses the kind of informal and hard-to-pin-down skills or crafts often captured in the term "know-how". Master craftsmen or three-star chefs, for example, develop a wealth of expertise at their fingertips, after years of experience. But they often have difficulty articulating the technical or scientific principles behind what they know. Highly subjective and personal insights, intuitions, hunches and inspirations derived from bodily experience fall into this dimension (Nonaka & Takeuchi, 1995).

Tacit knowledge also contains an important "cognitive" dimension. It consists of beliefs, perceptions, ideals, values, emotions and mental models so ingrained in us that we take them for granted. Though they cannot be articulated very easily, this dimension of tacit knowledge shapes the way we perceive the world around us (Nonaka & Takeuchi, 1995).

Capturing and sharing of tacit knowledge as discussed in the literature create hurdle to most of the knowledge management initiatives. Several techniques must be employed as well as social interaction is required to create an effective environment for tacit knowledge to be captured and shared. Social interaction among employees professionals groups are necessary for this knowledge to be captured and shared. Communities of practice (as will be discussed in the next section) are crucial to ensure that tacit knowledge is captured and shared well.

Essentially the tacit knowledge that is mainly focused in this research is an individual's teaching experience, insights, ideals and ideas in undergraduate computer science education. In this case a Web 2.0 framework will be designed and evaluated for this purpose (in the framework design chapter). Furthermore explicit knowledge which concerns teaching is also the focus of this research where by Web 2.0 seems also to be suitable for sharing knowledge.

2.4.5 Knowledge Market and Community

The knowledge market is the means for delivering knowledge resources. It has been described as a mechanism for enabling, supporting, and facilitating the mobilisation, sharing, or exchange of knowledge among providers and consumers (Davenport & Prusak, 1998; Stewart, 1997).

This transactional approach assumes that knowledge-based products or services are available for distribution, that someone wants to use them, and that the primary focus of the market is to connect the two. Typical example of knowledge market can be found in the software industry in which knowledge embedded in code is sold as software to people who use that as a service depending on their needs (Davenport & Prusak, 2000a, 200b).

The knowledge market is becoming the essence of the current global economy in which companies who wish to conduct a successful business require quality, value, service, innovation, and speed to market (Davenport & Prusak, 2000a, 200b). And these are driving factors for this economy which does not depend primarily on land, labour, and capital as a classic economy does. This kind of economy is now called a knowledge economy and requires people who are smart, adaptive, intelligent, skilled, and experienced as well as the ability to work as a team or collaboration (Conklin, 1996) to achieve the above factors. This type of collaboration form a new society of knowledge workers which is known as the knowledge society (knowledge community) (Drucker, 1994) and it is a complimentary factor for the success of knowledge economy.

But working collaboratively and gaining competitive advantage in the knowledge market needs a built-in infrastructure that will be a supportive factor for companies and organisations to succeed in a knowledge economy. The advancement of Internet and Web technologies will enhance even more this infrastructure. And Web 2.0 in particular will enormously support and enhance this infrastructure.

2.4.6 Knowledge Cycle

The knowledge cycle is the process, for knowledge finding/creation, organisation, sharing, utilisation (use)/and reuse with continuous improvements that the professionals are sharing. The scope of the knowledge cycle is the context boundary of the users. In a business context, it is linked to the complexity and evolving nature of the marketplace (Huang, 1999). Reuse is an important and effective way of encouraging innovation within the organisation.

In knowledge creation the knowledge is gained through publications, meetings and conferences, project experiences, research and industry expertise. Knowledge organisations focus on filtering and cataloguing knowledge and creating links so that other people can gain access to it. Using technology such as the Internet and other techniques such as conferences and journals, knowledge is then shared widely to other people. The final step of the knowledge cycle is knowledge utilisation/reuse where knowledge is applied and reapplied to solve real world issues such as designing better software, and improved project management. In this case new insights or knowledge can be captured as part of a lesson learned for another use as knowledge cycle begins again.

The diagram below demonstrates the knowledge cycle:
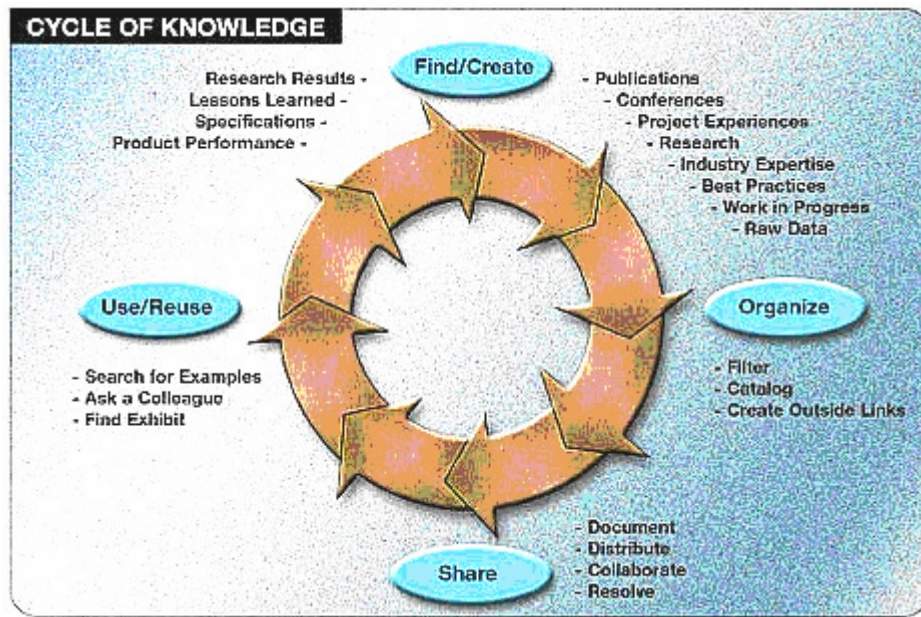
Figure 2.11 Knowledge Cycle (Public Roads[16]**)**

2.4.7 Communities of Practice (CoP)

A Community of Practice is a group of people who work together in the same area of interests within the business organisation (Rao, 2003). Similarly Brawn & Duguid (1998) defined communities-of-practice in term of "shared understanding" by saying: *Through practice, a community-of-practice develops a shared understanding of what it does, of how to do it, and how it relates to other communities and their practices – in all, a "world view".* However this concept was initially introduced by Lave & Wenger (1991) who insisted that the learning process involve the participation in the community-of-practice and is gradually increasing upon the individual's engagement in the community to 'full participation'.

The focus of community-of-practice is to enhance knowledge sharing (Walsham 2001), and Rao (2003) suggests that successful knowledge management is built upon a community of practice. According to Walsham (2001) a community-of-practice can be performed in two ways; the first is by face-to-face meeting in which interaction among individuals within the community can be in one-to-one basis or in one-to-many, and the second way is through technology-enhanced environment using technologies.

---

[16] http://www.tfhrc.gov/pubrds/novdec99/km.htm, accessed on 10/07/2008

However the combination of both seems to be more elegant and could make knowledge management initiative more effective (Walsham, 2001).

Many companies already have these formal communities to facilitate their daily business activities. For instance Siemens in its Medical Solution department has a global knowledge community called *KnowledgeSharing@Med* which provides community support in both computer based manner using an integrated portal, expert map, and a hotline (Rao, 2003).

Lave (1992) pointed out that the process of learning is well accomplished through participation of communities of practice. The underlying infrastructure of Web 2.0 might well suite to enhance a community of practice. This is because one of the ideas behind Web 2.0 concept is architecture of participation and openness (Anderson, 2007) which complies with a community of practice that require willingness, openness and readiness to participate in the community. Thus the major function of Web 2.0 is to identify these communities and enhance interactive communication and collaboration between and within these communities as might be supported by social software applications (Yang *et al.,* 2007).

This research endeavours to build a Web 2.0-supported environment that will enhance community-of-practice-like activities within the faculty of computer science in undergraduate education in an attempt to improve knowledge sharing and collaboration in academic environment.

2.4.8 Knowledge Management in Higher Education

Many institutions and organisations in some way or another store, access, and transfer knowledge intrinsically. The effective use of this knowledge within the organisations could add value to the services they deliver (Milam Jr, 2001).

Higher education organisations like other institutions can apply knowledge management practices in every part to achieve their objectives (Kidwell *et al.,* 2000).

Higher education institutions are in the knowledge business due to their involvement in knowledge creation, dissemination and learning[17].

It is argued that if knowledge management practice is done well and effectively in higher education, it will improve the effectiveness of the decision making process, reduce product development cycle time (for example curriculum development and research), improve academic and administrative services and also reduce cost(Kidwell *et al.,* 2000). Nevertheless from an organisational culture perspective, most higher education institutions are in transition mode to change their culture toward the one that support knowledge management (Kidwell *et al.,* 2000).

There are two types knowledge involved in the higher education arena according to (Education, 2005): an academic knowledge and organisational knowledge. Academic knowledge primarily keeps universities and colleges functioning and is the core of their existence. Organisational knowledge concerns knowledge of overall business within an institution, institution's strength and weaknesses, the market it serves and the factor critical to organisational success (Coukos-Semmel, 2003).

Typical knowledge processes that are inherently found in higher education and also are within the range of knowledge management perspectives are creating, capturing, storing, disseminating, and sharing of knowledge (William & Amin, 2006; Reid, 2000). However the general trend is that, most of these are done in unidirectional manner; that is from lecturers to students (William & Amin, 2006). Similarly knowledge inherently is managed in universities through teachers and researchers who create and disseminate knowledge, or through sponsored libraries that store and codify knowledge (Reid, 2000). Furthermore knowledge creation in universities can be done through the collection of data and information that are generally available such as student records, personal information, financial data, course evaluation, library catalogues, and data found in websites (Hijazi & Kelly, 2003).

Knowledge sharing is also another example of knowledge management that are done in higher education. This can exclusively be found in the form of team working for

---

[17] https://dspace.jaist.ac.jp/dspace/bitstream/10119/4115/1/15.pdf. Accessed on 08/08/2008.

instance in large scientific research projects (Rowley, 2000).But due to the shifting of the global economy toward knowledge economy as discussed earlier universities find themselves in competitive environment (Reid, 2000) in which they require to undertake formal rather than typical inherently knowledge management practices. However in this case the most challenging thing that must be addressed and overcome so as to be able to adopt knowledge management strategy in universities is the absence of sustainable knowledge management culture. Therefore this leaves cultural practices to be considered (Reid, 2000) before carrying out knowledge management practices in the context of higher education. For instance rewards are a key element of any culture, and in higher education the embedded and international reward structure places a high value on evidence of individual achievement in research and scholarship (Rowley, 2000).

In general academia can largely benefit from knowledge management applications though it is not widely adopted in higher education institutions. And there is great possibility that these institutions can increase their social and cognitive skills by applying knowledge management (Hijazi & Kelly, 2003).

Furthermore the literature shows that there is a viable environment for knowledge management to be practiced in higher education. Some of common knowledge activities are those that support for instance knowledge sharing and knowledge creation. The focus of this research was to establish an environment that could facilitate a knowledge sharing mechanism in computer science higher education by using Web 2.0 technologies. In the next section the discussion on how knowledge management activities could be facilitated using some Web 2.0 tools will be presented.

2.4.9 Web 2.0 in Knowledge Management

Knowledge management is gradually embracing new technological shift of the Web which is Web 2.0. From literature the Web 2.0 tools seem to have potential for enhancing knowledge management activities. Knowledge management encompasses all activities that aim at creating, transferring, storing, and reusing knowledge. Web 2.0 tools support knowledge acquisition, transfer, storage, and application (Ma & Harmon, 2006). In the organisational perspective when users start to collaborate and share using

Web 2.0 tools, the underlying approaches to knowledge management (Caldwell & Linden, 2006) start to evolve (Avram, 2006)

It has been said that the interesting thing about Web 2.0 in relation to knowledge management programmes is that it reflects a wider interest in harnessing the individual expertise of users (Tredinnick, 2006). A number of Web 2.0 tools can be applied to support knowledge management activities. In this section the discussion will be done to explore various Web 2.0 tools and the way they are applied to support different types of knowledge, and the knowledge management processes.

2.4.9.1 Wiki and Knowledge Management

In the knowledge management context a wiki can be defined as a knowledge repository where users are encouraged to add new documents or working on the existing ones (Pfaff & Hasan, 2006). The arrangement of the content that is produced using a wiki page does not follow a particular order as in blog or discussion forum which makes wiki a highly flexible knowledge management space (Duffy & Bruns, 2006). Wiki are used within learning organisations that are seeking the capability to co-create a knowledge repository in which all users are motivated and empowered to take responsibility of their own knowledge management processes (Hasan *et al.*, n.d.). Wikis are extremely well functioning as collaborative knowledge repositories (Fichter 2005a; Fichter 2005b; Frumkin 2005; Tonkin 2005; Wagner 2004; Wagner & Bolloju 2005) in which they can be utilised for instance in library as knowledge base for reference librarians (Kille, 2006).

By developing a knowledge repository for an organisation, wikis can help the organisation by improving collaboration and knowledge reuse (Majchrzak *et al.*, 2006). This signifies the fact that wiki systems are becoming a more popular tool for knowledge management and plenty of knowledge is available in systems such as Wikipedia (Schaffert, 2006) for reuse. Furthermore wikis are used in project management for instance for tracking a project, brainstorming, and the exchange of ideas and coordination activities. Similarly it is used in personal knowledge management to collect and elaborate personal ideas (Schaffert, 2006).

A Wiki is categorised in the form of conversational knowledge management systems called groupware (Wagner & Bolloju, 2005). According to Wagner conversational knowledge management provide benefits to the number of stages involving knowledge management processes from knowledge creation to knowledge use and refinement (Wagner & Bolloju, 2005). Wikis as groupware have the ability to support collaboration between people at different times and locations due its web based nature (Kille, 2006). As a conversational technology wikis are most efficient and helpful when used for ad hoc problems with decentralised knowledge sources (Wagner, 2004).

Moreover wikis encourage incremental knowledge creation, in the sense that after the page is created its content can be in an incomplete state while other collaborators are still editing and adding information to that particular page (Kille, 2006). Wikis also "create joint ownership of the work product" (Wagner, 2004) where everyone can share knowledge freely (Kille, 2006). Wikis also are good for collaboration and sharing content, such as codifying best practices and writing documentation (Fichter, 2005a).

Looking at knowledge types, wikis may be providing a more proper knowledge management facility and environment for capturing tacit knowledge (Hasan & Pfaff, 2006) and explicit knowledge as well. A typical example of this is the potential uses of a wiki in a library service where reference librarians can use wikis to help them recording explicit knowledge about particular sources as well as capturing internalised tacit knowledge that can be organised, managed and reused (Gandhi, 2004).

When wikis are working jointly with complimentary technologies such as RSS they become an even more influential knowledge management tool (Kille, 2006). For example wikis can use RSS to push recent changes or additions to people who subscribe to a wiki's RSS feed (Kille, 2006).

In general wikis within the knowledge management field have significant benefits, and in particular as a knowledge management tool they have a tremendous value to many types of organisations (Kille, 2006) hence to educational organisation as well.

2.4.9.2 Blog and Knowledge Management

Blogs are also considered as among conversational knowledge management technologies (Wagner & Bolloju, 2005). Furthermore weblogs are prevalently supporting the knowledge management concepts of collaboration, best practices, and knowledge sharing (Ojala, 2004). The fundamental relevance of blogs to the knowledge management practice is the fact that they can be useful to knowledge managers in overcoming the hurdle of employees sharing their knowledge (Ojala, 2004). Ojala continued to say that by providing the case study of the Rolls Royce scientist who needed to share his knowledge of 30 years working in a single day. Rationally Ojala argues that, by using an incremental writing to blogs this huge amount of tacit knowledge of this scientist could be well captured, shared and utilised widely in the organisation.

As far as knowledge management is concerned Angeles (2003) have referred to the notion of blogging as k-blogging. According to him this is a type of knowledge logging whereby knowledge bloggers depend on librarians to provide a taxonomy to categorise the blog entries that could be used by them. In this case he said there is potential knowledge capturing and knowledge sharing between the two sides that will have a positive impact to the organisation (Angeles, 2003).

Blogs are the essence of peer-to-peer communication and are helpful in knowledge transfer and knowledge sharing (Ojala, 2004). In general organisations should be incorporating blogs while thinking about knowledge management, sharing, and dissemination programs in them (Ojala, 2004). In business intelligence, blog reading seem to be an excellent way of collecting information on markets, competitors and latest innovation, and also locating experts both inside and outside of an organisation (Avram, 2006). Moreover bloggers use blogs for capturing their own opinions and those of other people during research, project development or in any regular work (Avram, 2006). The tendency of bloggers of reading each other's posts across several blogs may enhance the creation of common social networks of the same interests which in turn may necessitate knowledge transformation across these networks which could lead to knowledge reuse and innovation (Avram, 2006).

2.4.9.3 Tagging and Knowledge Management

Corporate organizations are starting to explore the potential of social tagging tools in their concept of knowledge management. For example IBM is examining social bookmarking through their intranet-based *DogEar* tool (Millen *et al.*, 2006).

The identifying and mapping of knowledge resources is one of the activities of knowledge management. Tagging is used to find expertise in an organisation. For instance a group at Avaya tried to induce expertise based on a persons' tagging behaviour. They built a tool called *Hermes* that would help them find experts quickly.[18] In a similar way collaborative tagging helps in knowledge discovery in the sense that users of this service might discover resources, other users' collection, or tags, he or she might interested in (Macgregor & McCulloch, 2006).

2.4.9.4 Podcasting Knowledge management

Podcasting facilitates the compilation, valuation, and sharing of large amounts of media objects across the network by millions of users (Kulathuramaiyer, 2007). Podcasting in combination with RSS facilitate the sharing of tacit knowledge such as teaching experiences and insight (Duffy & Bruns, 2006). Podcasting may help to instantly disseminate knowledge in an academic perspective when lecturers use them to record their lectures (Dale, 2007).

In the organisational knowledge creation perspective podcasting may help to transfer tacit to tacit knowledge (socialisation). For instance in Cisco Systems they have created a video-on-demand library of training and knowledge content that engineers can easily access.[19]

2.4.9.5 Social Networking and Knowledge management

Social networks are circles in which people interact and connect to other people. They surpass strict delineation between personal and business, and tend to go beyond organisational boundaries and hierarchies (Avram, 2006). The first online social networks were launched in 2002 when the term was first used to describe the

---

[18]http://controlledagility.typepad.com/weblog/2006/06/there_was_an_in.html. Retrieved on 21/07/2008.

[19] http://cdgroup.blogs.com/design_channel/2005/10/podcasting_for_.html. Retrieved on 21/07/2008

mechanisms of virtual communities, and gained popularity in 2003 with the arrival of websites such as Friendster (www.friendster.com), TheHoosierWeb (www.thehoosierweb.com), and Linkedin (www.linkedin.com) (Avram, 2006).

As far as knowledge management is concerned social networks can provide the necessary environment needed to make knowledge sharing possible, valuable, efficient and effective (Pollard, 2004). Furthermore browsing social network sites may lead to the acquisition of new customers, employees or consultants. It is mainly focused on discovering the needs, expertise and offers of other people and indirectly of other organisations (Avram, 2006).

2.4.10 Knowledge Management Using Web 2.0 in Education

This section discusses how knowledge management is practiced in higher education using Web 2.0 tools. It has been suggested that Web 2.0 tools provide opportunities for effective knowledge generation, knowledge sharing, collaboration, learning, and collective decision-making within an education context due to their ease-of-use, portability, rapid development and deployment time (Saeed & Yang, 2008).In this regard different Web 2.0 tools will be scrutinised to see which aspects of knowledge management are being applied in academic environments.

Blogs from the knowledge management perspective can be used in education for faculty development to share research and pedagogy, facilitate pee-to-peer learning, publish research insights, and teaching innovation, and create community of practice (Moore, 2006b).

Podcasting in combination with RSS feeds facilitate sharing of tacit knowledge such as teaching experiences and insight (Duffy & Bruns, 2006) as well as voice conference presentations (Ractham & Zhang, 2006). Podcasting may help to instantly disseminate knowledge from an academic perspective when lecturer may record his/her lectures (Dale, 2007).

Most wiki tools have the capability of supporting several aspects of knowledge management for teaching and learning such as group creation, and revision of web pages; storage and retrieval of related documents, images, and presentations and their searching; management of changes to these documents; and online discussion (Raman *et al.,* 2005).Wikis can support collaborative knowledge creation within an academic environment for supporting teaching and learning activities (Fuchs-Kittowski & Köhler, 2002), and as a knowledge base for reference librarians (Kille, 2006). Wiki technology has been used to implement knowledge management system for supporting teaching and learning for collaborative knowledge creation and sharing (Raman *et al.,* 2005).

Social bookmarking was used in the Faculty of ICT in Swinborne University to make a repository of Web programming resources for easy access to students and lecturers as well as aiming at knowledge generation and sharing during the teaching of a Web programming course, and creation of a virtual community (Saeed &Yang, 2008). In this case lecturers were frequently posting resources and students were engaged by maintaining their individual accounts in *Del.icio.us*.
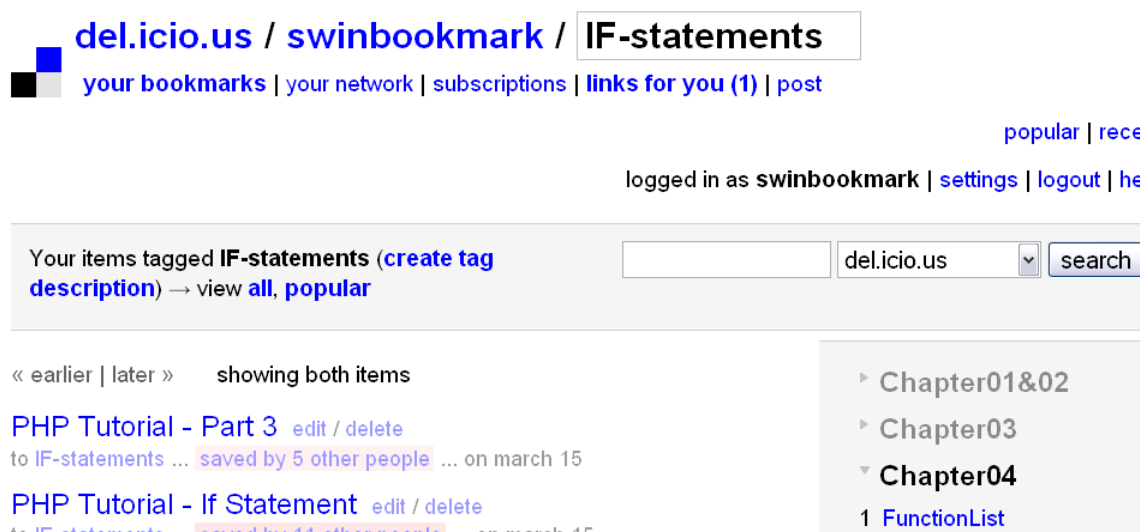
Figure 2.12 Social Bookmarking for collaborative knowledge building in teaching (Saeed & Yang, 2008)

2.4.11 Conclusion

Generally Web 2.0 technologies have potential to help the managing knowledge in a technology driven way, but the main challenge is getting people to actively participate

in community and to share knowledge (Efimova, 2004). Therefore higher education cannot benefit from these tools unless lecturers are willing to participate in the community and share their teaching knowledge.

2.5 CONCLUSION

The purpose of this chapter was to undertake an extensive literature review regarding three different areas contained in this research. These were education and specifically higher education, Web 2.0 as the technology under investigation in respect to higher education, and knowledge management aspects in which significant emphasis was put on the ways they are carried out in higher education using Web 2.0 technologies.

In the education section an extensive discussion was done looking at different issues related to education particularly higher education. In this case discussion about history of education in both Ireland/Europe and Tanzania/Africa was done. The main purpose was to investigate different changing scenarios that had a great impact on the general development of higher education. Discussion on teaching and learning was followed where crucial aspects related to teaching and learning were examined. In this case important theories of teaching and learning were discussed. It is clearly that some of these theories could be greatly enhanced using Web 2.0 technologies. For instance constructivism which requires students (learners) and teachers to work in a peer-to-peer manner to build students' knowledge from their pre-existing knowledge could be largely supported by Web 2.0 innovative services (Fumero, 2006a, 2006b) such as wikis and blogs. Students could work together in a virtual collaborative way to share their ideas and construct new knowledge. Likewise lecturers could potentially utilise this virtual environment to share their teaching experiences.

Similarly several teaching approaches used in higher education and particularly in computer science were discussed. It became apparent that most of them could be well enabled using Web 2.0 features. If you closely examine concept mapping approach you could see that it might be well enabled using tagging and social bookmarking. Furthermore the teaching community approach that was adopted at Monash University in Australia for enhancing teaching skills of programming through collaborative

sharing might well be enabled using some incredible services of web 2.0 such as wiki, blog and RSS.

Aspects of Web 2.0 were closely examined. As a vague term which lacks a consensus definition, many people have defined Web 2.0 in different ways. But the important things about Web 2.0 are the potentials which it provides. In that case, several core services such as Wikis, Blogs, Podcasting, RSS, Tagging and Social Networking, and Mashups were discussed with their diversity of uses in the corporate environment. Apart from being used in the corporate environment it was also clearly observed that these tools are adopted in higher education within the academic context.

This chapter also reviewed various knowledge management aspects starting from its meaning, history, knowledge processes and types, as well as knowledge conversional cycle. Recently knowledge management has got close attention in higher education as it was reviewed. Great effort is undertaken on knowledge management initiatives in the academic environment. However there are some cultural barriers that impede this movement which necessitate high priorities in culture change initiatives.

In the context of higher education knowledge management could be greatly facilitated using Web 2.0 services as reviewed from the literature. Several tools seemed to be applied to enhance knowledge management activities in different aspects in higher education. For instance, in the learning perspective students can share ideas within virtual collaborative environment supported by these tools.

In the same way core computer science subjects which are complex to teach can be well taught by enhancing teaching skills through collaborative sharing of teaching approaches, experiences and skills using Web 2.0 services, tools and technologies. Building on the understanding gained from the literature review the next chapter will survey computer science lecturers of several higher learning institutions in Ireland and Tanzania to assess how these tools are feasible in enhancing knowledge sharing of their teaching approaches, skills, and experiences when teaching computer science subjects

3 SURVEY ANALYSIS AND DESIGN

3.1 Introduction

This chapter presents the findings of the survey analysis that was conducted to assess the familiarity of computer science lecturers with Web 2.0 tools, the level of usage of these tools and their experience and opinions on using them for sharing teaching knowledge. This survey was designed in two different ways. The first technique was in the form of a questionnaire that was supplied to computer science academic staff across several higher education institutions including universities and institutes of technology. The questionnaires were both online and paper-based. The paper questionnaires were sent to Tanzania whereas online questionnaires were deployed using surveymonkey (www.surveymonkey.com) and were distributed in Ireland universities and institutions through emails. Another form of the survey was interviews that were conducted with some of the senior lecturers in the Dublin Institute of Technology (DIT). The interviews were face-to-face and in a structural way. The questionnaire is available in Appendix A, and the interview questions can be reviewed in Appendix B.

The main objectives of the survey were:

- Obtaining a general understanding to what extent Web 2.0 applications and services are known and how they are used within computer science community of lecturers.

- Verifying that Web 2.0 tools are used by computer science lecturers when they teach students.

- Understanding which modules are or could be better taught using Web 2.0 tools.

- Understanding several approaches used by computer science lecturers while teaching students and how Web 2.0 tools could be used to facilitate these approaches.

- Evaluating on how these tools could be used by these lecturers for sharing their teaching knowledge and to enhance it by sharing through Web 2.0 tools.

To achieve these objectives 19 were designed for the questionnaire and 12 questions for the interview survey were asked. The questionnaire questions involved both closed and open questions while the interview survey was conducted on a face-to-face basis and the questions contained, were structural and in a directed manner. The data was collected and graphed using Microsoft Excel.

The questionnaire analysis was divided into two main categories. The first category concerned respondents from Tanzania who responded through the paper based format. The second and last category was dealing with the respondents obtained from online. That is respondents from Irish universities and Institutes of technology.

3.2 Analysis of Data from Tanzania

This section presents analysis of the data collected through the questionnaire survey that was conducted in Tanzania. The questionnaire was in paper format and was distributed in different universities across Tanzania. The total of number of the population who were given this questionnaire was 50 computer science lecturers. The actual number of people who responded this survey was 20 which represents a response rate of 40%.

The questionnaire had three main sections. The first section tried to elicit the general understanding of computer science lecturers on Web 2.0 applications, tools, and services and how they interact with them. The second section was to verify whether computer science lecturers use these tools while teaching. The third section aimed at evaluating the range of these tools in supporting collaboration and sharing of teaching knowledge. The questions in this section were asked in the form of grading statements that used a Likert Scale, which is a popular response scale used in questionnaire design (Bhaskaran, 2007).

3.2.1 Section 1 – General Usage of Web

This section had 11 questions designed to gain a general understanding of computer science lecturers on web and Web 2.0 in particular. The questions contained were in the form of multiple choices in which users could select more than one answer or a single answer depending on the requirement of the question.

The first question of the questionnaire survey was *"Do you usually use any computer applications when you teach students?"* The question was designed to determine whether lecturers preferred using computer applications in teaching. This could pave the way to understand the familiarity of computer science lecturers and their use of technology while teaching. Figure 3.2.1 depicts the results obtained from the question.

Level of usage of computer applications in teaching student
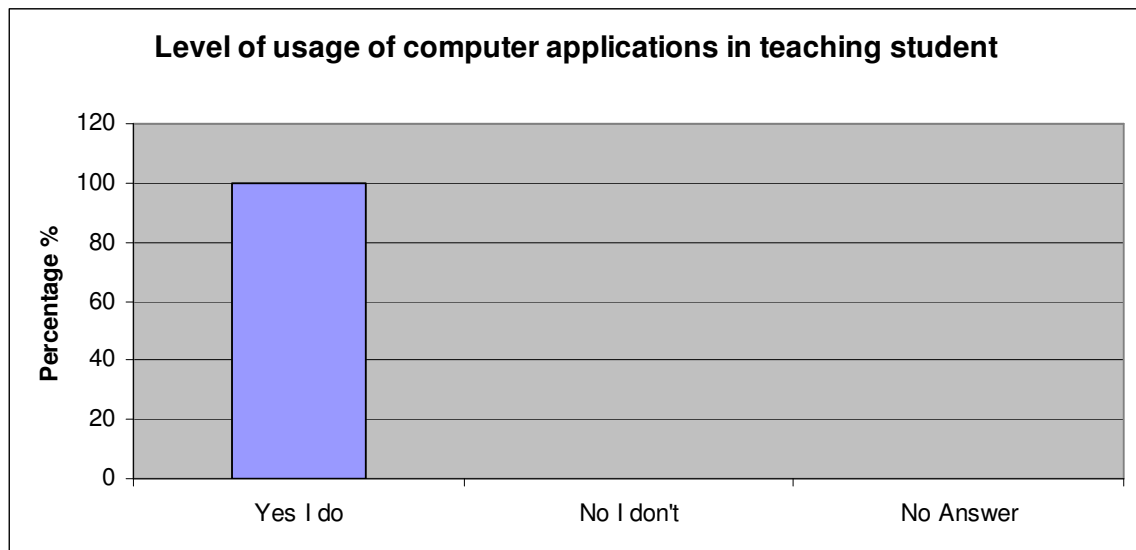
Figure 3.1a 1 Lectures' Use of Computer Applications

The respondents were able to select one answer in multiple choices given, 99% of the respondent selected they use computer application while teaching which implied that they prefer to accommodate technology in their teaching.

The second question of the survey was "*Which applications do you usually use as a lecturer in your teaching?*" The purpose of the question was to understand which technologies are widely used by lecturers in their teaching. Figure 3.2.2 depicts the results obtained from this question.

The type of applications that are used by lecturers in their teaching
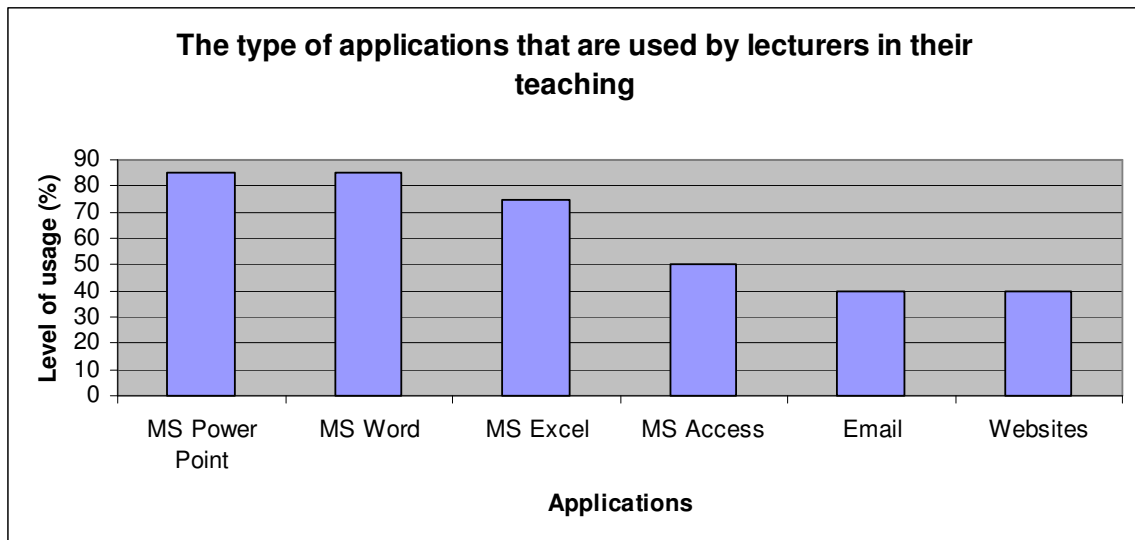
Figure 3.2a 1 Type of Applications Preferred

The majority of respondents (85%) were using MS Power Point and MS Word, which shows that computer science lecturers in Tanzania prefer to use those applications as widely used technologies in teaching within Tanzanian higher education institutions in computer science. However others applications are considerably used in teaching in some ways such as MS Access (50%), Email application (40%), and Website (40%).

The third question of the questionnaire was *"Do you use the Web in your work as a lecturer?"* This question aimed at understanding whether computer science lecturers prefer to use Websites in their work regardless in teaching or in other academic works. The general purpose was to understand whether they interact with the Internet. Figure 3.2.3 depicts the results of this question.
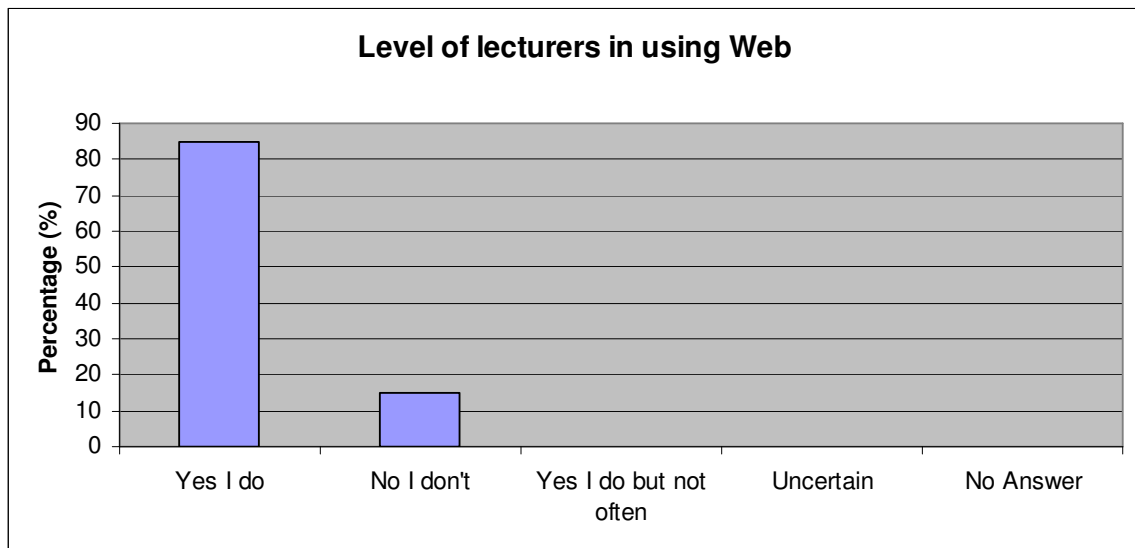
Figure 3.3a 1 Lecturers who use the Web

The majority of respondents were using Web in their work in which 85% of computer science lecturers in Tanzania have a tendency to interact with the Web in their work. This shows that the level of interacting with the Internet amongst computer science lectures is high which necessitates acceptance of web technologies and services in that community. However 15% of respondents generally do not interact with global network.

The fourth question of the survey was *"Are you familiar with any of the following terms "Wikipedia", "YouTube", "FaceBook", "Flickr" or "MySpace" ?"*. The purpose of this question was to determine the awareness of computer science lecturers with Web 2.0 applications. This could help to envisage the applicability of Web 2.0 tools within computer science lecturers in different contexts. Figure 3.2.4 depicts the results obtained from this question.
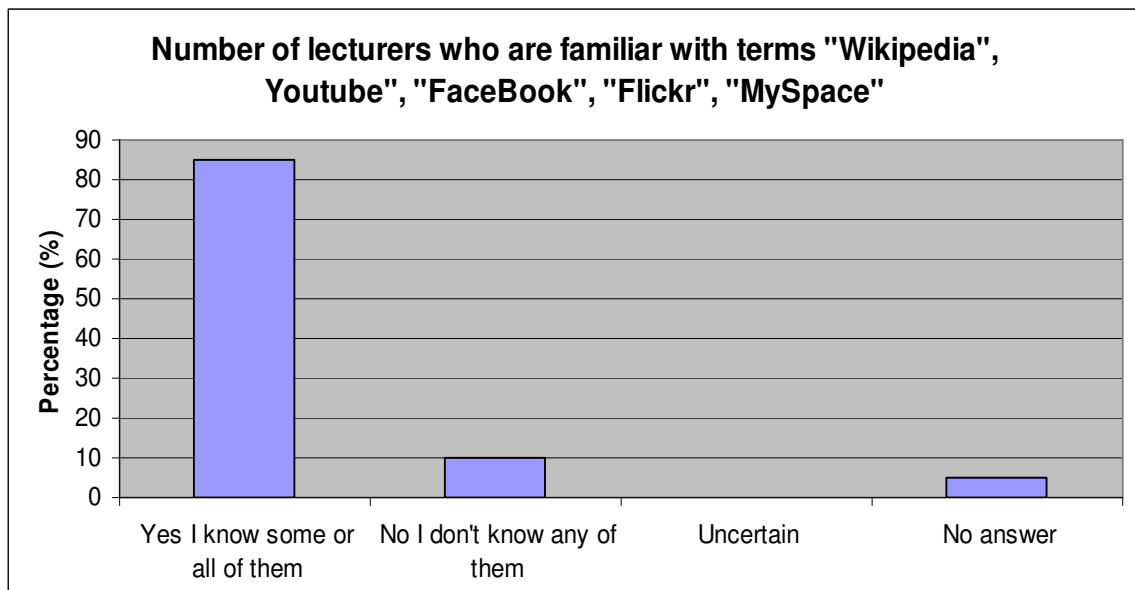
Figure 3.4a 1 Awareness of Web 2.0 Applications

The majority of the respondents were familiar with Web 2.0 applications in which 85% replied that they know some or all of the Web 2.0 applications mentioned to them. This implies that these applications are widely known by computer science lecturers in higher education institutions in Tanzania. Nevertheless 10% of the respondents replied that they don't know these applications, while only 5% of the respondents had no specific answer to this question.

The fifth question of the survey was "*Have you ever used any of the following?* The purpose of this question was to determine which Web 2.0 application(s) are widely used in the computer science lecturers. This could help to understand which tool(s) are most implicitly used within computer science lecturers. The respondents were able to select multiple answers. Figure 3.2.5 depicts the results of this question.
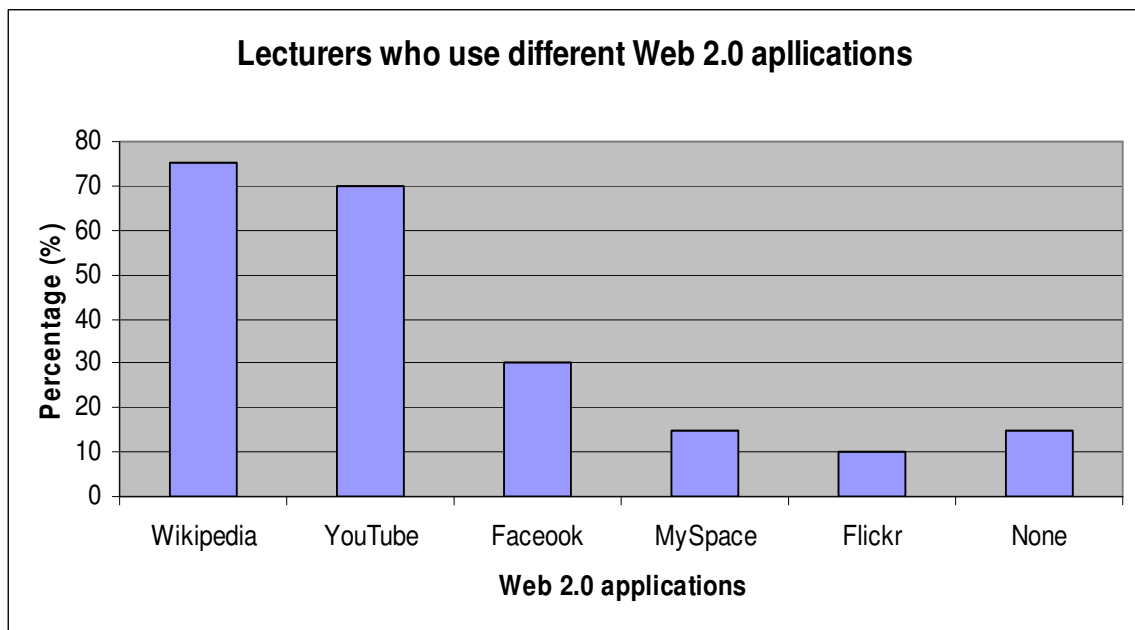
Figure 3.5 1 Usage of Different Web 2.0 Applications

The majority of respondents (75%) were using Wikipedia. This shows that this Wiki tool is the most implicitly used Web 2.0 tool. 70% of the respondents use YouTube, 30% use Facebook, 15% use MySpace and 10% of the respondents use Flickr. However 15% of the respondents use none of these applications.

The sixth question was "*Do you know or have you heard of any of the following "Wikis", "Blogs", "RSS", "Podcasting", "AJAX", or "Mashups*" The purpose of this question was to obtain a general understanding whether the Web 2.0 tools are explicitly known to computer science lecturers. Figure 3.2.6 illustrates the results obtained from this question.
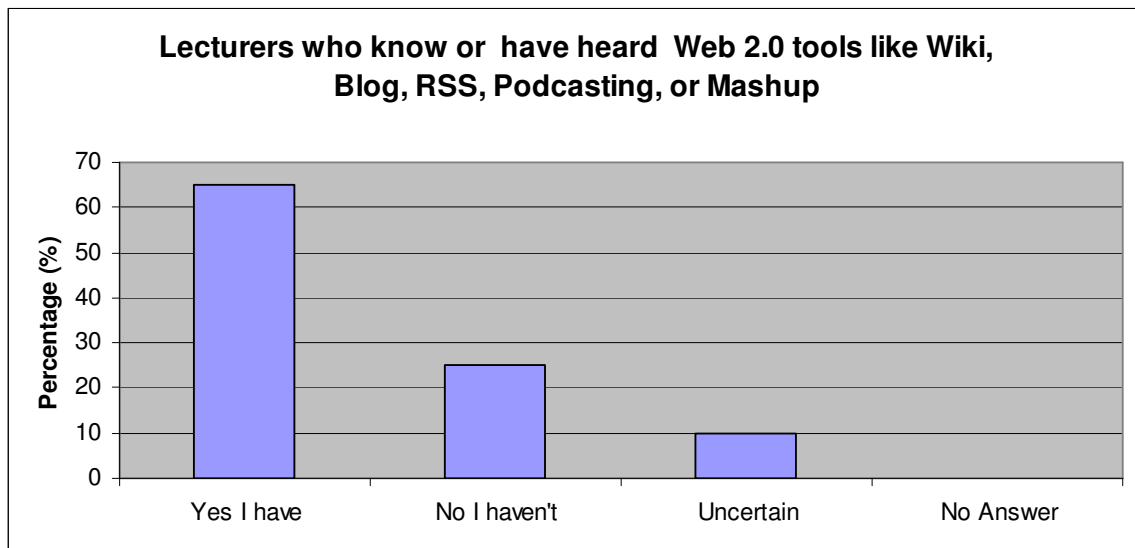
Figure 3.5a 1 Familiarity of Web 2.0 tools

The majority of the respondents (65%) replied that they know or have heard of Web 2.0 tools, 25% of the respondents said they don't know these tools whereas 10% of them were uncertain whether they know about them.

The seventh question was "*Are you familiar with the term "Web 2.0"?*" The purpose of this question was to obtain a general understanding of computer science lecturers of the term Web 2.0. The figure below provides illustration of the results.
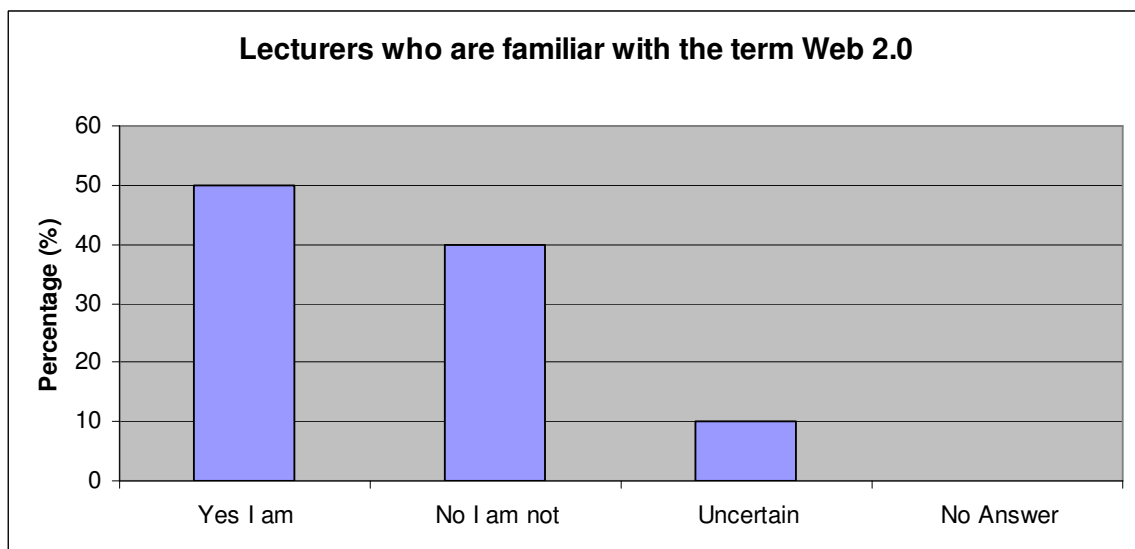
Figure 3.6a 1 Understanding of the Term Web 2.0

Half of the respondents (50%) who responded said they are familiar with the term "Web 2.0". However 40% of the computer science lecturers in Tanzania said they do

not know the term and 10% of the respondents were uncertain about the term. This results show that despite the fact that computer science lecturers know or have heard of the tools that represent Web 2.0, they don't know explicitly the term Web 2.0.

The eighth question of the survey was *"Do you interact with any Web 2.0 tools, applications, or services like YouTube, Wikipedia, FaceBook, MySpace, or Flickr either for fun or in your work?"* The purpose of this question was to determine which Web 2.0 tool the lecturers know and prefer specifically to use through interaction with Web 2.0 applications and the reason of interacting with them. The figure below depicts the results of this question.
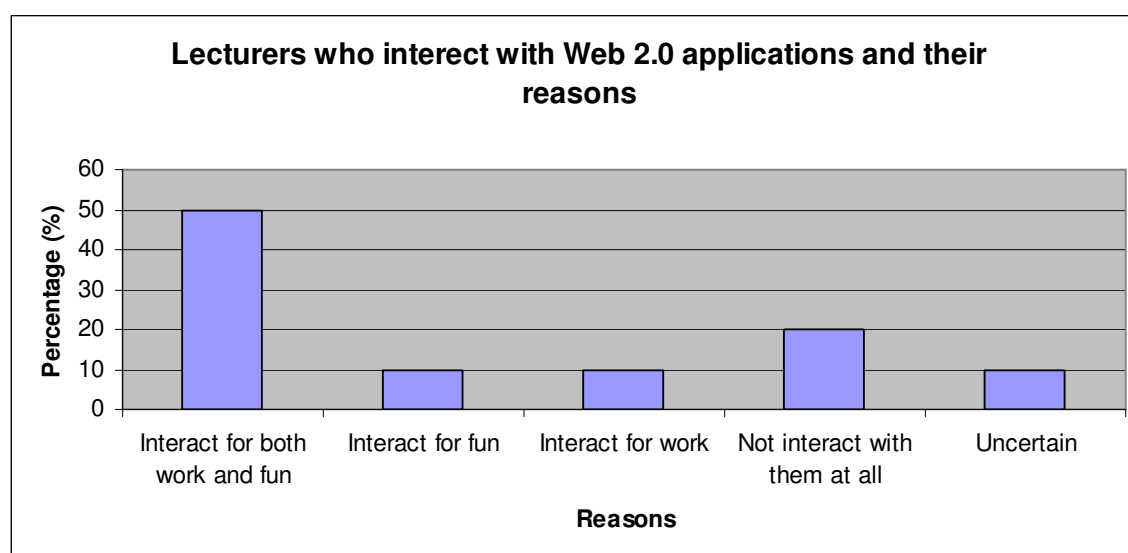
Figure 3.7a 1 Interaction with Web 2.0 Applications/Services

Half of the respondents (50%) said that they were interacting with Web 2.0 applications for both work and fun, while 10% interact with them for fun only likewise 10% interact with them for work only, 20% do not interact with them at all, and 10% were uncertain.

The ninth question requires those computer science lecturers who do not interact with these applications to suggest the reason of not interacting with them. The following graph depicts the results of this question.
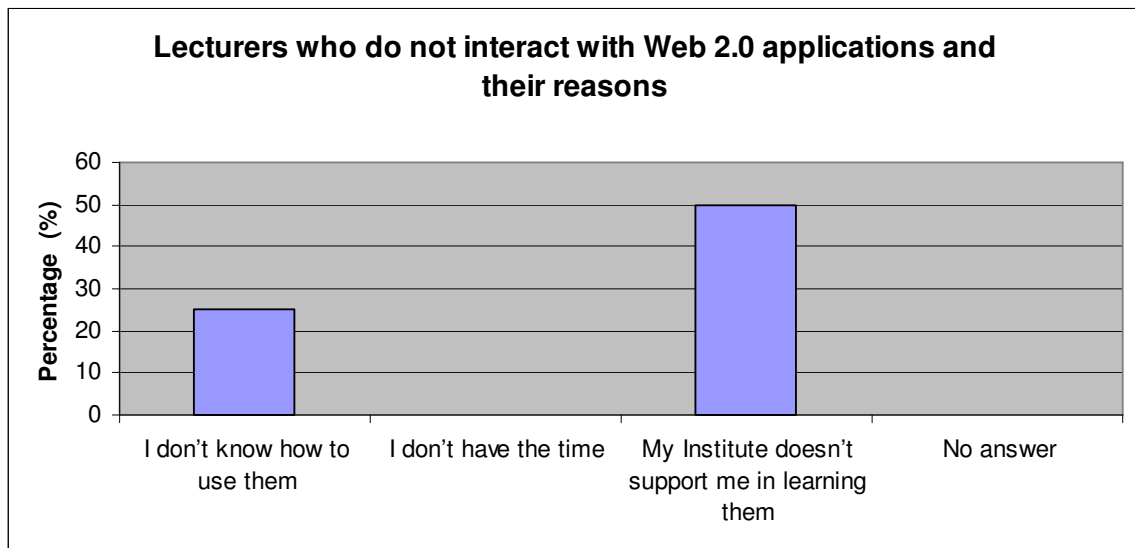
Figure 3. 8a 1 Reasons for not Interacting with Web 2.0 Applications

50% of the respondents suggested that the main reason for not interacting with Web 2.0 applications was *"My Institute doesn't support me in learning them"* which suggest that computer science lecturers in Tanzania need organisational supports to be able to use these tools for teaching. 25% who do not interact with these applications said they don't know how to use them. Whereas none of the respondents said they don't have the time to use them.

The tenth question aimed at understanding common Web 2.0 tools that lectures use to interact with Web 2.0 applications. The figure below depicts the results of the question.
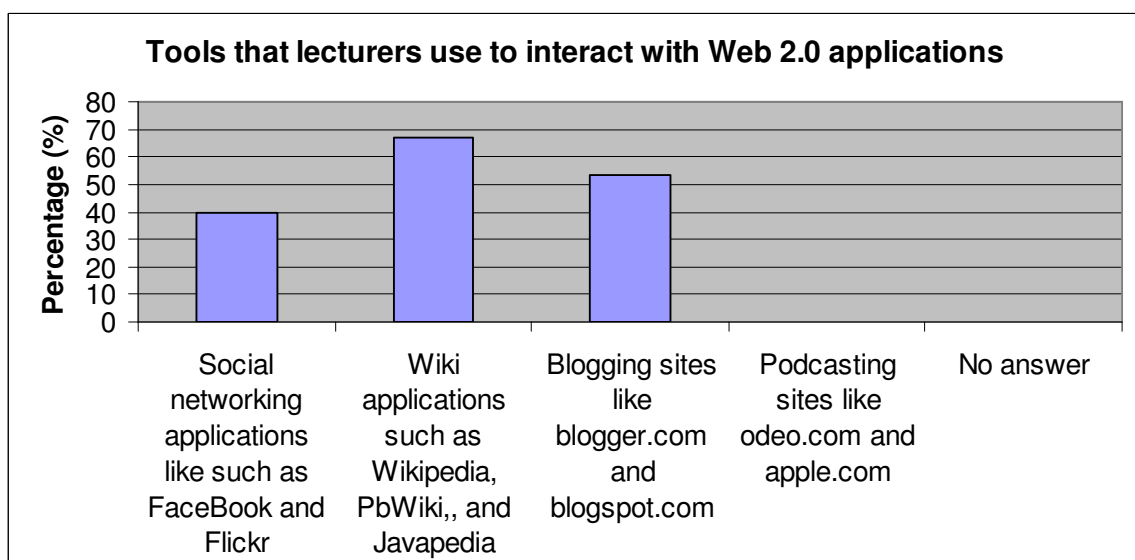
Figure 3.9a 1 Commonly used Web 2.0 Applications

The majority of respondents (67%) who interact with Web 2.0 application use Wiki applications like Wikipedia, followed by 53% who use Blogging sites like blogger.com to interact with Web 2.0 applications. Only 40% prefer to use social networking applications such as FaceBook to interact with Web 2.0 applications. And unfortunately none of the lecturers were interacting with podcasting sites. This shows that Podcasting technology is more unfamiliar than other Web 2.0 technologies amongst Tanzanian computer science lecturers.

The last question of the section A was "*Do you have favourite Web 2.0 tools?*" The purpose of this question was to determine which Web 2.0 tools are used and hence any application or environment that would be based on them could be well accepted by computer science lecturers. The figure below depicts the results of this question.
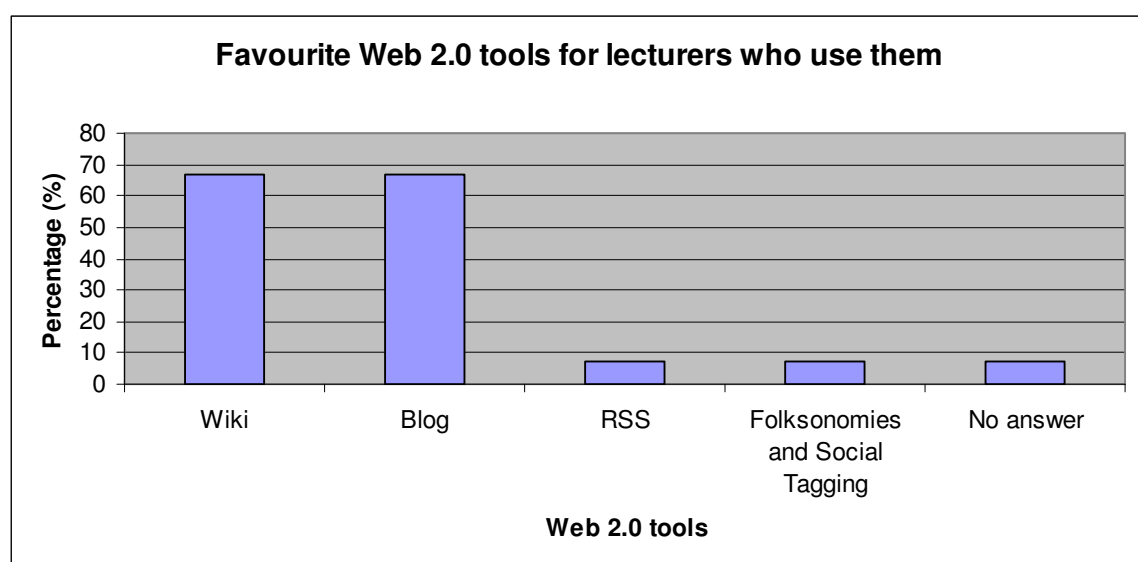
Figure 3.10a 1 Favourite Web 2.0 tools

The majority (67%) of lecturers who use Web 2.0 applications said that they prefer most using more Wiki and Blog to other Web 2.0 tools. While 7% prefer to use RSS, and Tagging. 7% had no answer on the favourite tools question.

3.2.2 Section 2 – Usage of Web 2.0 Tools for Teaching

This section contained 4 questions aimed at eliciting computer science lecturers' opinions on whether they used Web 2.0 tools while teaching. As discussed in *section 2.3.3* Web 2.0 tools are used in higher education for both teaching and learning, these

questions gauge the inclusion of these tools in teaching and identifying potential subjects that could be taught using these tools.

The first question in this section was: "*Do you use Web 2.0 tools such as blogs, podcasting, wikis, RSS, and Social Software for teaching and for faculty use?*" Figure 3.2.12 depicts the results provided. 40% selected that they use Web 2.0 tools for teaching. 5% use them for other faculty works 0% use them for both faculty and teaching. 20% they don't use them for both purposes, and 5% had no answer for this question.
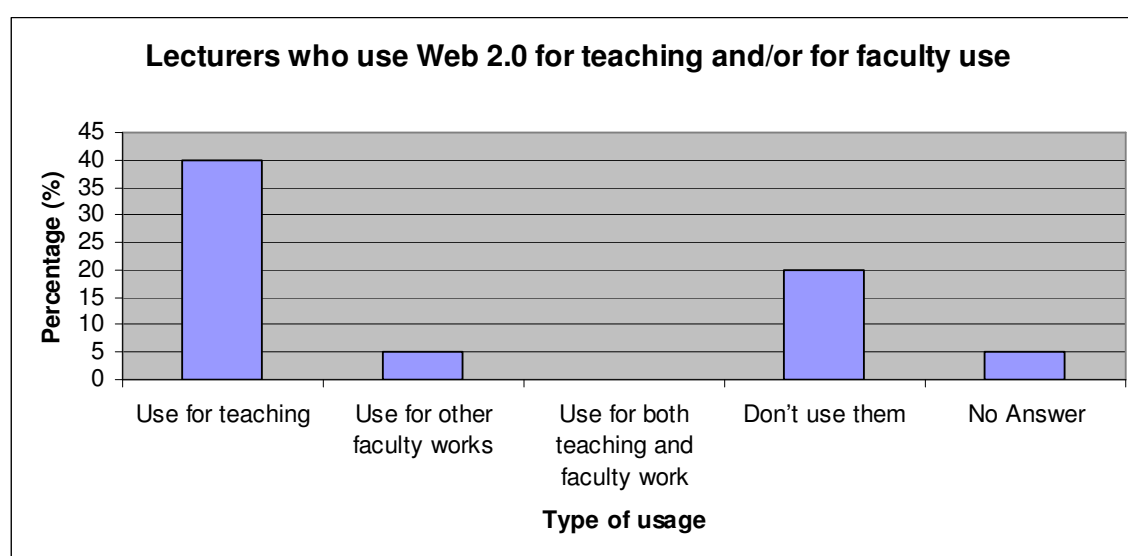
Figure 3.11a 1 Usage of Web 2.0 tools within Computer Science Faculty

The second question of this section was "*What kind of Web 2.0 tools do you use for teaching?*" Figure 3.2.13 displays actual results obtained from this question. 40% declared that the use Wiki for teaching. 15% selected that they use Blog for teaching. 5% use Audio Podcasting for teaching. 0% use RSS and Video Podcasting and 60% had no answer.
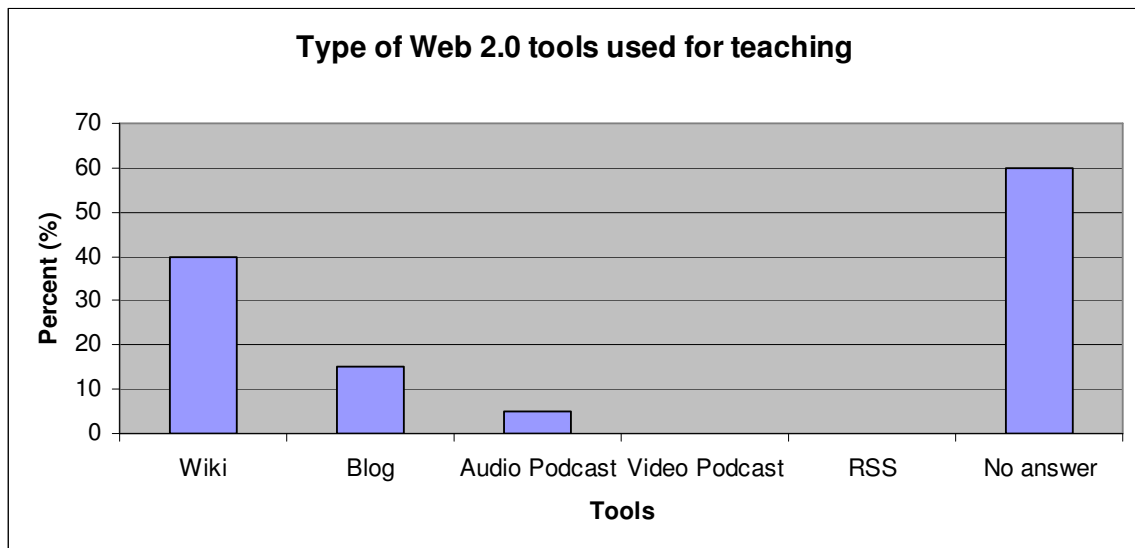
Figure 3.12a 1 Type of Web 2.0 tools used for Teaching

The third question was "*If you had the time and/or training what other Web 2.0 tools would use for teaching?*" Figure 3.2.13 displays the results provided. 35% suggested that they had more interest in using Wiki.if they had time or training, 25% preferred to use Blog and Audio Podcasting if had training. 40% would like to use Video Podcasting. 5% had interest in using RSS, and 30% had no answer.
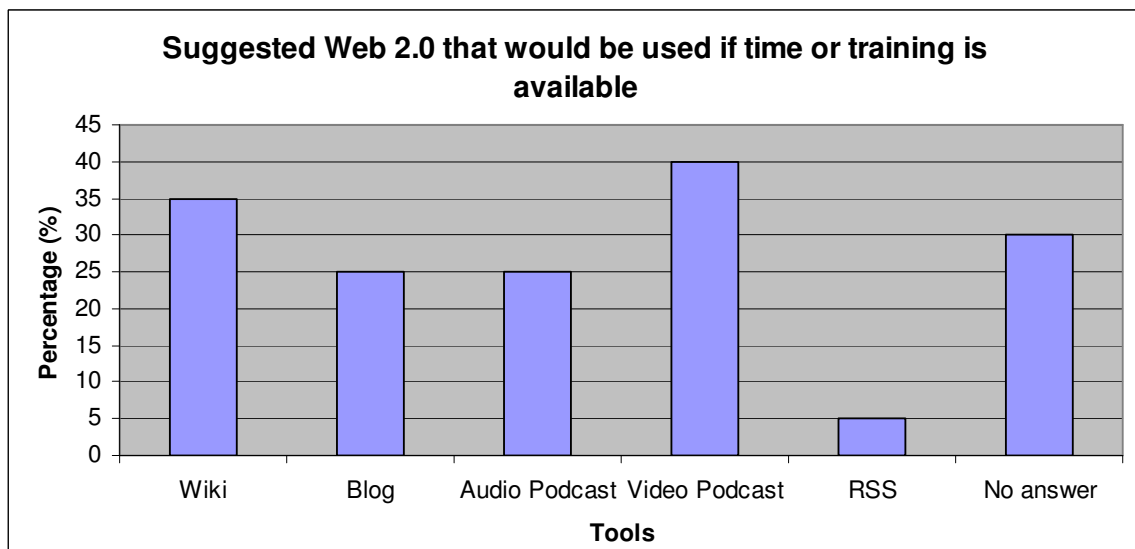
Figure 3.13a 1 Selected Web 2.0 tools would be liked to be learned

The fourth question was "*List some subject (s) that you or would like to teach through Web 2.0 tools.*" Figure 3.2.14 depicts results provided. 30% responded suggested

69

Networking to be taught using Web 2.0. 15% preferred database design to be taught using Web 2.0 tools. 5% preferred System development, System Analysis and Design, and Computer Architecture to be taught using Web 2.0 tools. 25% preferred Web Development, 10% preferred Mathematics, 20% preferred Programming, and 30% had no answer
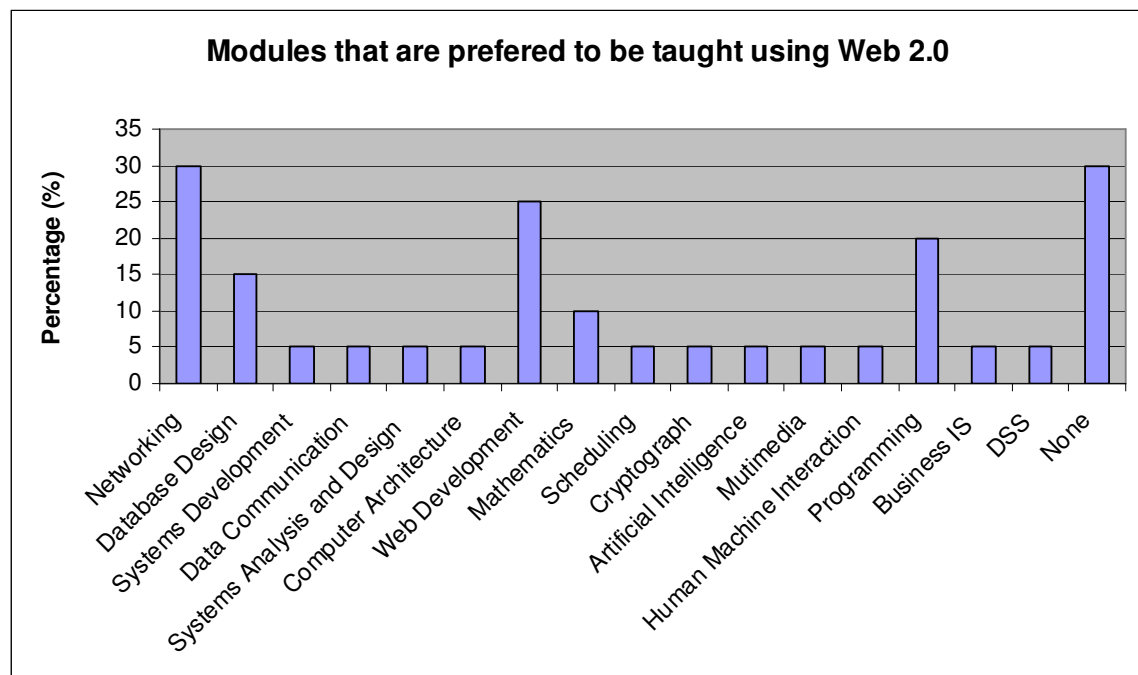
Figure 3.14 1 Modules for Web 2.0

3.2.3 Section 3 – Using Web 2.0 Tools for Sharing Teaching Knowledge in the Faculty

The purpose of this section was to verify whether Web 2.0 tools are useful in sharing of computer science teaching knowledge. This section contained four questions which were in the form of statements and had to be answered in a form of a Likert Scale. It is very apparent in *section 2.4.9* and *section 2.4.10* that Web 2.0 tools are used in different aspects of knowledge management in the context of higher education. Therefore these questions intended to obtain a general assessment from computer science lecturers on the suitability of these tools in enhancing the sharing of teaching knowledge regarding approaches, methods and techniques discussed in *sections 2.2.5 and 2.2.6*.

The first question was intended to examine important means which could facilitate the sharing of computer science lecturers' teaching knowledge. Table 3.2.15 displays the results.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The Web is a good way of sharing experiences and teaching knowledge in computer science.	**56.8% (10)**	35.3% (9)	5.9% (3)	0% (0)	0% (0)
Web tools such as Blogs, Wikis, Social Software, Mashups, or RSS are effective in sharing teaching experience.	20.0% (3)	**60.0% (9)**	20.0% (3)	0.0% (0)	0.0% (0)
My Institute should provide training to help understand new Web tools so that I can easily use them for teaching students and to share my teaching knowledge with my colleagues to encourage collaboration within the faculty.	**70.6% (12)**	23.5% (4)	0.0% (0)	5.9% (1)	0.0% (0)
I would like to share the teaching experience and knowledge that I use when teaching, through the Web and especially using Web 2.0 tools like Wikis, Blogs, Podcasting and others.	40.0% (6)	**53.3% (8)**	0.0% (0)	6.7% (1)	0.0% (0)
Institutional policy should encourage lecturers to use new Web tools like Blogs, Wikis, Video Podcating and Audio Podcasting in the faculty to share their teaching experience and knowledge.	**50.0% (8)**	43.8% (7)	0.0% (0)	6.3% (1)	0.0% (0)

Table 3.1 1 Tanzanian lecturers' views on ways to enhance sharing of teaching knowledge

The qverwhelming majority (59%) of Tanzanian respondents strongly agree that the Web is a good way of sharing computer science teaching knowledge. The trend is similar for Web 2.0 tools in which 60% of Tanzanian respondents agreed that they are effective for being used in sharing of teaching knowledge. In a more cultural perspective manner 70.6% of the respondents had strongly agreed that their particular institute should provide training in order to become familiar with Web 2.0 tools so that they can use these tools for teaching and for collaboration amongst their colleagues. While 53% said they liked to share their teaching knowledge through using Web 2.0

tools. And 50% had strongly agreed that institutional policy should encourage lecturers to use Web 2.0 tools to share their teaching experience and knowledge which implies that management support and policy is necessary to make lecturers share their knowledge.

The second question was asking about the most important module that students must have its fundamental basic when lecturers are teaching computer science. The aim was to examine which subject should its teaching skills more shared in a collaborative ways through Web 2.0 tools. The table 3.2.16 depicts the results.

When teaching computer science it is important that students have a comprehensive understanding of:					
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Programming	**72.2% (13)**	22.2% (4)	0.0% (0)	0.0% (0)	5.6% (1)
Hardware	21.1% (4)	**73.7% (14)**	0.0% (0)	0.0% (0)	5.3% (1)
Formal Methods	26.3% (5)	**63.2%** (12)	5.3% (1)	0.0% (0)	5.3% (1)
Mathematical Underpinnings	**42.1% (8)**	**42.1% (8)**	5.3% (1)	5.3% (1)	5.3% (1)
Operating Systems	**47.4% (9)**	**47.4% (9)**	0.0% (0)	0.0% (0)	5.3% (1)
Web Technologies	42.1% (8)	**52.6% (10)**	0.0% (0)	0.0% (0)	5.3% (1)
Computer Graphics	31.6% (6)	**36.8% (7)**	21.1% (4)	5.3% (1)	5.3% (1)
Games Design	0.0% (0)	**66.7% (10)**	20.0% (3)	13.3% (2)	0.0% (0)

Table 3.2 1 Tanzanian lecturers' views on Important Subject on Computer Science

The majority (72%) of Tanzanian respondents strongly agreed that in teaching computer science they emphasise more on the comprehensive understanding of Programming. 73% agreed on emphasising more on the understanding of Hardware while 63.2% agreed that they must emphasise more on Formal Methods. 42.1% had strongly agreed on emphasising comprehensive understanding of Mathematical Underpinnings. 47.4% strongly agree on emphasising understanding of Operating Systems. 53% agreed that they must emphasise more understanding of Web Technologies. 37% of respondents agreed on emphasising understanding of Computer graphics and 67% had agreed the emphasis on understanding of Games Design in teaching computer science.

The third question aimed at examining the factors that are taken into consideration when teaching programming. Table 3.2.17 displays the results provided by Tanzanian respondents.

When I teach programming I emphasise the following factors:					
	Strongly Agree	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Theory	33.3% (6)	**55.6% (10)**	5.6% (1)	5.6% (1)	0.0% (0)
Practical Programming	**83.3% (15)**	16.7% (3)	0.0% (0)	0.0% (0)	0.0% (0)
Algorithm Design	**72.2% (13)**	16.7% (3)	11.1% (2)	0.0% (0)	0.0% (0)
Documentation	44.4% (8)	**50.0% (9)**	5.6% (1)	0.0% (0)	0.0% (0)
Testing	33.3% (6)	**55.6% (10)**	11.1% (2)	0.0% (0)	0.0% (0)
Big – O notation	11.1% (2)	**50.0% (9)**	33.3% (6)	5.6% (1)	0.0% (0)
Problem Solving	40.0% (6)	**53.3% (8)**	6.7% (1)	0.0% (0)	0.0% (0)

Table 3.3 1 Factors to be considered in teaching programming from Tanzanian lecturers

56% of the Tanzanian respondents agreed that the important factor when they teach programming is Theory. However an overwhelming majority (83%) strongly agreed that practical programming was an important factor they take into consideration when teaching programming. Likewise 72% of them strongly agreed that algorithm design was an important factor when teaching programming. 50% agreed that documentation has to be considered while teaching programming, 56% similarly agreed that testing is an important factor when they teach programming. 50% agreed that big-O notation is important factor in their teaching of programming, and 53% agreed that problem solving has to be considered when teaching programming.

The fourth question aimed at gaining an understanding on the category of tools that seemed to be useful in sharing of computer science teaching knowledge in a collaborative environment. Table 3.2.18 depicts the results provided.

	Extreme Useful	Useful	Neutral	Not Very Useful	Not at all Useful
Wikis	27.8% (5)	**44.4% (8**)	16.7% (3)	5.6% (1)	5.6% (1)
Audio Podcasting	0.0% (0)	**46.7% (7)**	46.7% (7)	0.0% (0)	6.7% (1)
Video Podcasting	6.7% (1)	**53.3% (8)**	33.3% (5)	0.0% (0)	6.7% (1)
Blogs	11.1% (2)	**50.0% (9)**	27.8% (5)	5.6% (1)	5.6% (1)
Social Software	6.3% (1)	**50.0% (8)**	31.3% (5)	6.3% (1)	6.3% (1)
Mashups	6.7% (1)	33.3% (5)	**53.3% (8)**	0.0% (0)	6.7% (1)
RSS	6.7% (1)	40.0% (6)	**46.7% (7)**	0.0% (0)	6.7% (1)
Taggings	6.7% (1)	33.3% (5)	**53.3% (8)**	0.0% (0)	6.7% (1)
MS Word	23.5% (4)	**64.7% (11)**	11.8% (2)	0.0% (0)	0.0% (0)
MS Power Point	31.6% (6)	**57.9% (11)**	10.5% (2)	0.0% (0)	0.0% (0)
Email	22.2% (4)	**72.2% (13)**	5.6% (1)	0.0% (0)	0.0% (0)
Websites	35.3% (6)	**52.9% (9)**	5.9% (1)	5.9% (1)	0.0% (0)

Table 3.4 1 Tanzanian lecturer' view on useful tools for sharing teaching knowledge

44% of respondents declared that Wikis are useful for sharing teaching knowledge, 47% selected that Audio Podcasting are useful for sharing their knowledge, 53% believed that Video Podcasting is useful in sharing computer science teaching knowledge. 50% selected that both Blogs and Social networking tools are useful in sharing computer science teaching knowledge. 53% had a neutral position for Mashups and Tagging and 46% for RSS as well. A considerable number (64%) said that MS Word is useful for the same purpose. 58% said that MS Power Point is useful; A majority (72%) said Email is useful for sharing their knowledge and 53% said Websites are useful for sharing teaching knowledge.

3.3 Analysis of Data Collected in Ireland

This section presents an analysis of data findings collected in Ireland using the online questionnaire survey. The questionnaire was distributed to computer science lecturers across universities and institutions of technology in Ireland using the public website (www.surveymonkey.com). The number of sample population was three hundred and twenty six computer science lecturers. The number of responses received was thirty seven, which is an 11.35% response rate.

3.3.1 Section 1- General Usage of Web

This section had eleven questions. The first question which was *"Do you usually use any computer applications when you teach students?"* Figure 3.3.1 displays its results provided.
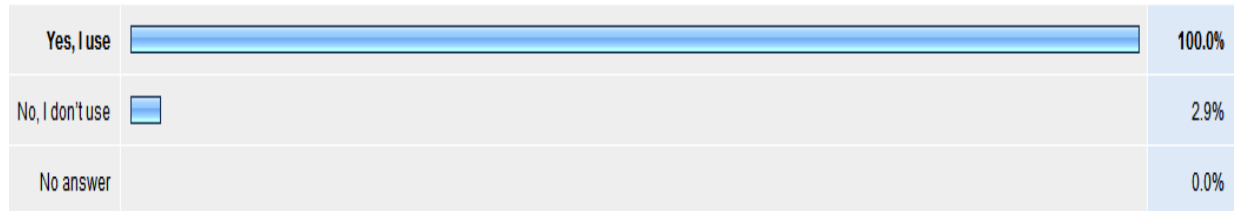
Figure 3.1B 1 Lecturers' Use of Computer Applications

Overwhelming majority (100%) of computer science lecturers use computer applications, 2.9% don't use any application while none selected the No answer choice. This graph shows that 100% of respondents selected YES and 2.9% of respondents (equal to one person) selected NO. The question allowed people to select both options and it is clear that in this case one person checked both YES and NO.

Figure 3.3.2 depicts the results provided from the second question which was *"Which applications do you usually use as a lecturer in your teaching?"*
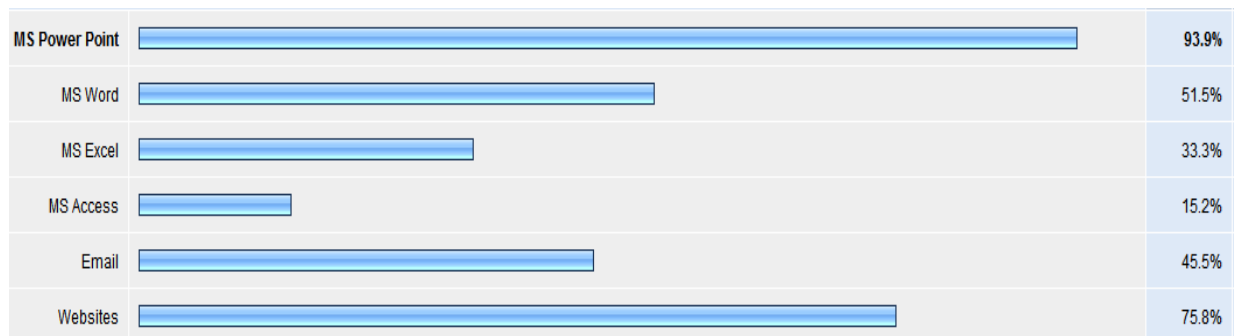
Figure 3.2B 1 Type of Applications Preferred

The majority of lecturers use MS Power Point application, 52% use MS Word, 33% use MS Excel, 15% use MS Access, 46% use Email, and 75% use Websites.

The third question which was *"Do you use the Web in your work as a lecturer?"* Figure 3.3.3 depicts the results provided.

Yes, I use	97.1%
No, I don't use	2.9%
Yes, I use but not often	0.0%
Uncertain	0.0%
No answer	0.0%

Figure 3.3B 1 Lecturers who use the Web

The majority (97%) of computer science lecturers in Ireland use the Web in their work. This shows that the level of interacting with the Internet amongst computer science lecturers here is high compared to Tanzania. Nevertheless 2.9% of Ireland respondents do not use the Web.

The fourth question which was *"Are you familiar with any of the following terms "Wikipedia", "YouTube", "FaceBook", "Flickr" or"MySpace"?"* The results provided can be displayed in the figure 3.3.4 below.

Yes, I know some or all of them	100.0%
No I don't know any of them	0.0%
Uncertain	0.0%
No answer	0.0%
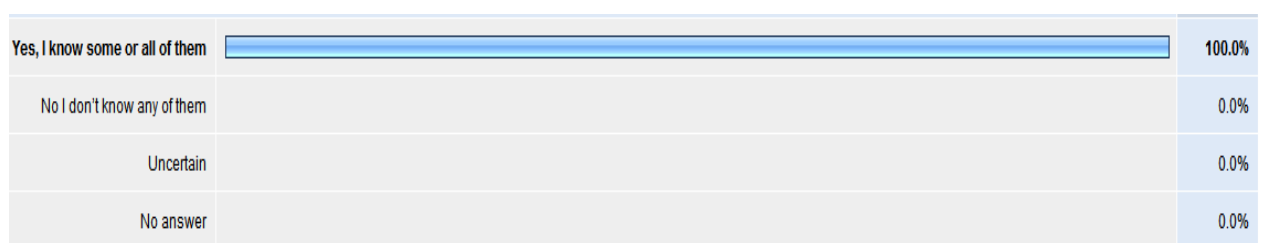
Figure 3.4B 1 Awareness of Web 2.0 Applications

All of the respondents in Ireland were familiar with the Web 2.0 applications in which 100% replied that they know some or all of the Web 2.0 applications that were mentioned to them. This is in contrast with Tanzanian respondents where 85% of them know these applications.

The sixth question was "*Do you know or have you heard of any of the following "Wikis", "Blogs", "RSS", "Podcasting", "AJAX", or "Mashups*". Figure 3.3.5 displays the results provided.

Yes, I know	94.1%
No, I don't know	2.9%
Uncertain	2.9%
No answer	0.0%
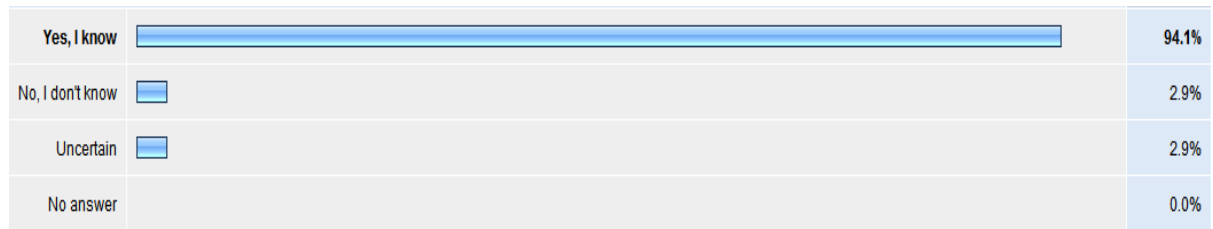
Figure 3.5B 1 Familiarity of Web 2.0 tools

The majority of the respondents (94%) in Ireland replied that they know Web 2.0 tools, 3% said that they don't know these tools and 3% of them were uncertain if they know them. In this comparing to Tanzanian respondents the results show that in Ireland most of lecturers know these tools than in Tanzania.

The seventh question was "*Are you familiar with the term "Web 2.0"?*" Figure 3.3.6 displays the results provided.

Yes, I am	85.7%
No I am not	2.9%
Uncertain	11.4%
No answer	0.0%

Figure 3.6B 1 Understanding of the term 'Web 2.0'

The overwhelming majority of the Ireland respondents (86%) who were asked about their familiarity of the term "Web 2.0" said they are familiar with the term this is in contrast with Tanzanian respondents who 50% said they know the term. 3% of the Ireland respondents said they are not familiar with the term and 11% said they are uncertain of the term.

The eighth question "*Do you interact with any Web 2.0 tools, applications, or services like YouTube, Wikipedia, FaceBook, MySpace, or Flickr either for fun or in your work?"*. Figure 3.3.7 depicts the results provided.

Figure 3.7B 1 Interaction with Web 2.0 Applications/Services

69% of the respondents said that they were interacting with Web 2.0 applications for both work and fun, while 17% interact with them for fun only. 11% interact with them for work only, 3% do not interact with them at all.

The ninth question was asking for reasons for not interacting with Web 2.0 applications for those who responded that they do not interact with Web 2.0 applications. Figure 3.3.8 displays the results provided.
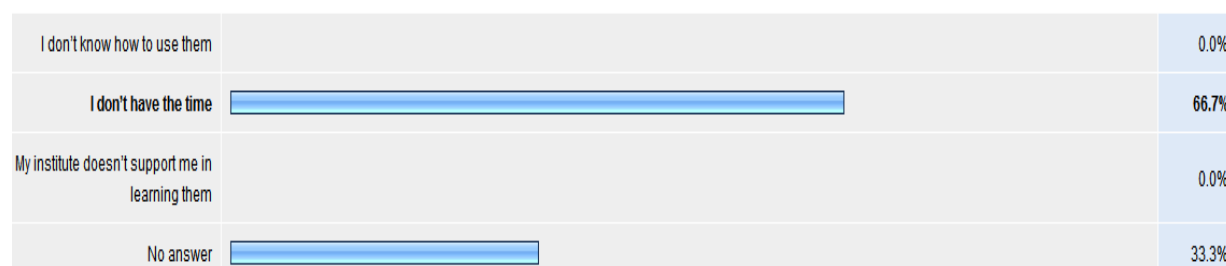
Figure 3.8B 1 Reasons for not Interacting with Web 2.0 applications

67% of the respondents suggested that the main reason for not interacting with Web 2.0 applications is that they don't have the time. 33% who do not interact with these applications said they had no answer. None said that his/her institute doesn't support him/her in learning them or said that they don't know how to use them.

The tenth question required those who do interact with these applications to specify in which ways they interact with them. Figure 3.3.9 display the results provided
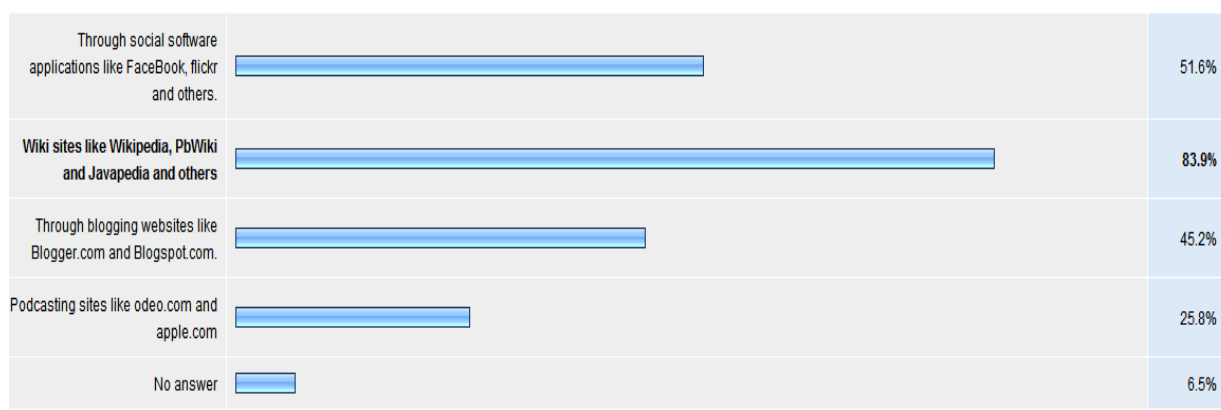
Figure 3.9B 1 Commonly used Web 2.0 applications

The majority of respondents (84%) in Ireland who interact with Web 2.0 application use Wiki applications like Wikipedia, followed by 52% who use social networking applications such as FaceBook to interact with Web 2.0 applications. 45% use Blogging sites like blogger.com to interact with Web 2.0 applications. 26% use podcasting sites to interact with Web 2.0 applications which in contrast with Tanzanian respondents none of the Tanzanian lecturers were interacting using podcasting sites. And 7% had no answer.

The eleventh question was "*Do you have favourite Web 2.0 tools?*" Figure 3.3.10 displays the results provided.
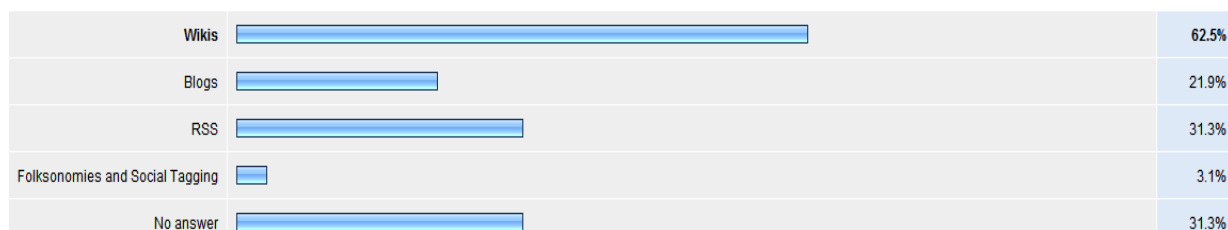
Figure 3.10B 1 Favourite Web 2.0 tools

The majority (63%) of lecturers who use Web 2.0 applications said that they prefer using Wiki to other Web 2.0 tools, while 22% like Blogs. 31% prefer to use RSS, 3% favour Tagging. And 31% had no answer.

3.3.2 Section 2- Usage of Web 2.0 for Teaching

This section of the questionnaire survey intends to verify whether respondents from Ireland do use Web 2.0 tools in teaching students.

The first question was "*Do you use Web 2.0 tools such as blogs, podcasting, wikis, RSS, and Social Software for teaching and for faculty use?*" Figure 3.3.11 depicts the results provided.
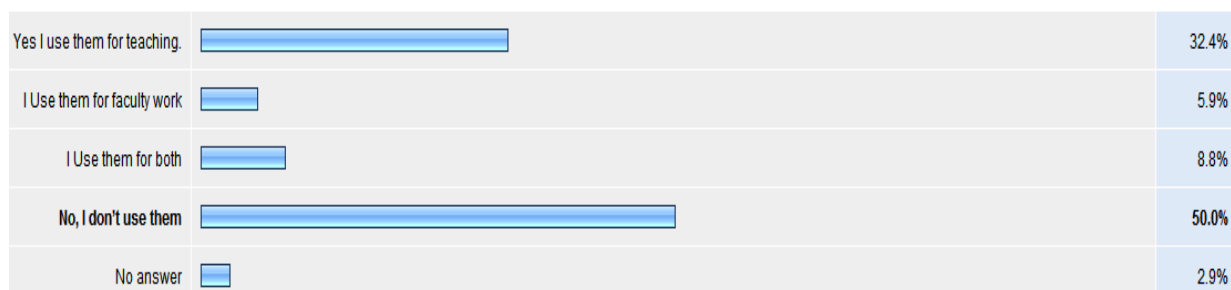
Figure 3.11B 1 Usage of Web 2.0 tools within computer science faculty

32% selected that they use Web 2.0 tools for teaching. 5.9% use them for other faculty works, 9% use them for both faculty and teaching. The majority (50%) they don't use them for both purposes and 3% had no answer for this question.

The second question was "*What kind of Web 2.0 tools do you use for teaching?*" Figure 3.3.12 displays the results provided.
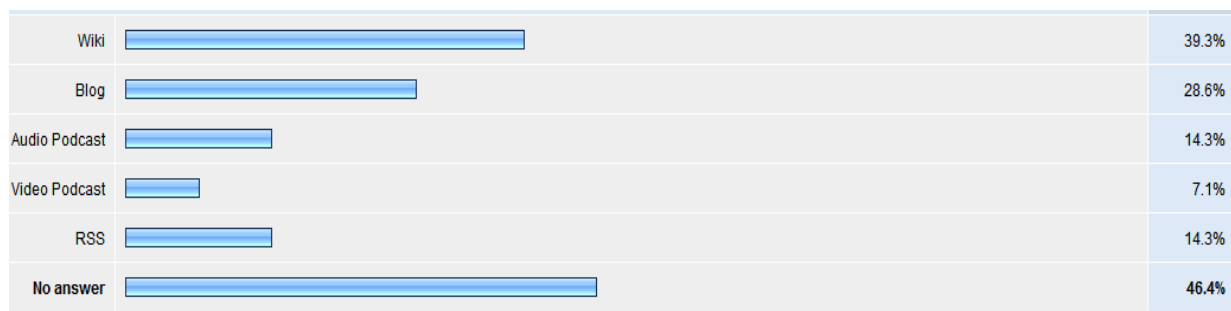
Figure 3.12B 1 Type of Web 2.0 tools used for teaching

39% declared that they use Wikis for teaching. 29% selected that they use Blog for teaching. 14% use Audio Podcasting for teaching.14% use RSS, 7%Video Podcasting and 46% had no answer.

The third question was "*If you had the time and/or training what other Web 2.0 tools would use for teaching?*" Figure 3.3.13 depicts the results provided.
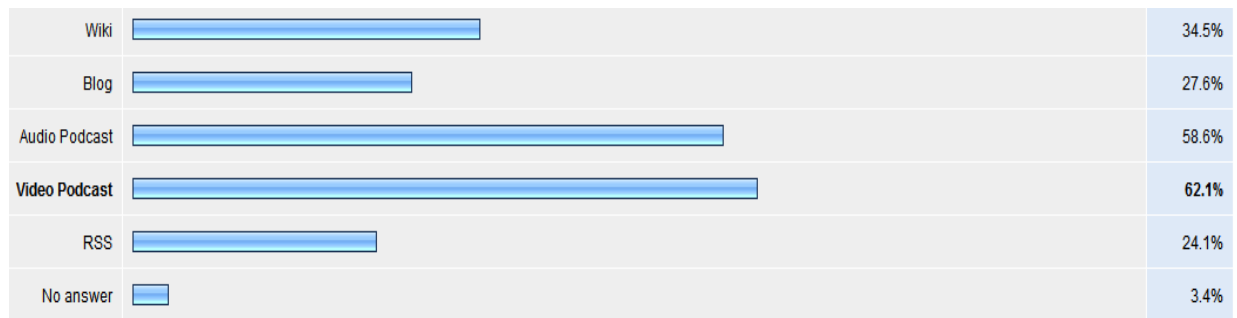
Figure 3.13B 1 Selected tools would be liked to be learnt

35% suggested that they had more interest in using Wikis if they had time or training. 28% preferred to use Blogs if had training. 59% prefer to use audio Podcasting if had training. The overwhelming majority (62%) would like to use Video Podcasting. This result agree with that from Tanzanian computer science lecturers who also would like to learn video podcasting if they had a time or training. 24% of Ireland respondents had an interest in using RSS, and 3% had no answer.

3.3.3 Section 3- Usage of Web 2.0 tools for sharing teaching knowledge

The purpose of this section was to obtain an assessment from computer science lecturers on the usefulness of Web 2.0 tools in sharing of teaching approaches and methods with their colleagues. All of the questions were in form of statements required to be selected using a Likert Scale approach of gathering data.

The first question had 5 statements in which respondents had to select each of them using these scales: - Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree. Table 3.3.14 depicts the results provided.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The Web is a good way of sharing experiences and teaching knowledge in computer science.	**56.3% (18)**	40.6% (13)	0.0%(0)	3.1% (1)	0.0% (0)
Web tools such as Blogs, Wikis, Social Software, Mashups, or RSS are effective in sharing teaching experience.	21.9% (7)	**43.8% (14)**	31.3% (10)	3.1% (1)	0.0% (0)
My Institute should provide training to help understand new Web tools so that I can easily use them for teaching students and to share my teaching knowledge with my colleagues to encourage collaboration within the faculty.	**34.4% (11)**	**34.4% (11)**	21.9% (7)	9.4% (3)	0.0% (0)
I would like to share the teaching experience and knowledge that I use when teaching, through the Web and especially using Web 2.0 tools like Wikis, Blogs, Podcasting and others.	28.1% (9)	28.1% (9)	**34.4% (11)**	9.4% (3)	0.0% (0)
Institutional policy should encourage lecturers to use new Web tools like Blogs, Wikis, Video Podcating and Audio Podcasting in the faculty to share their teaching experience and knowledge.	26.7% (8)	**40.0% (12)**	23.3% (7)	10.0% (3)	0.0% (0)

Table 3.5 1 Ireland lecturers' views on ways to enhance sharing of teaching knowledge

The majority (59%) of respondents from Ireland strongly agreed that the Web is a good way of sharing computer science teaching knowledge. Similarly 44% agree that Web 2.0 tools are effective for the sharing of teaching knowledge. 34% of the respondents strongly agreed and agreed that institute should provide training in order to become familiar with Web 2.0 tools so that they can use for teaching and for collaboration amongst their colleague. Nevertheless 34% of them were neutral in agreeing or disagreeing of sharing their teaching experience using Web 2.0 tools. The majority (40%) had agreed that institutional policy should encourage lecturers to use Web.0 tools to share their teaching experience and knowledge which implies that management support and policy is crucial to enhance lecturers sharing their knowledge.

The second question had the following results as depicted in table 3.3.15

When teaching computer science it is important that students have a comprehensive understanding of:					
	Strongly Agree	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Programming	**78.1% (25)**	18.8% (6)	3.1% (1)	0.0% (0)	0.0% (0)
Hardware	18.8% (6)	**59.4% (19)**	18.8% (6)	3.1% (1)	0.0% (0)
Formal Methods	18.8% (6)	**56.3% (18)**	21.9% (7)	3.1% (1)	0.0% (0)
Mathematical Underpinnings	**56.3% (18)**	34.4% (11)	6.3% (2)	3.1% (1)	0.0% (0)
Operating Systems	40.6% (13)	**53.1% (17)**	6.3% (2)	0.0% (0)	0.0% (0)
Web Technologies	31.3% (10)	**50.0% (16)**	12.5% (4)	6.3% (2)	0.0% (0)
Computer Graphics	9.4% (3)	**53.1% (17)**	21.9% (7)	15.6% (5)	0.0% (0)
Games Design	3.1% (1)	21.9% (7)	**50.0%(16)**	12.5% (4)	12.5% (4)

Table 3.6 1 Ireland lecturers' views on important module in computer science

The majority (78%) of the respondents from Ireland strongly agreed that in teaching computer science they emphasise more a comprehensive understanding of Programming. 59% agreed on emphasising more understanding of Hardware while 56% agreed that they must emphasise more Formal Methods. 56% had strongly agree on emphasising a comprehensive understanding of Mathematical Underpinnings. 53% agree on emphasising an understanding of Operating Systems. 50% agreed that they must emphasise more Web Technologies. 53% of respondents agreed on emphasising an understanding of Computer graphics and 50% were unable to agree or disagree an emphasis on understanding of Games Design in teaching computer science.

The third question required lecturer to select factors they usually take into consideration when teaching programming. Figure 3.3.16 displays the results provided.

When I teach programming I emphasise the following factors:					
	Strongly Agree	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Theory	20.0% (6)	**70.0% (21)**	10.0% (3)	0.0% (0)	0.0% (0)
Practical Programming	**70.0% (21)**	20.0% (6)	10.0% (3)	0.0% (0)	0.0% (0)
Algorithm Design	**50.0% (15)**	36.7% (11)	10.0% (3)	3.3% (1)	0.0% (0)
Documentation	20.0% (6)	**60.0% (18)**	20.0% (6)	0.0% (0)	0.0% (0)
Testing	33.3% (10)	**60.0% (18)**	6.7% (2)	0.0% (0)	0.0% (0)
Big – O notation	13.3% (4)	26.7% (8)	**46.7% (14)**	13.3% (4)	0.0% (0)
Problem Solving	**73.3% (22)**	23.3% (7)	3.3% (1)	0.0% (0)	0.0% (0)

Table 3.7 1 Factors to be considered in teaching programming from Ireland lecturers

70% of respondents from Ireland agreed that an important factor when they teach programming is Theory. The similar number strongly agreed that practical programming was an important factor they take into consideration when teaching programming. 50% of them strongly agreed that algorithm design was an important factor when teaching programming. 60% agreed that both documentation and testing have to be considered in teaching programming. 47% failed to agree or disagree if big-O notation is important factor in their teaching of programming, and 73% strongly agree that problem solving have to be considered when teaching programming.

The fourth question which required respondents to assess the feasibility of some Web 2.0 tools in sharing approaches, method and experiences of teaching computer science. Table 3.3.17 displays the results provided.

	Extreme Useful	Useful	Neutral	Not Very Useful	Not at all Useful
Wikis	26.7% (8)	**56.7% (17)**	13.3% (4)	3.3% (1)	0.0% (0)
Audio Podcasting	13.8% (4)	**51.7% (15)**	27.6% (8)	3.4% (1)	3.4% (1)
Video Podcasting	13.3% (4)	**60.0% (18)**	23.3% (7)	3.3% (1)	0.0% (0)
Blogs	19.4% (6)	**54.8% (17)**	22.6% (7)	3.2% (1)	0.0% (0)
Social Software	7.1% (2)	35.7% (10)	**46.4% (13)**	10.7% (3)	0.0% (0)
Mashups	3.8% (1)	23.1% (6)	**57.7% (15)**	15.4% (4)	0.0% (0)
RSS	3.6% (1)	**57.1% (16)**	35.7% (10)	3.6% (1)	0.0% (0)
Taggings	0.0% (0)	45.8% (11)	**50.0% (12)**	4.2% (1)	0.0% (0)
MS Word	3.6% (1)	**67.9% (19)**	17.9% (5)	3.6% (1)	7.1% (2)
MS Power Point	23.3% (7)	**53.3% (16)**	13.3% (4)	6.7% (2)	3.3% (1)
Email	20.0% (6)	**53.3% (16)**	20.0% (6)	6.7% (2)	0.0% (0)
Websites	40.0% (12)	**60.0% (18)**	0.0% (0)	0.0% (0)	0.0% (0)

Table 3.8 1 Ireland lecturers' views on useful tools for sharing teaching knowledge

57% of respondents from Ireland declared that Wikis are useful for sharing teaching knowledge, 52% selected Audio Podcasting as being useful for sharing their knowledge, 60% believed that Video Podcasting is useful in sharing computer science teaching knowledge. 54% selected Blogs are useful, However 46% remain sceptical in believing that Social networking tools are useful or not very useful in sharing computer science teaching knowledge. 58% had also a neutral position for Mashups. 57% declared that RSS is useful for sharing teaching knowledge. 50% were in between with regard to Tagging is useful or not very useful. Considerable number (68%) said that MS Word is useful for that purpose. 53% said that both MS Power Point and Email are useful, and 60% said Websites are useful for sharing teaching knowledge.

3.4 Interview Results Analysis

As part of the fact finding I also conducted an interview with some computer science senior lecturers in Dublin Institute of Technology (DIT). This section presents some important findings obtained from this survey. The interview survey was in face-to-face and structured form. The data were collected based on two perspectives of lecturers. One perspective focuses on examining actual computer science teaching approaches

used in DIT with the lecturers' use of Web 2.0 applications and tools in teaching. Another perspective was based on determining the means in which they share their teaching knowledge with their faculty members and if Web 2.0 tools suit in the domain to share their teaching expertise.

In determining some approaches used in teaching for instance a Programming module the following question was asked "*How do you approach the teaching of Introduction to Programming?*" From the questionnaire results most of the responses favoured programming as an important module in which its teaching skill and methods could be useful to be shared. In answering that question one of the lecturers had the following reply:

"*The way I like to teach programming is problem solving…get people think about the problems and how those problems can be solved*"

The response above supports the discussion in *section 2.2.5.3* and *section 2.2.6.4* where it was described that Programming was helped by teaching problem solving. Also referring to the results of the questionnaire data in *section 3.3.3* in *table 3.3.16* we find that lecturers prefer to use the problem solving method as a good approach when teaching programming.

In ascertaining whether they use Web 2.0 tools in their teaching some of the interviewees declared that they use them in teaching and others see them potential and could be incorporated in their future lecturers. In response to the question *"Do you use Web 2.0 in your teaching?"* One of the interviewees replied as follows:

"*Yes I have used variety over the years. I have used **Blogs**, I have used **Wikis**, I have used Portal which allows students to create **RSS feeds** for themselves and for lectures ....*"

This response supports the results of *question 1 and 2* of *section B* of the questionnaire survey whose graphs were displayed in *figure 3.2.12*; *figure 3.2.13; figure 3.3.11* and *figure 3.3.*12 where the majority of questionnaire respondents said that they use Web 2.0 tools in their teaching. This in turn also supports the literature findings discussed in

section 2.3.3 where it was found that most of Web 2.0 tools are applied in higher education to support both teaching and learning.

When asked in which ways they incorporate Web 2.0 tools in their teaching, on of the interviewee replied as follows; "…*most assignments that I give I require that the students work as group to come to the consensus in documentation on a particular task…I have been using **wikis** for that…*".

This response supports the results of *question 2* in *section 3.2.2* and *section 3.3.2* of the questionnaire survey where the majority of computer science lecturers who use Web 2.0 tools in their teaching prefer to use Wiki. It also supports the results from the literature findings in *section 2.3.3.1* where it was found that wiki supports collaborative and constructive learning approaches.

But some lecturers have recommended measuring the 'added value' from using these tools in teaching, to the time investment in their set up. That is, it is important to measure the amount of feedback that you get from using these tools in your teaching.

From the perspective of knowledge sharing, interviewees were asked first the following question: *How do you share your teaching knowledge with lecturing staff in your Institute?*

The aim was to examine specific and formal methods they use to share their teaching knowledge. In response to that question some of the lecturers replied that there are no formal means that are used to share their teaching skills and knowledge rather than face-to-face mechanism as the following response from one participant says:

"*Mostly this is done in informal ways and that people discuss various thing over coffee or wherever else. I don't think if there are any specific forms that are used to exchange teaching skills and knowledge within the school itself but we should have more opportunity to do that... I think it is important that people to talk about their teaching...*"

Another senior lecture had the following comments:

"…Its really on a person-by-person basis…a lot of lecturers often come to me and ask me how I should teach a particular topic or what new educational approaches are coming up or what theories are happening. The DIT doesn't have a specific platform or place where you could share this…At the moment sharing is done pretty much on one-to-one basis…"

Therefore this result implies that not only informal methods should exist for sharing expertise, there must be also other formal methods which will facilitate sharing of expertise more effectively. Lecturers' responses showed they are more enthusiastic to participate in sharing of their teaching expertise; however currently there is lack of formal means rather than an occasional face-to-face method.

When asked *"Do you think Web 2.0 is useful in sharing teaching knowledge"* One of the interviewees replied as follows: *"I think it has potential....and might be useful…"*

Another interviewee replied as follows: *"Web 2.0 is important… because it facilitates different types of collaboration…"*

Another senior lecturer had this reaction to that question: *"I think there is lot of potential for using Web 2.0 technologies for sharing how to teach. At the moment I am using Web 2.0 stuff for sharing information about the topics being taught, but there is huge potential for lecturers to share how things are being done. I have lectured on blog even; what the class was about, what did they do? What went well, what went badly…that is useful to do that if you are blogging that kind of information and tagging bad lecturing or bad days…"*

Therefore upon looking at these responses you will find that lecturers hugely support the argument built upon the main idea of this research that Web 2.0 tools are useful and great potential for sharing teaching knowledge and collaboration as well, hence lecturers could use them to facilitate sharing of their teaching expertise. For instance the following comment from one of the lecturers could underpin the idea of collaboration using Web 2.0 tools to improve sharing of teaching knowledge:

"I can see creating collaborative environment where everybody let us say who teaches programming throws in idea of how methods of teaching programming, different techniques different people use will be ideal indeed if different programming lecturers who are teaching at the same level try different techniques; somebody used project based learning, somebody else use teaching by analogy, somebody use case based approach...they each use different approaches and then they discuss and give feedback how it worked ...A new lecturer could take best of each of their approaches and merge them all together "

However there are some criticisms on some of the Web 2.0 tools on their impact on sharing of teaching knowledge. For instance one of the interviewee had this comment on Wikis:

"I am not quite sure something like Wikis would necessarily evolve to the state you could say that it is a consensus view because... teaching a module to particular group of students is very different to teaching another group of students... ".

Therefore from this answer it could be argued that using a wiki to build a consensus view on one approach might not be an effective way to share particular teaching knowledge. However it could be still a useful means to share common approach to teaching.

Generally responses from the interview surveys tremendously agree with the idea that Web 2.0 tools are potential in sharing of teaching knowledge, but it depends on which way they will be used to suit for that purpose.

3.5 Conclusion

From both questionnaire surveys results, it is obvious that substantial number of the computer science lecturers use computer applications while teaching. It is a fact that vast contextual information can be obtained from the Web through the Internet. In this regard the vast majority of lecturers surveyed through the questionnaire use the web in their teaching. Hence it is possible for individuals to be aware of any upcoming web technologies, or changes in the trends of web services. That is why it could be clearly

observed from the questionnaire survey that most computer science lecturers are familiar with Web 2.0 applications and tools even be aware of the "Web 2.0" term. The majority of computer science lectures in Tanzania also are aware of Web 2.0 applications.

Generally the survey results from both Tanzanian and Irish respondents showed that computer science lecturers are aware of Web 2.0 tools such as Wiki, Blog, RSS, Podcasting, Social Networking tools and Mashups although in utilising these tools computer science lecturers from Ireland tend to interact more with them compared with their Tanzanian counterparts. In this case the results showed that four tools; Wikis, Blogs, RSS and Podcasting are preferred to other tools however Podcasting is rarely used compared with others in teaching. Tanzanian respondents seemed not to use RSS and Podcasting. The main reason could be lack of knowledge or training in using them

From the teaching perspective there is a little disappointment from questionnaire survey results. Most computer science lecturers do not use these tools in teaching. However the majority, who use them when teaching students, usually use Wiki, Blog, RSS and rarely Podcasting. This suggests that computer science lecturers see that Web 2.0 tools might conform to the teaching approaches that they use. Programming and Networking are subjects that seemed to be more favoured to be efficiently taught with the aid of these tools. In the programming module the overwhelming majority of lectures favour practical programming when they teach a Programming module.

In the context of knowledge management, responses from both questionnaire surveys agreed that these tools are suitable and have potential in sharing of knowledge in teaching computer science. However a few are sceptical of the suitability of some tools in enhancing the sharing of teaching knowledge within academic context. Also the current culture seemed not to be supportive to motivate lecturers to effectively share their knowledge using these tools. For instance majority of respondents of the questionnaire survey strongly agree with this statement in the questionnaire survey of question 1 in section C:

"My Institute should provide training to help understand new Web tools so that I can easily use them for teaching students and to share my teaching knowledge with my colleagues to encourage collaboration within the faculty"

This suggests that lecturers need to be motivated whether by giving enough time for training to learn new technologies, setting up a formal means, and ensuring that there is executive support from the Institute that encourages them to use these tools to share their knowledge.

From the research, the majority of the Irish and Tanzanian respondents agreed that Wiki, Blogs, Audio Podcasting, and Video Podcasting are useful for the sharing of teaching knowledge. Nevertheless from the survey interview some lecturers suggested that Wiki might not be very useful in the teaching domain for sharing a particular agreed approach since in teaching a particular module approaches differ from group of students to another.

Moreover there are different findings from both Tanzania and Ireland regarding RSS and Social Networking tools in which the majority of Irish respondents agree that RSS are useful in sharing of teaching knowledge while the majority of Tanzanian respondents remain neutral. For Social Networking tools the majority of Tanzanian respondents agreed that they are useful in sharing teaching knowledge while those from Ireland were neutral on accepting whether they are useful or not useful for that purpose.

The table below is the result summary of the questionnaire analysis results. The summary contains large response rate of each question of section A and B from both participants of Tanzania and Ireland.

S/N	Question	Tanzania	Ireland
1	Do you usually use any computer applications when you teach students?	100% use computer applications	100% use computer applications
2	Which applications do you usually use as a lecturer in your teaching?	85% use MS Power Point and MS Word	93% MS Power Point
3	Do you use the Web in your work	85% use Web	97% use Web

	as a lecturer?		
4	Are you familiar with any of the following terms "Wikipedia", "YouTube", "FaceBook", "Flickr" or "MySpace" ?	85% are familiar	100% are familiar
5	Have you ever used any of the following?	75% have used Wikipedia	97% have used Wikipedia
6	Do you know or have you heard of any of the following "Wikis", "Blogs", "RSS", "Podcasting", "AJAX", or "Mashups	65% know them	94% know them
7	Are you familiar with the term "Web 2.0"?	50% know the term	86% know the term
8	Do you interact with any Web 2.0 tools, applications, or services like YouTube, Wikipedia, FaceBook, MySpace, or Flickr either for fun or in your work?	50% interact for both work and fun.	69% interact for both work and fun
9	If you do not use Web 2.0 tools (skip Q 10 and 11), can you suggest reasons why you don't use these tools?	50% said "institute doesn't support me in learning them"	67% don't have the time
10	How do you interact with Web 2.0 tools, services or applications?	67% interact with wiki applications such as Wikipedia.	84% interact with wiki applications such as Wikipedia.
11	Do you have favourite Web 2.0 tools?	67% chose wiki and blog as favourite	63% wiki is their favourite tool
12	Do you use Web 2.0 tools such as blogs, podcasting, wikis, RSS, and Social Software for teaching and for faculty use?	40% use for teaching	50% don't use for teaching
13	What kind of Web 2.0 tools do you use for teaching?	60% no answer	46% no answer
14	If you had the time and/or training what other Web 2.0 tools would use for teaching?	40% video podcasting	62% video podcasting

Table 3.9 1 Questionnaire Results Summary – Section A and B

And the table below is the comparison summary of both results from Tanzania and Ireland regarding their opinion on usefulness of the outlined Web 2.0 tools in sharing their teaching knowledge.

	Extreme Useful		Useful		Neutral		Not Very Useful		Not at all Useful	
	Tanzania	Ireland	Tanzania	Ireland	Tanzania	Ireland	Tanzania	Ireland	Tanzania	Ireland
Wikis	27.8% (5)	26.7% (8)	**44.4% (8**)	**56.7% (17)**	16.7% (3)	13.3% (4)	5.6% (1)	3.3% (1)	5.6% (1)	0.0% (0)
Audio Podcasting	0.0% (0)	13.8% (4)	**46.7% (7)**	**51.7% (15)**	46.7% (7)	27.6% (8)	0.0% (0)	3.4% (1)	6.7% (1)	3.4% (1)
Video Podcasting	6.7% (1)	13.3% (4)	**53.3% (8)**	**60.0% (18)**	33.3% (5)	23.3% (7)	0.0% (0)	3.3% (1)	6.7% (1)	0.0% (0)
Blogs	11.1% (2)	19.4% (6)	**50.0% (9)**	**54.8% (17)**	27.8% (5)	22.6% (7)	5.6% (1)	3.2% (1)	5.6% (1)	0.0% (0)
Social Software	6.3% (1)	7.1% (2)	**50.0% (8)**	35.7% (10)	31.3% (5)	**46.4% (13)**	6.3% (1)	10.7% (3)	6.3% (1)	0.0% (0)
Mashups	6.7% (1)	3.8% (1)	33.3% (5)	23.1% (6)	**53.3% (8)**	**57.7% (15)**	0.0% (0)	15.4% (4)	6.7% (1)	0.0% (0)
RSS	6.7% (1)	3.6% (1)	40.0% (6)	**57.1% (16)**	**46.7% (7)**	35.7% (10)	0.0% (0)	3.6% (1)	6.7% (1)	0.0% (0)
Taggings	6.7% (1)	0.0% (0)	33.3% (5)	45.8% (11)	**53.3% (8)**	**50.0% (12)**	0.0% (0)	4.2% (1)	6.7% (1)	0.0% (0)
MS Word	23.5% (4)	3.6% (1)	**64.7% (11)**	**67.9% (19)**	11.8% (2)	17.9% (5)	0.0% (0)	3.6% (1)	0.0% (0)	7.1% (2)
MS Power Point	31.6% (6)	23.3% (7)	**57.9% (11)**	**53.3% (16)**	10.5% (2)	13.3% (4)	0.0% (0)	6.7% (2)	0.0% (0)	3.3% (1)
Email	22.2% (4)	20.0% (6)	**72.2% (13)**	**53.3% (16)**	5.6% (1)	20.0% (6)	0.0% (0)	6.7% (2)	0.0% (0)	0.0% (0)
Websites	35.3% (6)	40.0% (12)	**52.9% (9)**	**60.0% (18)**	5.9% (1)	0.0% (0)	5.9% (1)	0.0% (0)	0.0% (0)	0.0% (0)

Table 3.10 1 Questionnaire Results Summary – Section C

In general from the research methodology, it might be clearly observed that there is a low response rate regarding the number of online questionnaire survey compared to that of paper – based questionnaires. The number of the online sample population across Ireland institutes was 326; unfortunately the number of responses obtained was 37. While number of population in paper-based questionnaire distributed in Tanzania was 50 and the response obtained was 20. This show that a medium of delivery has significant impact on the response rate when comparing of paper – based response rate which is 40% to that of online which is 11.35%.

Hence there are several criticisms of online questionnaires as Lumsden & Morgan (2005) argued that among the vulnerabilities of this type of questionnaire is non-response rate in which individuals fail to respond to the invitation to participate in survey or abandon a questionnaire before it is completed as probably happened in this research.

Based on the research findings the next chapter will design a framework incorporating the proposed Web 2.0 tools for sharing of teaching knowledge. This framework will be partly demonstrated using a working prototype of Web 2.0 tools that will show how teaching knowledge could be shared using these tools.

4 FRAMEWORK & PROTOTYPE IMPLEMENTATION

4.1 Introduction

The critical idea of this research was based on the technological aspects for enhancing knowledge management practice in the higher education context. The underlying hypothesis was that the current web technology status quo which is conceptually recognised as Web 2.0 could hugely foster a knowledge sharing process within a collaborative culture in an academic environment as far as knowledge management is concerned. In order to verify this hypothesis extensive research was conducted and data from computer science lecturers in the Universities and Institutes of technology was collected and analysed. Therefore this chapter endeavoured to devise a conceptual framework of Web 2.0 for knowledge sharing in computer science academic staff based on the findings obtained from data analysis. The second section of this chapter intended to partially implement this framework whereby a working prototype was developed to demonstrate this framework.

4.2 Framework

Among the deliverables of this research was to create a framework of Web 2.0 tools that would facilitate knowledge sharing in higher learning institutions. The knowledge that is essentially focused for this purpose is both tacit and explicit teaching knowledge possessed by computer science lecturers. Using the findings from the research and literature a framework for knowledge sharing using Web 2.0 tools and technologies within computer science faculty can be deduced.

This framework will have the following phases:

- Improving the Sustainable Knowledge Culture
- Willingness of Participation
- Web 2.0 – Enhanced Technology Environment
- Training Support for Emerged Tools
- Continuous Knowledge Sharing

Phase 1: Improving the Sustainable Knowledge Culture

As it was observed in *section 2.4.8* in the literature the most challenging thing that must be addressed and overcome to be able to adopt a knowledge management strategy in universities is the absence of a sustainable knowledge management culture. Therefore Reid (2000) recommended cultural practices in carrying out knowledge management.

Referring to *section 3.3* in the analysis of data collected from computer science lecturers in Ireland, when individual lecturers were asked to provide their opinions on the following statement: "*I would like to share the teaching experience and knowledge that I use when teaching, through the Web and especially using Web 2.0 tools like Wikis, Blogs, Podcasting and others*" the majority seemed to be neutral to this statement which can arguably be said that they are reluctant to share their knowledge using these tools. From this fact the underlying Web 2.0 framework for knowledge sharing hugely depends on the improved knowledge culture which will encourage lecturers to share the teaching knowledge and to collaborate to improve this knowledge

Rowley (2000) pointed out in *section 2.4.8* that rewards are a key element of any culture and basing on the factors that Lee et al. (2006) suggested for fostering knowledge sharing the following could be one of key factors to improve and attaining sustainable knowledge culture in the computer science faculty that might facilitate academic staff to use Web 2.0 tools to share their teaching knowledge; Extrinsic Motivation and Intrinsic Motivation.

Extrinsic motivation fundamentally includes elements such as reward, image/reputation and reciprocity. In reward lecturers could be given incentive in the form of money or gift for frequently contributing or posting contents into the faculty wiki, or regular posting of teaching approaches and experience using blog, or podcasting. In image/reputation the lecturer will be receiving sizeable recognition for quality contents that have been posted in wikis, blogs or using podcasting. Furthermore in reciprocity lecturers would have a sense of mutual indebtedness for collaborating and sharing of their teaching experiences and skills using Wikis, Blogs, Podcasting or RSS.

Intrinsic motivation includes an element of "*enjoyment of helping*" in the sense that lecturers will be feeling good, fun and challenging for sharing their teaching approaches, skills and experiences using individual blogs, through podcasting or the faculty wiki.

These factors must be reinforced through Institutional policies which should explicitly be laid out and address these key elements so that lecturers might feel more encouraged and become accustomed to use these tools to share their teaching knowledge. Based on the findings in *section 3.3.3* the majority of lecturers who responded the survey agreed with this statement; "*Institutional policy should encourage lecturers to use new Web tools like Blogs, Wikis, Video Podcasting and Audio Podcasting in the faculty to share their teaching experience and knowledge*". Therefore in order that these tools would be well accepted and used by lecturers to share their knowledge there must be strong support which is built upon the institutional policy.

Phase 2: Willingness to Participate

Basing on the findings it appears that computer science lecturers are unwilling to participate in sharing their teaching knowledge using Web 2.0 tools. This can be vividly observed in *section 3.3.3* when analysing data where majority of lectures from Ireland were neutral when asked about their willingness to share their teaching experience with their colleagues using Web 2.0 tools. Referring to *chapter 2 in section 2.3.2* the underlying aspects of Web 2.0 is driven by participation which is enabled by the core platforms such as blogs, wikis, social networks and tools that allow easy content creation and sharing. Therefore lacking user participation will make these platforms meaningless and useless as it was pointed out in the *section 2.3.4* by the co-founder of FaceBook who emphasised on the importance of community to use technologies to make them existing and useful.

Participation will be enforced by the existence of the improved and sustainable culture as discussed in *phase 1* of the framework. So in order for Web 2.0 tools to be used by computer science lecturers for sharing there must be an active participation of lecturers in contributing contents about their teaching experiences, approaches and skills. Institutional policies must also address and recognise this community participation.

Phase 3: Web 2.0 – Enhanced Technology Support

Among the deliverables of this research project was to propose a set of Web 2.0 tools that are efficient and effective for sharing of teaching knowledge relating to teaching approaches, experiences and skills of computer science lecturers. Basing on the findings from *section 3.2 and 3.3* it appears that likely Web 2.0 tools that have been assessed and agreed by majority lecturers are; Wikis, Blogs, Audio Podcasting, Video Podcasting and RSS.

From those findings Video Podcasting seemed to be largely favoured by lecturers as to be more useful tools for sharing of teaching knowledge followed by Wikis and RSS, and Blogs. Lecturers were sceptical about the usefulness of Social Networking tools, Mashups and Tagging. Nevertheless *section 2.4.10* of the literature showed that tagging is used in university by both lecturers and students to share knowledge during the teaching of web programming.

The majority of lecturers verify that video podcasting is importance for sharing of teaching knowledge. Referring to *section 2.4.9.4* Duffy & Bruns (2006) explained that video podcasting in combination with RSS facilitate sharing of tacit knowledge which includes teaching experiences and insight. *Section 2.4.4* showed that tacit knowledge is highly personal and hard to formalise, and difficult to communicate with others. Thus computer science lecturers prefer video podcasting due to its support for sharing of an individual lecturer's tacit knowledge. Specific approaches that individual lecturers uses while teaching might be visually seen and captured by others through video podcasting and hence improving and retaining computer science teaching knowledge.

Another proposed tool is the wiki which is a collaborative tool and hugely supports tacit knowledge sharing. As it was explained in *section 2.4.10* wikis offer support for collaborative knowledge sharing related to teaching and learning hence lecturers has verified it as a useful tool for the sharing of teaching knowledge they own in a collaborative manner.

The blog is another tool which was accepted by computer science lecturers as an important tool for the sharing of teaching knowledge. Referring to *section 3.2* and

section 3.3, the majority of computer science lecturers agreed that the blog is useful in the sharing of computer science teaching knowledge. This can be more substantiated in *section 2.3.3.2* in which blogs were described as a useful tool for academic purposes such as support for reflection on teaching experiences and categorised descriptions of resources and methodologies for teaching (Duffy & Bruns, 2006)

The findings from the research in *section 3.3* showed the majority of lecturers in Ireland declared that RSS is useful for the sharing of teaching knowledge although the findings based on the Tanzanian respondents showed that they are neutral in suggesting the usefulness of RSS in sharing of teaching knowledge. However this can be argued that they are unaware of this tool, since *section 2.4.9.4* showed that RSS can be used in combination with video podcasting to share teaching experience and insights.

Therefore the main objective of this phase was to introduce the set of Web 2.0 tools that are potential for enhancing sharing of teaching knowledge and can be highlighted as follows:

- Video podcasting for enhancing visual sharing of tacit teaching knowledge
- Wikis for collaborative sharing of teaching knowledge
- Blogs for providing reflection on teaching experience and support categorised descriptions for teaching methodologies
- Audio podcasting also for helping sharing of tacit teaching knowledge.
- RSS for providing currently updates of contents posted in Podcasting, Wiki or Blog.

Furthermore from the interview that I conducted with some leading computer science teaching gurus they suggested that these tools will be useful to lecturers for a knowledge sharing purpose if they are deployed and operating under an improved knowledge culture supported by strong institutional policy. Furthermore participation of lecturers in using these tools to share their teaching knowledge is necessary to make them meaningful.

Phase 4: Training Support

Basing on the research findings in *section 3.3.3* it appears that majority of computer science lecturers need some training support for the emerging new technologies related to teaching. Training is important to increase the enthusiastic usage of Web 2.0 tools which consequently will encourage collaboration and sharing of teaching knowledge. For instance in *section 3.3.3* considerable number of lecturers strongly agreed with this question: "*My Institute should provide training to help understand new Web tools so that I can easily use them for teaching students and to share my teaching knowledge with my colleagues to encourage collaboration within the faculty*".

Therefore the research findings verify that training is an important part of the Web 2.0 framework for sharing of teaching knowledge.

Phase 5: Continuous Knowledge Sharing

The last phase of this conceptual framework is the continuous sharing of teaching knowledge in the faculty by the support of Web 2.0 tools. This could be well achieved through sequential coordination with the above phases in an iterative manner. The knowledge sharing process is not a one time process but is continuous processes given that above factors are well implemented.

The process must be maintained through constant revised and improved knowledge culture, followed by continuous participation of lecturers, then more enhancements and improvements of Web 2.0 tools that would fit existing culture and environment, and regular training of these tools to keep lecturers more motivated. Figure 4.2.1 displays the visual representation of the whole model
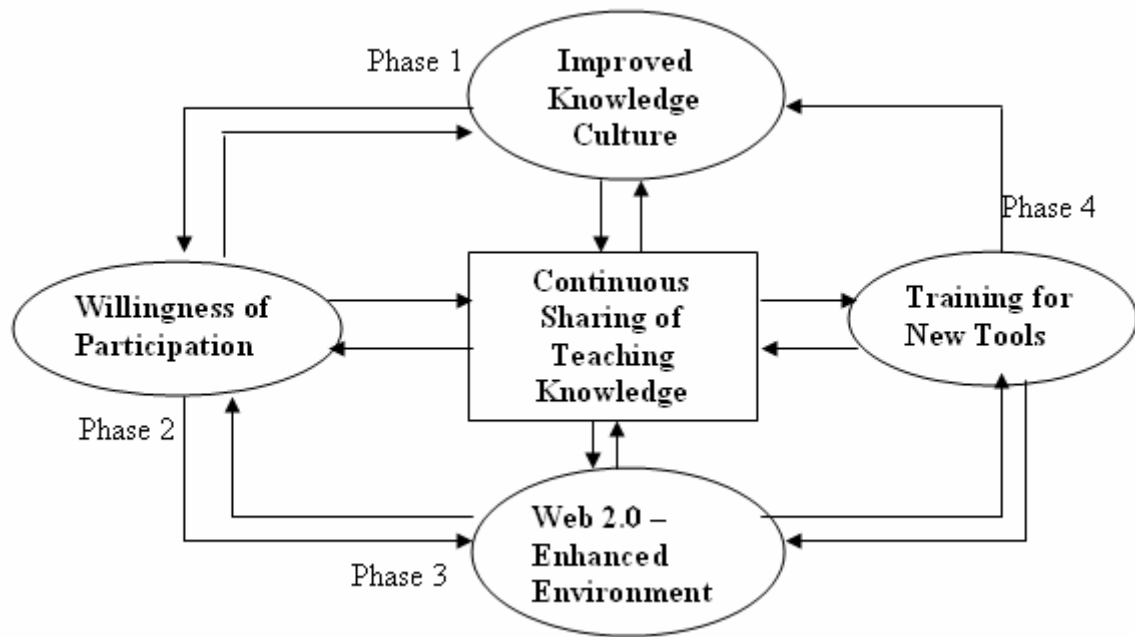
Figure 4.1 1 Framework (Author 2008)

4.3 Working Prototype

To demonstrate the implementation of the framework a working prototype system was developed which encompasses the Web 2.0 part of the framework.

4.3.1 Technical Architecture of the Prototype

The underlying architecture of the prototype has been built on 3-tier architecture. The first tier is the client tier which controls the presentation views of the blog posts, wiki articles, and podcasting posts. The second tier is the application/business logic tier which controls the communication between back end data resources and presentation layer (client tier). The third tier is the data tier which stores the necessary data for blog, wiki and podcasts.

Figure 4.3.1 below represents the architectural view of the working prototype.
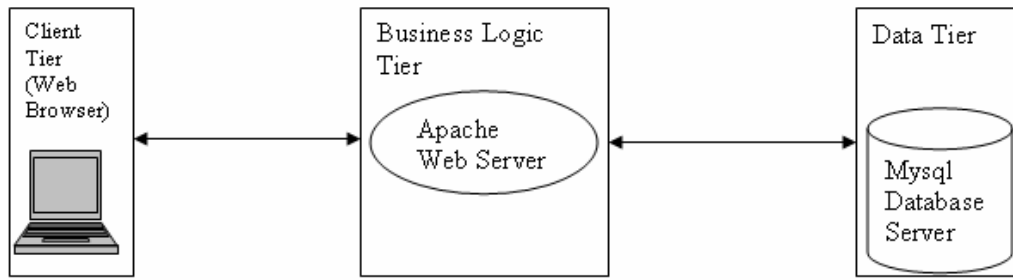
Figure 4.2 1 Prototype Architecture (Author 2008)

As figure 4.3.1 shows the Logic tier of this prototype is entirely controlled by an Apache Web Server with PHP Script which handles the flow of Information between the Data tier and the Client tier for display. The back end layer consists of the Data tier which stores the data and information such as databases for Blogs, Wikis, and Podcasts and is managed by a MySQL database management system. So the whole working prototype system runs under an Apache/MySQL Servers platform.

Therefore the prototype will be working in a Web Based environment. Essentially it integrates all the necessary Web 2.0 features. The entry page consists of the necessary links to Blogs, Wikis, and Podcasting, with RSS which are tools that have been recommended in *section 4.2* based on the research findings. From the research findings the teaching knowledge that could be shared through these tools would be a Programming teaching module.

The operational mode of the prototype is that lecturers could post contents regarding their programming teaching skills and approaches in blog explaining how his/her lectures are delivered in a reflective manner. Also they could use wiki to share particular teaching knowledge in a collaborative manner and they could use podcasting to listen or watch media files about programming teaching skills and expertise as well as podcasting their lectures. RSS is important tool which will be acting as a bridge as discussed in *section 2.3.2.4* to inform lecturers about any new postings from the wiki, blog or podcasting so that they could contribute to them through commenting. Hence each of these tools will demonstrate how teaching knowledge could be shared.

The home page technically contains the static features with global links in the page header. These links will send a user to the desired application such as the blog, the wiki, or podcasting. The home page of this portal can be shown in the figure below:
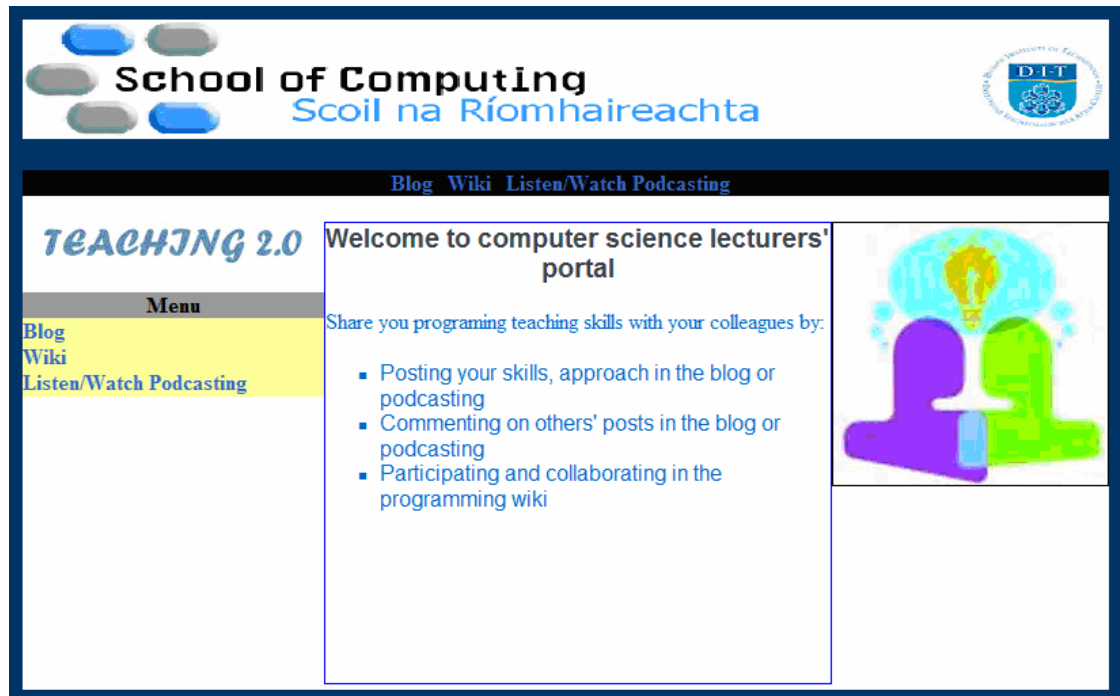

Figure 4.3 1 Home Page (Author 2008)

When a lecturer clicks on the blog link he/she will be sent to the particular blog where he/she could read posts and comments from different lecturers about their programming teaching skills as well as being able to post contents about teaching programming and provide real time comments on others' posts. In this prototype I have used the Wordpress blog software for blog creation. All users of blog will be managed by the Blog administrator who will have to register blog users, managing what they post and comment.

Teaching knowledge related to programming will be shared and captured using blog due to the ability of the posting and the commenting provided by blog that enhance people exchanging their views in a conversational manner. The screen shot in figure 4.3.3 below shows the blog post on a particular programming teaching skill.

Figure 4.4 1 Blog Post (Author 2008)

RSS as proposed by lecturers is an important tool to share teaching knowledge. In this prototype RSS helps to remind lecturers on any updates from the wiki, the blog, and podcasting in their own time without necessarily having to visit site. The screen shot in figure 4.3.4 below represents an RSS feed of the teaching programming blog displayed using a feed aggregator;

Figure 4.5 1 Feed Reader (Author 2008)

A '*Wiki*' link in the home page sends a user to a wiki application where lecturers will be collaborating together to create and share articles relating a particular teaching approaches and skills. The Wiki application in this prototype has been configured using *a MediaWiki* software tool which operates under an Apache/Mysql server environment. The screen shot in figure 4.3.5 below demonstrates an editable wiki article which describes a consensus view on particular programming teaching approach.
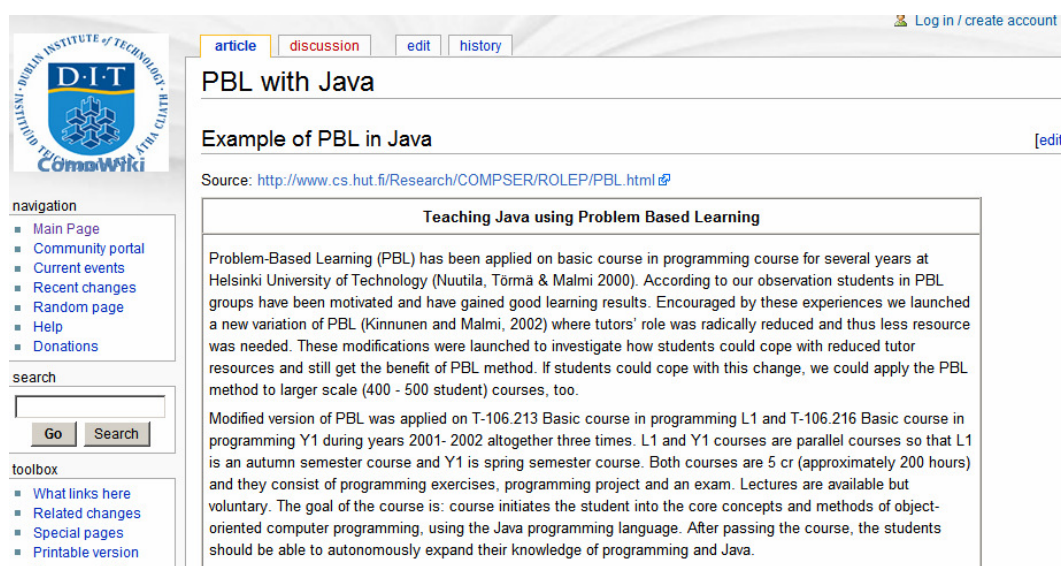
Figure 4.6 1 Wiki Page (Author 2008)

Therefore by using a Wiki, teaching knowledge of programming in this case could be incrementally generated and shared in collaborative way due to its capability of allowing more than one person to contribute to the same document which is regarded as 'many to many knowledge sharing'.

Another link which is available in the home page is '*Listen/Watch podcasting*'. This link will send a lecturer to a podcasting application where he/she can share and gaining new teaching approach by listening to podcasting posts. This is an audio podcasting application which has been configured using *Loudblog* podcasting software tool. To be able to podcast every lecturer must be registered by administrator. An individual lecturer has the ability to comment on a particular podcast through text or audio recording. Podcasting will be a more powerful tool for enhancing sharing of individual

tacit teaching knowledge. The screen short in figure 4.3.6 below demonstrates this feature.
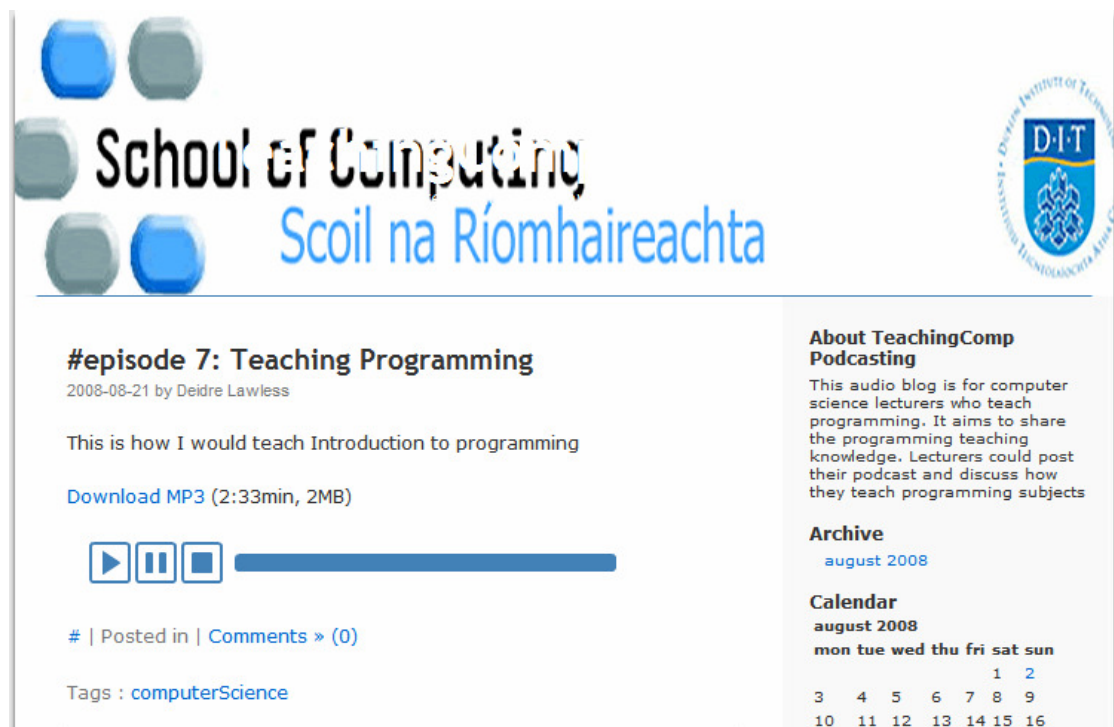
Figure 4.7 1 Audio Podcast (Author 2008)

In order to make a podcast, an audio file must be created using any audio recording software such as *Audacity* which is a freeware license. Audacity has the ability to convert a recorded audio file into MP3 format file which is a required format for audio podcasting. Then using loudblog the file is uploaded ready for podcasting.

The *"Listen/Watch Podcasting"* also enables a computer science lecturer to watch the syndicated video posts showing a visual representation of some teaching programming approaches used by a particular lecturer. The video podcasting application has been configured using loudblog software. Video podcast enables some implicit techniques to be visually shared to other lecturers. Hence video podcasting potentially facilitates sharing of a particular teaching technique. Also the ability of a visitor to contribute by visual, audio or text comment makes this tool more useful in exchanging views hence improving sharing. Figure 4.3.7 below is a simple screen short displaying video podcasting or video blog.

Figure 4.8 1 Video Podcast (Author 2008)

To video–podcast the video file must be created first using digital video camera or webcam or whatever means. In sample videos that I have used I downloaded from the YouTube video sharing website which are normally in flash video format. I used *Smart FLV Converter* software to convert from flash video to Window Media Video (*.wmv*) format. Then I used *ImTOO MPEG Encorder Standard* to convert *wmv* file format into MP4 format which is compatible for video podcasting using LoudBlog. In order for file to be played using LoudBlog, the *QuickTime* Player must be installed in the system.

An important thing to note is that for each of the above applications which consists of some knowledge management features which will assist users to perform other knowledge management related activities. For instance users can search for other posts in the blog, podcasting using tags; also a wiki page is enabled by searching ability where users are able to search for any available Wiki articles.

4.4 Conclusion

This chapter interpreted the results obtained from the analysis findings by devising a framework for Web 2.0 tools in sharing particular teaching knowledge in a computer science undergraduate education. The prototype was then developed to demonstrate how these tools might be interacted within this framework. In examining the prototype it could be obviously seen that these tools are capable of enhancing knowledge sharing within the academic context. The next section discusses the evaluation of this prototype after being reviewed by some computer science teaching expert

5   EVALUATION

5.1 Introduction

To determine its feasibility in enhancing sharing of teaching knowledge, the devised framework in *section 4.2* and the prototype developed in *section 4.3* were presented to some senior computer science lecturers in the Dublin Institute of Technology (DIT) for evaluation and feedback. The purpose of this chapter is to test and evaluate the devised framework and the developed prototyped system of the integrated Web 2.0 tools.

5.2 Evaluation

In doing the evaluation four interview questions were asked to lecturers after they have reviewed the framework and tested the prototype. The first two questions focused on the features presented in the framework. These are:

- Do you think the devised framework is useful in supporting the sharing of teaching expertise regarding the current culture of the institute?
- Do you think there has to be some changes to the framework or is it workable as it is?

The last two questions focused on the developed prototype and these are:

- Do you think the prototype developed is useful in facilitating sharing of teaching expertise?
- What necessary changes should be made to the prototype so as to be more enhanced to facilitate sharing of teaching expertise?

In response to the first question one of the undergraduate lecturers had the following comments:

"*...the framework is a good idea and it is quite appropriate…*"

The second senior lecturer had the following response:

"*…I do think it is useful…*"

From this feedback it could be verified that the framework is a potential solution in enhancing the sharing of teaching expertise in higher education environment with a facilitation of the Web 2.0 platform.

However the following suggestion was provided by one of the lecturers concerning phase 2 of willingness of participation:

"*…the willingness of participation is going to be a large hurdle to get over in the beginning…*"

This means that phase 1 which addresses the importance of establishing sustainable knowledge culture must be followed in order to have a big impact on the Willingness to Participate phase which consequently will encourage people to share their teaching expertise using the provided Web 2.0 tools.
.

In responding to the second question about the framework which was "*Do you think there has to be some changes to the framework or it can be workable?*" the following comments were provided:

"*I think the training problem is less of an issue, I think if you look at the usability aspect… people are familiar with using the Web…if you talk about recording lectures it may need a certain amount of facilitation for that…*"

The above feedback generally suggests that although people are familiar with the Web as shown in the survey results of *question 3* in *section 3.2.1* and *section 3.3.1* there is requires a considerable amount of training in using some tools such as video and audio podcasting which also supports the results obtained from *question 3* in *section 3.2.2* and *section 3.3.2* where participants preferred to have a training on using or recording lectures for Podcasting. However it was suggested that training could be a part of a wiki article within the system.

In response to the third question which was: "*Do you think the prototype developed is useful in facilitating sharing of teaching expertise?*" the following feedback was obtained from one of the lecturers:

"*...It is a good integrated idea to have all three…so it has potential and I think it is interesting*" Which means that lecturers approve the prototype to be implemented and become workable.

However they have recommended that an important thing is to get people who will use the system and measure the benefit after a certain period of time as the following quotation suggests:

"*I think a priority should be to get this to a workable state, so it is not just a prototype but it is an actual working system and then give it a year…and see does it actually work, do people use it…*"

Hence the important thing is to put the working prototype into actual working system and measure the benefit over long period of time which suggests that the phase 1 of the framework which emphasises on improving knowledge culture must be well implemented as Reid (2000) suggested in *section 2.4.8* so as to achieve the real benefit of the system.

In responding to the following question "*What necessary changes should be made to the prototype so as to be more enhanced to facilitate sharing of teaching expertise?*"

Most of the recommendations provided from this question were based on the technical aspects of the system. For instance one of the lecturers said: "*…generate a kind of familiar user experience, obviously there are some parts of homepage that are little bit difficult like colour scheme,…so if you login once is very easy for people to see whether there is a recent updates, who is commenting my articles, what are the articles I would be interesting now…*"

This suggests that the colour of homepage must change to get more experienced user interface. Another recommendation was to include a login page, however when looking at individual applications of blogs, wikis, and podcasting within the prototype have included the ability to login to post any contents.

5.3 Conclusion

This section was aimed to experiment the developed prototype, and evaluating the framework. The targeted lecturers used the prototype system and also reviewed the framework. The overall feedback from the computer science lecturers showed that both the framework and prototype have potential and could be deployed in an academic environment to enhance collaboration and knowledge sharing about computer science education and hence support the key theory of this research. However some lecturers suggested that the prototype system should be run over a longer period of time to understand its usage statistics and measuring its real benefit in improving teaching performance and innovation in teaching computer science.

6   CONCLUSIONS AND FUTURE WORK

The main objective of this research was to evaluate the potentials of Web 2.0 tools in enabling the process of the sharing of teaching knowledge related to computer science within the context of higher education. The knowledge investigated was both implicit and explicit teaching knowledge, regarding computer science. The answers from the lecturers showed that not only are these tools useful for helping in learning and teaching but they also facilitate the sharing of their teaching knowledge.

6.1 Conclusions

Each chapter in this research explained directly or indirectly the importance of the inclusion of Web 2.0 in disseminating academic knowledge in higher education. Chapter 2 was broken down into three main sections which are education, knowledge Management and Web 2.0. The Education section discussed various concepts relating to teaching and learning. It described a variety of approaches to teaching different aspects of computer science in higher education and also different learning styles that are adopted. The chapter that discusses various aspects of knowledge management and how knowledge management is incorporated in an academic perspective in higher education.

The education systems of both Tanzania and Ireland were reviewed to see what cultural impact their history have in the ways in which higher learning institutions in these two countries can share knowledge about computer science education using Web 2.0 tools. What was interesting was to see how both have a similar history in terms of colonisation and commitment to learning in education. The following are the highlights of the education section in chapter 2:

- Discussion on the history of education in Tanzania and Ireland was discussed. The aim was to look at the gradual processes and mechanisms in which higher education improved over time and oversee potential challenges facing the current situation in higher education as well as envisaging its adaptive ability in the dynamic environment.

- Core concepts relating to education were then discussed; including important theories related to teaching and learning which are used in higher education.

The aim was to understand which aspects could be enhanced through Web 2.0 technology.

- The last part of the education section discussed various approaches used in teaching computer science in higher education. The main objective was to examine how Web 2.0 could fit and enhance particular approaches. For instance Problem-Based Learning approach which Kaldoudi *et al.* (2008) said that it could be strongly supported by Wikis and Blogs.

The next section was concerned with Web 2.0 technologies and tools. The objective of this review was to determine which Web 2.0 tools exist, what Web 2.0 means, and what the current state of the art is in Web 2.0 technology. From this review of the literature it is clear that Wikis, Blogs, and Podcasting are three dominant tools available in Web 2.0 that have potential to facilitate the sharing of knowledge about teaching computer science. The following are most important highlights of Web 2.0 section;

- The first part of this section was focusing on a general understanding of Web 2.0. It can be observed that there is no consensus definition regarding of Web 2.0. A number of definitions of the term Web 2.0 were reviewed. However most of them are based on the services and values that are provided by new Web tools and applications which have changed the role of Web users in interacting with Web where they have a new role of contributing and shaping the Web contents. Based on the framework proposed in this project and research findings, Web 2.0 is the 'architecture of participation'. In this part of the Web 2.0 section, several web tools such as Wikis, Blogs, Social Bookmarking and Tagging, and Mashups constitute the features of Web 2.0 discussed and examined their general use. The important thing which must be noted regarding these tools is a community is required to use them which aligns with the 'architecture of participation'; and it can arguably be said that, the more they are used by the community the more their usefulness and values could be realised.

- The next part of Web 2.0 section discussed in detail the extent to which Web 2.0 tools are used in higher education. It was observed that these tools are widely used in higher education and they support range of aspects involved in

education such as teaching and learning. However lecturers must be involved in mentoring the usage of these tools among students in higher education.

Knowledge management was discussed in third section of chapter 2. What was important was to identify approaches, models, and techniques of knowledge sharing. Since this research is focused on the sharing of knowledge about computer science education using Web 2.0 tools, understanding the context in which knowledge sharing exists is vitally important. This section revealed that a range of approaches have been applied in the past to using Web 2.0 tools in sharing knowledge regarding computer science education. The following are important highlights of this section of chapter 2.

- It was observed that knowledge management could be more enhanced using Web 2.0 tools. Most of these tools appeared to support particular knowledge management aspects in different ways. But still usage of these tools must be improved through constant culture initiatives.

- In higher education, knowledge management is being vigorously undertaken in some institutes. Various initiatives are being initiated to ensure that knowledge management is practised in higher education. The most important factor which appeared to be given little consideration by knowledge management initiatives is academic knowledge which is relating to research, assessing, teaching and learning. There are very few findings regarding management practices of this knowledge. The main objective of this research was to investigate which ways that sharing of teaching knowledge could be enhanced. Therefore in the second part of this section was to examine knowledge management practices in higher education.

- The last part of the knowledge management section was discussing knowledge management in education using Web 2.0 tools. This part was essential to be explored since the main objective of this research was to investigate the usefulness of Web 2.0 tools in enhancing the sharing of computer science teaching knowledge. Although the essence of Web 2.0 tools is based on participation and collaboration which could foster more knowledge sharing, there are few findings which show that these tools are used for knowledge sharing.

Chapter 3 primarily was associated with the basic research which was done in this project. The research took the form of interviews and questionnaires. The objective was to identify the views of people with regard to the sharing of knowledge in computer science education using Web 2.0 technologies. What was interesting about this section was the contrast between the Irish and the Tanzanian respondents. Mostly their responses were comparable, but there were a few interesting differences where Irish lecturers agreed that RSS is useful in the sharing of teaching knowledge and remain neutral on Social Networking tools whereas Tanzanian lecturers were neutral on RSS and agreed that Social Networking tools are useful in sharing knowledge about computer science education. Also it was interesting to note that majority of Irish lecturers want to learn about video and audio podcasting if they could have the time or training while most of the Tanzanian lecturers prefer to learn more about Wikis than other tools. In terms of the Interviews although the main themes were shared throughout all respondents there were some differences. For instance some people were dubious about building a consensus view of a particular teaching approach using Wikis by arguing that, approaches may differ from one group of students to another group, whereas other people said that Wikis are useful in putting all approaches together and refining them to get a good approach of teaching programming. Also using the triadic method of knowledge acquisition on the three concepts of *Teaching*, *Learning*, and *Assessment*; some people said all three exist in the same orbit and none can be separated from any other two, whereas some lecturers said that learning and assessment are more similar and can be distinguished from teaching.

The questionnaire which also aimed at investigating the applicability of Web 2.0 tools in higher education as well as verifying whether they are useful in sharing of computer science teaching knowledge was divided into three main sections. The first section of the questionnaire aimed at understanding to what extent computer science lecturers are familiar with Web 2.0 tools and applications.

- The interesting thing when analysing responses particularly from Tanzania is that most lecturers use Web 2.0 applications and tools, however when asked specifically their understanding of the term *Web 2.0* they replied that they are not familiar with it, which could imply that the situation might be more difficult in the corporate environment if asked about '*Web 2.0*' since in the academic environment where new knowledge is regularly created, people

within still lack clear understanding of the term. However some research is needed to verify this argument.

The second section of the questionnaire aimed at understanding whether lecturers in higher education prefer to use Web 2.0 tools while teaching students.

- The interesting thing in this section was that most lecturers in Ireland do not use Web 2.0 tools for teaching despite their familiarity of the term Web 2.0 and its applications. However the findings showed that lecturers in Tanzania who responded to the survey do use them in teaching and Wikis scored high points for that purpose.

The third section of the questionnaire intended to verify the usefulness of Web 2.0 tools in sharing of computer science teaching knowledge regarding a particular module related to the computer science field.

- The interesting thing is that there is some scepticism about some tools whether they suit to share teaching knowledge however they agree that they are useful. But due to this fading uncertainty of Web 2.0 tools lecturers still prefer some other applications which are not related to Web 2.0 tools, such as MS PowerPoint and MS Word to share their knowledge. Nevertheless these applications in a virtual environment cannot support real time knowledge sharing, as Web 2.0 tools do.

However lack of enough time for individual lecturers to have a thorough training of these tools could be argued as the potential reason for scepticism on Web 2.0 tools.

After obtaining the results, Chapter 4 endeavours to interpret the results of the analysis of all the data collected concerning the viability of sharing knowledge about computer science education using Web 2.0 technologies and tools. The analysis uncovered the fact that Web 2.0 tools have a great deal of potential in terms of the feasibility to allow sharing to occur. The following bullet points explain the main highlights of this chapter.

- The main aim of this research was to investigate the usefulness of Web 2.0 tools in sharing of knowledge within higher education context. The knowledge that was dealt with was the tacit and explicit academic knowledge related to

teaching computer science students. The results showed that they are useful for that purpose. Furthermore they could be very useful if some necessary procedures followed to accomplish this process such as inducing and enhancing knowledge culture within the faculty, providing enough time and support for individual for training.

- Among the objectives of this research was to propose a set of Web 2.0 tools that could be useful for sharing of teaching knowledge basing on the findings. Hence from the findings the proposed tools that seemed to be useful were Wikis, Blogs, Podcasting and RSS. However there is some elements of scepticism and also recommendations provided by some lecturers in using these tools for sharing knowledge about teaching. Some have recommended that sharing must ensure the lecturer-students relationship is not violated during the process.

- Also based on the objectives of the research, a framework was devised for Web 2.0 tools in sharing of computer science teaching knowledge. This framework will be acting as a methodology that will guide higher education institutions in establishing Web 2.0 a technology-centred approach of knowledge management initiatives aiming at the sharing of academic expertise within the academic context. The framework was devised basing on the research findings and the literature as well. The foundation of this framework depends upon the two main pillars which are essential in most of the knowledge management initiatives and also are the complimentary nature of Web 2.0 enabled environment. These are *Culture Change* and *Community Participation* which were discussed in the framework.

- Based on this framework the working prototype was developed to fulfil another objective of this research. This prototype constitutes all the necessary tools of Web 2.0 as proposed by lecturers in knowledge sharing–enabled environment. The prototype was reviewed by some computer science teaching experts.

The framework and prototype that were devised to allow knowledge sharing to occur about computer science education using Web 2.0 tools were evaluated in Chapter 5. The feedback from the evaluation revealed that the framework and prototype are useful.

The evaluation process was done through conducting interviews with some leading computer science lecturers in Dublin Institute of Technology (DIT) after they have reviewed the framework and tested the prototype. What was interesting here was that some of responses suggested that the tools could be expanded, modified and changed.

Generally most of the lecturers agreed that both framework and prototype are potentially useful. In my opinion I could argue that the overall implementation of framework and its prototype might yield a quality teaching experience in the same way as the quality software product is produced using Extreme Programming practices. Since you could have a pair teaching in which two lecturers for instance might share a similar approach while they continue to improve that approach. Also using something like Wikis you could have a potential collective ownership of a certain teaching skills and approaches.

Generally speaking the results obtained from the analysis of the research findings, and evaluation of the developed prototype, computer science lecturers nearly all agreed with the main hypothesis of this research which was that Web 2.0 tools have potential in enhancing sharing of computer science teaching knowledge.

6.2 Future Work

Some suggestions for future research based on this dissertation include;

- An investigation of other Web 2.0 tools that were not examined as part of this research in improving knowledge sharing and knowledge management in the higher organisation domain. In this research the Web 2.0 tools under consideration were Wikis, Blogs, and Audio and Video Podcasting with an RSS feeds. A range of other Web 2.0 tools exist, for example, Cascading Style Sheet, XML-based applications, AJAX technology, and SVG (Scalable Vector Graphics). The existing System could be enhanced to include these other Web 2.0 technologies to determine if any of these would further contribute to the ability of lecturers to share knowledge about computer science education. Furthermore Social Networking tools seemed to have significant potential in enhancing knowledge sharing practices such as Communities of Practice as claimed by Yang *et al.,* (2007). So its feasibility must

be also explored to determine if they could nurture the sharing of knowledge about computer science education and incorporated into the current system.

- This research focused principally on the idea of Communities of Practice and knowledge sharing. A range of other knowledge processes exist within the scope of knowledge management. The questions and interviews undertaken in this research were specifically geared towards evaluating the possibility of knowledge sharing using Web 2.0 tools for computer science education. Alternatively new questionnaires could be designed to assess the viability of using Web 2.0 tools for computer science education to consider knowledge acquisition, knowledge evaluation, knowledge authentication, knowledge creation, knowledge capturing or any other knowledge processes.

- This research focused principally on computer science education as it is taught in both Ireland and Tanzania. To extend and expand this research it might be interesting to compare other countries with a similar educational background to determine if their teaching of programming, in particular, and computer science education, in general, differ significantly from the results of the surveys and interviews in this research. For example, the results obtained from Irish lecturers could be compared to a survey deployed in Britain. Similarly the results from the Tanzanian lecturers could be compared to Kenya or another comparable country.

- As noted in the research the survey undertaken in this research was in two different ways. In Ireland the survey was deployed using online technology and in contrast in Tanzania the survey was deployed using a paper-based questionnaire. It may be interesting to swap those two around and deploy the online survey in Tanzania and the paper-based survey in Ireland to asses how the responses would have changed, in particular to assess the impact on *response rate* and determine if there are cultural dimensions to response rate.

- A novel technique of knowledge acquisition was used during the interview process. The triadic method [was used] to uncover lecturers' views on both education and technology. It could be extreme successful and suggest that future interviews should

incorporate other knowledge acquisition approaches in the research such as laddering, card sorting, 20-questions, Observation and Commentating.

- The system was up-and-running for only short period of time and the evaluation process included only three computer science lecturers. If there were more people in the evaluation process and the system was up-and-running for a longer period of time and was evaluated over that time, and could looked at the range of usage statistics, and could undertake periodic surveys, as well as look at what aspects of the system people are focusing on, and uncover shortcomings of the system and identify new potential approaches that could be employed within the system.

- Other future work that might be done is to investigate application of Web 2.0 tools in non-academic organisations in Tanzania that might foster knowledge management practices. From experience knowledge management is still a new field in the mainstream academics and mainly in corporate business in Tanzania. However people are enthusiastic in using Web due to increase availability of broadband. So investigating Web 2.0 tools could lead to encourage people to practise some form of knowledge management and providing a roadmap toward knowledge management initiatives in corporate environment and in academic as well.

REFERENCE:

Alavi, M. & Leidner, D.E., 1999. 'Knowledge management systems: issues, challenges, and benefits'. *Communications of the AIS*, 1(2es).

Aldrich, D., Bell, B. & Batzel, T., 2006. Automated podcasting solution expands the boundaries of the classroom. *Proceedings of the 34th annual ACM SIGUCCS conference on User services*, 1-4.

Anderson, P., 2007. What is Web 2.0? Ideas, technologies and implications for education. *JISC Technology and Standards Watch*, 2-64.

Angeles, M., 2003. K-logging: Support KM with Web logs. *Library Journal netConnect, 128 (1)*, 20-22.

Augar, N., Raitman, R. & Zhou, W., 2004. Teaching and learning online with wikis. Retrieved July 2008 from http://ascilite.org.au/conferences/perth04/procs/augar.html

Avram, G., 2006. At the Crossroads of Knowledge Management and Social Software. *Electronic Journal of Knowledge Management*, 4(1), 1-10.

Barclay, R.O. & Murray, P.C., 2000. What is knowledge management. *Knowledge Praxis*, 7(31), 00.

Barrows, H.S., 1986. A taxonomy of problem-based learning methods. *Med Educ*, 20(6), 481-6.

Bednar, A.K., Cunningham, D., Duffy, T.M. and Perry, J.D., 1992. Theory into practice: How do we link. *Constructivism and the technology of instruction*, 17-34.

Ben-Ari, M., 1998. Constructivism in computer science education. *ACM SIGCSE Bulletin*, 30(1), 257-261.

Biggs, J., 1999. Teaching for quality learning at university, Society for Research into Higher Education and Open University Press, Buckingham, Retrieved July 2008, from http://teaching.polyu.edu.hk/datafiles/R131.pdf.

Boud, D., 1985. Problem-based learning in perspective. *Problem-Based Learning in Education for the Professions*, 13-18.

Boud, D. & Feletti, G., 1997. *The Challenge of Problem-Based Learning*, Routledge, London.

Bouthillier, F. & Shearer, K., 2002. Understanding knowledge management and information management: the need for an empirical perspective. *Information Research*, 8(1), 8-1.

Brandon, B., 2003. Using RSS and Weblogs for e-Learning: An Overview. *The e-Learning Developers' Journal*, 1-8.

Brawn, J.S. & Duguid, P., 1998. Organising knowledge. *California Management Review*, 40(3), 90-111.

Brittain, S., Glowacki, P., Van Ittersum, J. and Johnson, L., 2006. Podcasting Lectures. *EDUCAUSE Quarterly*, 29(3), 24–31.

Brockbank, A. & Mc Gill, I., 1998. *Facilitating Reflective Learning in Higher Education*, SRHE/Open University Press, Buckingham.

Brown, J.S., Collins, A. & Duguid, P., 1989. Situated Cognition and the Culture of Learning. *Educational Researcher*, 18(1), 32.

Buchert, L., 1994. *Education in the Development of Tanzania, 1919-90*, James Currey, London.

Cahill, T., 1996. *How the Irish Saved Civilization: The Untold Story of Ireland's Heroic Role from the Fall of Rome to the Rise of Medieval Europe*, Hodder & Stoughton, London.

Caldwell, F. & Linden, A., 2006. PKN and Social Networks Change Knowledge Management, Retrieved July 2008, from http://www.gartner.com/resources/124100/124178/pkn_and_social_.pdf.

Gannod, G.C., Burge, J.E. & Helmick, M.T., 2008. Using the inverted classroom to teach software engineering. *Proceedings of the 13th international conference on Software engineering*, 777-786.

Chen, H.L., Cannon, D. & Gabrio, J.L., L. Toye, G. & Bailey, T.(2005). Using wikis and weblogs to support reflective learning in an introductory engineering design course. *Proceedings of the 2005 American Society for Engineering Education Annual Conference & Exposition*, 12-15.

Chi, M.T.H., Feltovich, P.J. & Glaser, R., 1981. Categorization and representation of physics problems by experts and novices. *Cognitive Science*, 5(2), 121-152.

Clark, S., Taylor, L. & Westcott, M., 2007, 'Using short podcasts to reinforce lectures', *UniServe Science 2007 Teaching and Learning Proceedings* Retrieved July 22, 2008, from http://science.uniserve.edu.au/pubs/procs/2007/08.pdf

Conklin, J., 1996. 'Designing Organizational Memory: Preserving Intellectual Assets in a Knowledge Economy', *Group Decision Support Systems*, 1, Retrieved July 2008, from http://cognexus.org/dom.pdf.

Coolahan, J., 1981. *Irish Education: Its History and Structure*, Institute of Public Administration, Dublin.

Coukos-Semmel, E., 2003. Knowledge Management in Research Universities: The Processes, Retrieved July 2008, from http://eric.ed.gov/ERICWebPortal/recordDetail?accno=ED477439, Accessed on June 2008.

Dale, C., 2007. Strategies for using podcasting to support student learning. *Journal of Hospitality, Leisure, Sport and Tourism Education*, 6, 49–57.

Davenport, T.H. & Prusak, L., 1998. *Working knowledge*, Harvard Business School Press Boston, Mass.

Davenport, T.H. & Prusak, L., 2000a. Working knowledge: how organizations manage what they know. *Ubiquity*, 1(24).

Davenport, T.H. & Prusak, L., 2000b. Working knowledge: how organizations manage what they know. *Ubiquity*, 1(24).

Davidson, C., 2006. Enterprise 2.0: the next generation-A growing number of banks are using Web 2.0 technologies within their risk management, trading and research operations. *RISK-LONDON-RISK MAGAZINE LIMITED-*, 19(10), 28.

Doctorow, C., 2002. *Essential Blogging*, O'Reilly Media, Inc, Beijing.

Drucker, P.F., 1994. The age of social transformation. *The Atlantic Monthly*, 274(5), 53-80.

Duffy, P. & Bruns, A., 2006. The Use of Blogs, Wikis and RSS in Education: A Conversation of Possibilities, *In Proceedings Online Learning and Teaching Conference 2006, Brisbane, pp. 31-38.*

Education, I.T.H., 2005. The Implementation Of Knowledge Management System In Taiwan's Higher Education. *Journal of College Teaching & Learning– September*, 2(9).

Efimova, L., 2004. Discovering the iceberg of knowledge work: A weblog case. *Proceedings of The Fifth European Conference on Organisational Knowledge, Learning and Capabilities (OKLC 2004), April 2-3, 2004*.

Ertmer, P.A. & Newby, T.J., 1993. Behaviorism, cognitivism, constructivism: comparing critical features from an instructional design perspective, performance improvement. *Quarterly*, 6, 50-7.

Felix, L. & Stolarz, D., 2006. Hands-On Guide to Video Blogging and Podcasting: Emerging Media Tools for Business Communication (Hands-on Guide), Retrieved July 2008, from http://portal.acm.org/citation.cfm?id=1200247

Fichter, D., 2005a. Intranets, wikis, blikis, and collaborative working. *Online*, 5, 47-50.

Fichter, D., 2005b. The many forms of E-collaboration: Blogs, wikis, portals, groupware, discussion boards, and instant messaging. *Online*, 29(4), 48-50.

Flanagan, B. & Calandra, B., 2005. Podcasting in the Classroom. *Learning and Leading with Technology*, 33(3), 4.

Frumkin, J., 2005. The Wiki and the digital library. *Perspectives*, 21(1), 18-22.

Fuchs-Kittowski, F. & Köhler, A., 2002. Knowledge creating communities in the context of work processes. *ACM SIGGROUP Bulletin*, 23(3), 8-13.

Fumero, A., 2006a. 'Eduweb 2.0'. *Proceedings of WEBIST*, 11–13.

Fumero, A., 2006b. 'Eduweb 2.0'. *Proceedings of WEBIST*, 11–13.

Gandhi, S., 2004. 'Knowledge management and reference services'. *The Journal of Academic Librarianship*, 30(5), 368-381.

John, P. & Urs, G., 2007. Case Study: Mashups Interoperability and eInnovation. *Berkman Publication Series, November 2007,* Retrieved July 2008, from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1033232.

Glaser, R. & Bassok, M., 1989. Learning Theory and the Study of Instruction. *Annual Reviews in Psychology*, 40(1), 631-666.

Glogoff, S. 2006. *The LTC wiki: experiences with integrating a wiki in instruction.* IN: Mader, Stewart L. (ed.) 2006. Using Wiki in Education. Retrieved from http://wikiineducation.com/display/ikiw/The+LTC+Wiki+-Experiences+with+Integrating+a+Wiki+in+Instruction, May 28, 2008

Gordon, D., 2007. Using Extended Analogy To Teach Fundamental Computing Concepts. *ITB Journal, no 15, pp4* Retrieved June 2008, from http://www.comp.dit.ie/dgordon/Publications/Author/JITB/itb.pdf#page=4.

Hamalainen, W., 2004. Problem-based learning of theoretical computer science. *Frontiers in Education, 2004. FIE 2004. 34th Annual*, S1H.

Harrsch, M., 2003. RSS: The next killer app for education. *The Technology Source* Retrieved June 2008, from http://technologysource.org/article/rss/.

Hasan, H., Maloche, J.A., Plaff, C.C. and Willis, D., n.d. Beyond Ubiquity: Co-creating Corporate Knowledge with a Wiki, Retrieved June 2008, from http://doi.ieeecomputersociety.org/10.1109/UBICOMM.2007.36.

Hasan, H. & Pfaff, C.C., 2006. The Wiki: a tool to support the activities of the knowledge worker. *Proceedings at the Transformational Tools for 21st Century (TT21) 2006 Conference. Central Queensland University, Rockhampton, Queensland*.

Haugen, S. & Claire, E., 2006. Blogs and Business: Opportunities and Headaches *Issues in Information Systems, Volume vii, no2, 2006, Retrieved July 2008 from http://www.iis-online.org/iis/2006_iis/PDFs/Wood_Behling_Haugen.pdf*.

Hijazi, S. & Kelly, L., 2003. Knowledge Creation in Higher Education Institutions: Conceptual Model, *Proceedings of the 2003 ASCUE Conference, www.ascue.org, Retrieved July 2008, from http://fits.depauw.edu/ascue/proceedings/2003/p78.pdf.*

Huang, K.T., 1999. Capitalizing on intellectual assets. *The Knowledge Management Yearbook 1999-2000.*

John, A. & Seligmann, D., 2006. Collaborative Tagging and Expertise in the Enterprise. *Collab. Web Tagging Workshop in conj. with WWW2006* Retrieved. June 2008 http://www.semanticmetadata.net/hosted/taggingws-www2006-files/26.pdf

Kaldoudi, E. Bamidis, P., Papaoiakeim, M. and Vargemezis, V., 2008. Problem-Based Learning via Web 2.0 Technologies. *Computer-Based Medical Systems, 2008. CBMS'08. 21st IEEE International Symposium on*, 391-396.

Kennedy, G., Dalgano, B., Gray, K., Judd, T and Waycott, J., 2007. The net generation are not big users of Web 2.0 technologies: Preliminary findings from a large cross-institutional study. *Providing choices for learners and learning. Proceedings ascilite Singapore 2007*, 517-525.

Kidwell, J.J., Vander Linde, K. & Johnson, S.L., 2000. Applying Corporate Knowledge Management Practices in Higher Education. *Educause Quarterly*, 23(4), 28-33.

Kille, A., 2006. Wikis in the Workplace: How Wikis Can Help Manage Knowledge in Library Reference Services. *LIBRES*, 15(2).

Klamma, R., Cao, Y. & Spaniol, M., Watching the Blogosphere: Knowledge Sharing in the Web 2.0 Retrieved June 2008, from http://icwsm.org/papers/2--Klamma-Cao-Spaniol.pdf.

Kulathuramaiyer, N., 2007. Mashups: Emerging Application Development Paradigm for a Digital Journal. *Journal of Universal Computer Science*, 13(4), 531-542.

Lage, M.J., Platt, G.J. & Treglia, M., 2000. Inverting the classroom: A gateway to creating an inclusive learning environment. *Journal of Economic Education*, 31(1), 30-43.

Lave, J., 1992. Learning as participation in communities of practice. *annual meeting of the American Educational Research Association, San Francisco, CA*.

Lave, J. & Wenger, E., 1991. *Situated Learning: Legitimate Peripheral Participation*, Cambridge University Press.

Lee, M.K.O. et al., 2006. Understanding customer knowledge sharing in web-based discussion boards. *Internet Research*, 16(3), 289-303.

Leonard-Barton, D., 1995. *Wellsprings of Knowledge: Building and Sustaining the Sources of Innovation*, Harvard Business School Press.

LONG, S., 2006. What's new in libraries exploring the wiki world: the new face of collaboration. *New library world*, 107(1222-3), 157-159.

Lorenz, C., 2006. Will the universities survive the European Integration. *Higher education policies in the EU and in the Netherlands before and after the Bologna Declaration. Sociologia Internationalis*, 1, 1–29.

Lumsden, J. & Morgan, W., 2005. Online-Questionnaire Design: Establishing Guidelines and Evaluating Existing Support. *Proceedings of International Conference of the Information Resources Management Association (IRMA'2005)*, 407-410.

Ma, Y. & Harmon, S.W., 2006. Integrating knowledge management systems, electronic performance support systems, and learning technologies: A conceptual model. *Performance Improvement Quarterly*, 19(3), 107.

MacDonald, I., 2001. The Teaching Community: recreating university teaching. *Teaching in Higher Education*, 6(2), 153-167.

Macgregor, G. & McCulloch, E., 2006. Collaborative tagging as a knowledge organisation and resource discovery tool. *Library Review*, 55(5), 291-300.

Majchrzak, A., Wagner, C. & Yates, D., 2006. Corporate wiki users: results of a survey. *Proceedings of the 2006 international symposium on Wikis*, 99-104.

Marton, F., Dall'Alba, G. & Beaty, E., 1993. Conceptions of learning. *International Journal of Educational Research*, 19(3), 277-300.

Matocha, J., Camp, T. & Hooper, R., 1998. Extended analogy: an alternative lecture method. *Proceedings of the twenty-ninth SIGCSE technical symposium on Computer science education*, 262-266.

McManus, D.A., 2001. The Two Paradigms of Education and the Peer Review of Teaching. *Journal of Geoscience Education*, 49(5), 423-34.

McMullin, B., 2005 Putting the Learning Back into Learning Technology. *Emerging Issues in the Practice of University Learning and Teaching, 67-76.*

Miers, J., 2004. BELTS or Braces. *Technology School of the Future,* Retrieved July 2008, from http://www.scribd.com/doc/167120/Wiki-as-a-Teaching-Tool.

Milam Jr, J.H., 2001. *Knowledge Management for Higher Education.* ERIC Clearinghouse on Higher Education

Millen, D.R., Feinberg, J. & Kerr, B., 2006. Dogear: Social bookmarking in the enterprise. *Proceedings of the SIGCHI conference on Human Factors in computing systems*, 111-120.

Mintzes, J.J., Wandersee, J.H. & Novak, J.D., 1998. Teaching science for understanding. *San Diego*.

Moore, T.M., 2006a. Social Computing in the Enterprise. Available at: http://www.michelle-moore.com/portfolio/671/671_SocialComputing_ThelmaMichelleMoore.pdf Accessed July 2008.

Moore, T.M., 2006b. Social Computing in the Enterprise. Retrieved July 2008, from http://www.michelle-moore.com/portfolio/671/671_SocialComputing_ThelmaMichelleMoore.pdf.

Muller, M.J., Ehrlich, K. & Farrell, S., 2006. *Social Tagging and Self-Tagging for Impression Management*, IBM Research technical report TR 06-02, Retrieved July 2008, from http://domino.watson.ibm.com/cambridge/research.nsf/~.pdf.

Murugesan, S., 2007. Understanding Web 2.0. *IT Professional*, 9(4), 34-41.

Nonaka, I. & Takeuchi, H., 1995. *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*, Oxford University Press, USA.

Ojala, M., 2004. Weaving weblogs into knowledge sharing and dissemination. *Nord I&D, Knowledge and Change*, 212–220.

Oluic-Vukovic, V., 2001. From information to knowledge: some reflections on the origin of the current shifting towards knowledge processing and further perspective. *Journal of the American Society for Information Science and Technology*, 52(1), 54-61.

Options, A. & Latest, T.O.C., 2007. Participative Web and User-Created Content: Web 2.0, Wikis and Social Networking Complete Edition-ISBN 9264037462. *SourceOECD Science & Information Technology*, 2007(15).

O'Reilly, T., 2005. Web 2.0: Compact Definition. *Retrieved September*, 24, 2006.

O'Reilly, T., 2005. What Is Web 2.0 Design Patterns and Business Models for the Next Generation of Software, Retrieved June 2008 from http://www.elisanet.fi/aariset/Multimedia/Web2.0/What%20Is%20Web%202.doc.

Owen, M., Grant, L., Sayers, S., Facer, K. 2006. Social Software and Learning. FutureLab: Bristol, UK

Parker, K.R. & Chao, J.T., 2007. Wiki as a Teaching Tool. *Interdisciplinary Journal of Knowledge and Learning Objects*, 3, 57-72.

Pavlov, I.P., 2003. *Conditioned Reflexes*, Dover Publications Inc.

Peters, K. & Ashridge, U.K., 2005. The impact of the Bologna Accord on management education around the world. *EFMD FORUM*, 36. Retrieved July 20, 2008 from http://www.efmd.org/attachments/tmpl_1_art_050622igbl_att_050622byte.pdf

Pfaff, C.C. & Hasan, H., 2006. Overcoming Organisational Resistance to using Wiki Technology for Knowledge Management. *Proceedings of the 10th Pacific Asian Conference on Information Systems*.

Pollard, D., 2004. Social networking, social software and the future of knowledge management. *How to Save the World, available at: http://blogs. salon. com/0002007/2003/05/28. html*.

Prosser, M. & Trigwell, K., 1998. Teaching for learning in higher education. *Buckingham: Open University*.

Prusak, L., 2001. Where did knowledge management come from? *IBM Systems* Journa Retrieved July 18 2008, from http://www.research.ibm.com/journal/sj/404/prusak.txt.

Ractham, P. & Zhang, X., 2006. Podcasting in academia: a new knowledge management paradigm within academic settings, *Proceedings of the 2006 ACM SIGMIS CPR conference on computer personnel research: Forty four years of computer personnel research: achievements, challenges & the future*, ACM Press, Claremont, California, USA.

Raman, M., Ryan, T. & Olfman, L., 2005. Designing Knowledge Management Systems for Teaching and Learning with Wiki Te... *Journal of Information Systems Education*, 16, 3.

Rao, M., 2003. Eight keys to successful KM practice. Retrieved July15, 2008, from http://www. destinationkm. com/articles.

Reid, I.C., 2000. The web, knowledge management and universities. *The Web: Communication and Information Access for a New Millennium. Proceedings of the Sixth Australian World Wide Web Conference, AusWeb2K, June*.

Rowley, J., 2000. Is higher education ready for knowledge management? *International Journal of Educational Management*, 14(7), 325-333.

Ruiz-Primo, M.A., 2000. On the Use Of Concept Maps As An Assessment Tool in Science: What We Have Learned so Far. *Revista Electrónica de Investigación Educativa*, 2(1), 30.

Ruiz-Primo, M.A. & Shavelson, R.J., 1996. Problems and issues in the use of concept maps in science assessment. *Journal of Research in Science Teaching*, 33(6), 569-600.

Saeed, N. & Yang, Y., 2008 Incorporating blogs, social bookmarks, and podcasts into unit teaching, *Proceedings of the tenth conference on Australasian computing education-Volume 78*, 113-118.

Säljö, R., 1982. *Learning and understanding: a study of differences in constructing meaning from a text*, Acta Universitatis Gothoburgensis, Göteborg, Sweden.

Schaffert, S., 2006. IkeWiki: A Semantic Wiki for Collaborative Knowledge Management. *1st international workshop on Semantic Technologies in Collaborative Applications STICA06.*

Schaffert, S., Bischof, D., Buerger, T. and Gruber, W., 2006. Learning with semantic wikis. Retrieved July 2008 from http://www.eswc2006.org/technologies/usb/proceedings-workshops/eswc2006-workshop-semantic-wikis. pdf.

Sleeman, D., Putnam, R.T., Baxter, J. and Kuspa, L., 1988. An Introductory Pascal Class: A Case Study of Students' Errors. *Teaching and Learning Computer Programming: Multiple Research Perspectives. RE Mayer. Hillsdale, NJ, Lawrence Erlbaum Asociates*, 237-257.

Snowden, D., 1999. A framework for creating a sustainable knowledge management program. *The Knowledge Management Yearbook 1999-2000*, 52-65.

Stewart, T.A., 1997. *Intellectual capital: the new wealth of organizations*, Doubleday New York, NY, USA.

Tonkin, E., 2005. Making the case for a wiki. *Ariadne*, 42, Retrieved July 06, 2008, from http://www.ariadne.ac.uk/issue42/tonkin/.

Tredinnick, L., 2006. Web 2.0 and Business: A pointer to the intranets of the future? *Business Information Review*, 23(4), 228.

Van der Vlist, E., 2007. *Professional Web 2.0 Programming*, Wrox/Wiley.

Voss, J., 2007. Tagging, Folksonomy & Co-Renaissance of Manual Indexing? Retrieved July13, 2008, from http://arxiv.org/abs/cs.IR/0701072

Wagner, C., 2004. Wiki: A Technology for Conversational Knowledge Management and Group Collaboration. *Communications of the Association for Information Systems (Volume13, 2004)*, 265(289), 265.

Wagner, C. & Bolloju, N., 2005. Supporting knowledge management in organizations with conversational technologies: discussion forums, weblogs, and wikis. *Journal of Database Management*, 16(2), 1-8.

Walsham, G., 2001. Knowledge Management: The Benefits and Limitations of Computer Systems. *European Management Journal*, 19(6), 599-608.

Webb, N.M., Ender, P. & Lewis, S., 1986. Problem-Solving Strategies and Group Processes in Small Groups Learning Computer Programming. *American Educational Research Journal*, 23(2), 243.

White, H.B., 1996. Dan tries problem-based learning: A case study. *To Improve the Academy*, 15, pp. 75-91.

Wiig, K.M., 2000. Knowledge management: an emerging discipline rooted in a long history. *Knowledge Horizons, Butterworth-Heinemann, Boston, MA*, pp. 3-26.

William, N. & Amin, G., 2006. Higher Education in Sudan and Knowledge Management Applications. *Information and Communication Technologies, 2006. ICTTA'06. 2nd*, 1.

Winch, C. & Gingell, J., 1999. *Key Concepts in the Philosophy of Education*, Routledge, New York.

Yang, S.J.H., Zhang, J. & Chen, I.Y.L., 2007. Web 2.0 Services for Identifying Communities of Practice through Social Networks. *Services Computing, 2007. sSCC 2007. IEEE International Conference on*, 130-137.

Yap, R., Muirhead, B. & Keefer, J., 2005 Blog RUBRIC: Designing your Business Blog. *Instructional Technology, International Journal of Instructional Technology and Distance Learning,* vol 2, no 11.

Yurcik, W. & Osborne, H., 2001. A crowd of Little Man Computers: visual computer simulator teachingtools. *Simulation Conference, 2001. Proceedings of the Winter*, 2.

Zentai, L., 2007. Application of web 2.0 in cartographic education: Is it time for Cartography 2.0?, *23rd International Cartographic Conference, 2001.* Available on http://itdl.org/Journal/Nov_05/Nov_05.pdf#page=57 Accessed June 2008

APPENDIX A

Questionnaire Survey

MSc in Computing (Knowledge Management)

This survey is to analyse the potential use and applications of new Web tools for use in Computer Science Lectures

This survey sets out to analyse the general usage of the new web tools, services and applications within the computer science lecturers' community. The survey is designed in the form of a questionnaire. The questionnaire is divided into three sections. Section A and B comprises open and closed questions and Section C contains questions of varying grades in the scale of 1 to 5.

Please feel free to fill in this questionnaire. Your answers will be treated in highly confidential way. Neither I, the Dublin Institute of Technology nor any other third part will identify your name, email address or any other personal details, nor will it be possible to identify you in any way in the report I will publish as part of my MSc dissertation. I would like to personally thank you for your time in taking part in this survey.

To return this questionnaire please forward it to bajuna.salehe@gmail.com, bajuna.salehe@dit.ie or to a person who has given this to you.

Section A: General Usage of Web tools

The purpose of this section is to get a general understanding of the usage of Web 2.0 tools within the community of computer science lecturers in undergraduate education.

Q: 1 Do you usually use any computer applications when you teach students?

      a) Yes, I use

      b) No, I don't use

      c) No answer

Q: 2 Which applications do you usually use as a lecturer in your teaching? You can check more than one answer.

      a) MS Power Point

      b) MS Word

      c) MS Excel

      d) MS Access

      e) Email

      f) Websites

      g) Others. Please specify _____

Q: 3 Do you use the Web in your work as a lecturer?

      a) Yes, I use

      b) No, I don't use

      c) Yes, I use but not often

      d) Uncertain

      e) No answer

Q: 4 Are you familiar with any of the following terms "Wikipedia", "YouTube", "FaceBook", "Flickr" or "MySpace" ?

      a) Yes, I know some or all of them

      b) No I don't know any of them

      c) Uncertain

      d) No answer

Q: 5 Have you ever used any of the following?

      a) Wikipedia

      b) YouTube

      c) FaceBook

      d) MySpace

      e) Flickr

Q: 6 Do you know or have you heard of any of the following "Wikis", "Blogs", "RSS", "Podcasting", "AJAX", or "Mashups"?

      a) Yes, I am

      b) No, I am not

      c) Uncertain

      d) No answer

Q: 7 Are you familiar with the term "Web 2.0"?

    a) Yes, I know

    b) No I don't know

    c) Uncertain

    d) No answer

Q: 8 Do you interact with any Web 2.0 tools, applications, or services like YouTube, Wikipedia, FaceBook, MySpace, or Flickr either for fun or in your work?

    a) I interact with them both for work and fun

    b) I just interact with them for fun

    c) I just interact with them for work

    d) I do not interact with them at all

    e) Uncertain

Q: 9 If you do not use Web 2.0 tools (skip Q 10 and 11), can you suggest reasons why you don't use these tools?

    a) I don't know how to use them

    b) I don't have the time

    c) My institute doesn't support me in learning them

    d) No answer

    e) Other. Please specify_____

Q: 10 How do you interact with Web 2.0 tools, services or applications? You can have more than one choice by ticking.

    a) Through social software applications like FaceBook, flickr and others.

    b) Wiki sites like Wikipedia, PbWiki and Javapedia and others

    c) Through blogging websites like Blogger.com and Blogspot.com.

    d) Podcasting sites like odeo.com and apple.com

    e) No answer

    f) Other way. Please specify_____

Q: 11 Do you have favourite Web 2.0 tools? You can tick more than one answer

    a) Wiki

    b) Blogs

    c) RSS

    d) Folksonomies and Social Tagging

    e) No Answer

    f) Others. Please specify _____

Section B: Usage of Web 2.0 tools for Teaching

The purpose of this section is to analyse the level of usage of web 2.0 tools in teaching.

Q: 1 Do you use Web 2.0 tools such as blogs, podcasting, wikis, RSS, and Social Software for teaching and for faculty use? If you answer (d) please skip to section 3

a) Yes I use them for teaching.
b) Use them for faculty work
c) Use them for both
d) No, I don't use them
e) No answer

Q: 2. What kind of Web 2.0 tools do you use for teaching? Choose your tool or tools by ticking.

a) Wiki
b) Blog
c) Audio Podcast
d) Video Podcast
e) RSS
f) No answer
g) Others. Please specify _____

Q: 3 If you had the time and/or training what other Web 2.0 tools would use for teaching?

a) Wiki
b) Blog
c) Audio Podcast
d) Video Podcast
e) RSS
f) No answer
g) Others. Please specify _____

Q: 4. List some subject (s) that you or would like to teach through Web 2.0 tools

1   ……………………….   4   ……………………….
2   ……………………….   5   ……………………….
3   …………………………

Section C: Using Web 2.0 tools for sharing computer science lecturers' teaching experiences and methods within the faculty.

The purpose of this section is to obtain computer science lecturers' opinions on the usefulness of the Web and specifically Web 2.0 tools such as Wikis, Blogs, Podcasting, RSS, etc. in sharing their methods, insights, experiences and general teaching knowledge that they use while teaching students.

Q: 1 Please give your view by ticking (√) the appropriate box.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The Web is a good way of sharing experiences and teaching knowledge in computer science.					
Web tools such as Blogs, Wikis, Social Software, Mashups, or RSS are effective in sharing teaching experience.					
My Institute should provide training to help understand new Web tools so that I can easily use them for teaching students and to share my teaching knowledge with my colleagues to encourage collaboration within the faculty.					
I would like to share the teaching experience and knowledge that I use when teaching, through the Web and especially using Web 2.0 tools like Wikis, Blogs, Podcasting and others.					
Institutional policy should encourage lecturers to use new Web tools like Blogs, Wikis, Video Podcating and Audio Podcasting in the faculty to share their teaching experience and knowledge.					

Q: 2 When teaching computer science it is important that students have a *comprehensive* understanding of:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Programming					
Hardware					
Formal Methods					
Mathematical Underpinnings					
Operating Systems					
Web Technologies					
Computer Graphics					
Games Design					
Others. Please specify					

Q: 3 When I teach programming I emphasise the following factors:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Theory					
Practical Programming					
Algorithm Design					
Documentation					
Testing					
Big – O notation					
Problem Solving					
Others. Please specify					

Q: 4 The following tools are useful for sharing teaching knowledge (approaches, methods and experiences) possessed by individual lecturers in the computer science faculty. Please give your view by ticking (√) the appropriate box.

	Extreme Useful	Useful	Neutral	Not Very Useful	Not at all Useful
Wikis					
Audio Podcasting					
Video Podcasting					
Blogs					
Social Software					
Mashups					
RSS					
Taggings					
MS Word					
MS Power Point					
Email					
Websites					
Others. Please specify					

APPENDIX B

Interview Questions

The aim of the interview was to obtain information from Computer Science Lecturers from DIT about their teaching methods, understanding how they incorporate Web 2.0 tools in their teaching, and the usefulness and potentials of these tools in sharing of their teaching knowledge.

1. What should a computer science degree emphasise?

2. What do you think are the most important things in Computer Science? Programming, Algorithms, Operating Systems, Web Technologies, Mathematics.

3. What modules do you teach in Computer Science?

4. How do you approach teaching a new module?

5. What kind of approach do you use when teaching? (Technology, Presentation). Example first, theory second or theory first, example second?

6. Do you use Web 2.0 tools in your teaching?

7. Can you think of any ways in which Wiki, Blogs, and Podcasting could be incorporated into your teaching?

8. Tell me how you would approach the teaching of Introduction to Programming. And do you think if it can be taught using PBL or case study approaches and how?

9. Tell me how you would approach the teaching of Introduction to Information Systems.

10. How would your approach to teaching evening students differ from that of day students?

11. How do you share your teaching knowledge within lecturing staff in your institute?

12. Do you think Web 2.0 tools are useful in sharing of teaching knowledge?