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ITJ

ISSN 1812-5638

INFORMATION TECHNOLOGY JOURNAL

ANSI*net*

Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

A Measurement Framework for Knowledge Transfer in E-Learning Environment

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Abstract: In this study, we proposed a framework for measuring knowledge transfer process in e-learning environment. This framework provides an element that covers all aspects to better evaluate the KTP and e-learning and provide a better description in explaining issues of effectiveness. We set up questionnaires to survey users of E-Faculty (e-learning system developed by FSKTM, UPM) and make a descriptive and inferential analysis for better findings on measurement attributes and correlation between hypothesis and testing result. We conclude that our framework provide a proper guideline to conduct evaluation on determining the effectiveness of process in e-learning.

Key words: Knowledge transfer, success factor, e-learning, measurement framework, knowledge management

INTRODUCTION

KTs has been proclaimed as one of the most critical Knowledge Management (KM) activities in the current information age where organizations have to continually learn and continually innovate to remain competitive (Joshi *et al.*, 2004). Moreover, in today's competitive global economy characterized by knowledge acquisition, the concept of KM has become increasingly prevalent in academic and business practices (Huang and Liaw, 2004). It has further been suggested, though, that whilst the management of this KT is a key for achieving competitive advantage (Argote and Ingram, 2000) it does not always take place efficiently or effectively (Szulanski, 1996; Gupta and Govindarajan, 2000).

Basically, the process of KT occurs between individual, groups and organizations. However, in E-learning environment, knowledge is transferred through information technology. Information technology is recognized as the enabler of E-learning which plays very significant role as the medium of Knowledge Transfer (KT).

E-Learning is a computer-based method that utilizes information technology to transfer knowledge. It is cost effective and capable to deliver knowledge to a large number of people. And today, E-Learning is still in an early stage with many uncertain issues to be clarified and investigated, including its relationships with the KT.

The most essential consideration in measuring KT is determining what we need to measure. Alavi (2000) suggests that one of the biggest reasons for focusing on

KT is that knowledge generation by itself cannot lead to the excellence of the organization. Rather, the organizations have to create value by using that knowledge, and knowledge can only be utilized if it is transferred successfully. Based on this premise, this research intends to concentrate on the internalization mode of knowledge conversion as in the SECI model proposed by Nonaka and Takeuchi (1995). It refers to the conversion from explicit to tacit knowledge, which involves putting the knowledge into action. However, internalization itself does not create organizational knowledge. Instead it is the process that transfers organizational knowledge to the individual. The attempt is set on the E-Learning environment as a significant alternative of delivering or transferring knowledge framework by integrating the previous frameworks. It consists of three aspects, knowledge resources, knowledge management activities and knowledge influences.

KT PROCESS IN E-LEARNING

Knowledge: In order to facilitate KT in an organization, it is first essential to understand what is to be transferred or learned (Smith and McKeen, 2003). As for the case of this research that focusing on the online learning environment, it is knowledge that is to be transferred and learned by the receivers.

Knowledge is more than information. Information is data organized into meaningful patterns. Information is transformed into knowledge when a person reads,

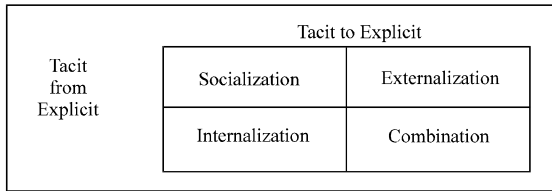


Fig. 1: SECI model

understands, interprets and applies the information to a specific work function. If a person cannot understand and apply the information to anything, it remains just information (Lee and Yang, 2000).

Knowledge is classified into explicit and tacit knowledge. Explicit knowledge is a knowledge that can be codified and documented while tacit knowledge is embedded in the background and experience of an individual or group and is thus highly idiosyncratic (Dixon, 2000; Roberts, 2000). Both explicit and tacit knowledge interact with each other and change from one form into another during activities (Nonaka and Takeuchi, 1995) as shown in Fig. 1.

KT in KM: In the current competitive environment, knowledge is recognized as a fundamental asset for organizations. In this context, KT has become one of the most critical knowledge management processes (Kuhn and Abecker, 1997; Krogh and Grand, 2000).

Several scholars, most notably Lind and Seigertho (2000), Argote and Ingram (2000), Hendriks, (1999), Kalling (2003), Lind and Persborn, (2000), Bender and Fish (2000) and Albino *et al.* (1998), argue that the process of the KT is the dissemination of knowledge from one individual or group to another within the organization. Von *et al.* (2000) also argue that with the increase in globalization, KT may also occur in geographic distances separated. Moreover, part of the information can be generated automatically by the Information System (IS) (Verkasalo and Lappalainen, 1998) which indicates that the transfer of knowledge may occur between people and the IS provided with the related knowledge.

Davenport and Prusak (2000) cites that KT is the process of transmitting (presenting or sharing knowledge to a potential recipient) and absorption (use) by that recipient. The transfer of knowledge is usually accompanied by a phase of knowledge application or practicing by the recipient. If the knowledge is not absorbed it has not been transferred. This additional phase is often fundamental to acquire those tacit and contextual aspects of knowledge not transmitted or acquired by the first phase of KT (Pfeffer and Sutton, 1999). Clearly, the ability to use or apply the knowledge received by the receiver is essential and should be

considered as a necessity to ensure a complete and effective KT. In the context of E-learning environment, KT is a process where knowledge is transferred from knowledge provider to knowledge receiver through information technology as the transfer medium.

The measurement frameworks of KM Initiatives:

Effectiveness measurement is defined as a process of quantifying the capacity to produce a desired result. In the case of this research, the issue brought up is what to measure towards an effective KT in E-Learning.

To ascertain the appropriate dimensions of a process is not an easy task. Furthermore, for measuring KT in E-learning, the measurement aspect should concentrate on the part where there has been a transfer of knowledge that has meaning and value or better knowledge as cited by Seidman and McCauley (2005). This is accordance with the objective to synthesize the KT with the context of learning. As suggested by Trittmann (2003) the selected measurement attributes have to be related to the business objectives of the organization. Here, it simply conveying that the effectiveness measurement framework to be developed should provide appropriate indicators that reflect the goal of the KT and the context where the knowledge is transferred and used and in this case, an E-Learning environment.

This section provides brief descriptions of the existing measurement frameworks that are tailored for KM initiatives and activities as shown in Table 1. Drawing from the existing literature, several limitations have been identified. Firstly, most of the existing measurement frameworks of KM are designed to determine strategic processes of an organization, which restricts the possibilities to practically change the underlying knowledge. Secondly, when it comes to the indicators, mostly are not described as closely as they would in order to be of any use for an organization which wishes to apply the indicators to their project. In other words, they are not flexible enough to be applied in other activities. Thirdly, they are often appear confusing and may not provide a satisfactory description of the process (Tillquist and Rodgers, 2002). Undoubtedly however, the frameworks have laid a ground foundation for developing a framework for this research.

Measurement approaches for KT in KM: A number of empirical studies have been focusing on how KT depends upon particular factors (Minbaeva and Michailove, 2004). The factors that have so far attracted researchers' attention are the characteristics of the knowledge recipient (Goh, 2002; Glazer, 1998) characteristics of the knowledge sources (Sarker *et al.*, 2003; Foss and Pedersen, 2002) characteristics of the transferred

Table 1: The existing measurement frameworks in KM

Authors	Framework/Model	Description
North <i>et al.</i> (1998); North and Romhardt (2000)	Classes of indicators	Class I: The content of the organizational knowledge base in qualitative and quantitative terms. Class II: Determine processes as measurable dimensions of attempts to change the knowledge base. Class III: Measure intermediate outcomes and transfer effects Class IV: Evaluate the effects of KM initiatives on business results
Resatsch and Faisst (2004)	Performance measurement framework for KM initiatives	Provides an overview on what kind of knowledge, its quality and structure is available in the company and builds the opportunity to change this knowledge base by targeted interventions of a capable knowledge expert.
Massey <i>et al.</i> (2002)	KM success model	Based on the framework reflects that KM success flows from understanding the organization, its knowledge users and how they use the knowledge
Lindsey (2002)	KM effectiveness model	Based on combining Organizational Capability Perspective Theory, and Contingency Perspective Theory Defines KM effectiveness in terms of two main constructs: Knowledge Infrastructure Capability and Knowledge Process Capability, with the Knowledge Process Capability construct being influenced by a Knowledge Task.
Orr and Persson (2003)	The performance indicator matrix	Categorizes the matrix according to these three focus areas: Process, Human and IT.
Hobley and Kerrin (2004)	Knowledge process factors	Define that the difficulty in designing Performance Measurement Framework (PMF) has been the lack of research into how people use knowledge in the context of their daily works. Reflects that individual is viewed as occupying a central position in knowledge process, over the culture, climate, knowledge practices and knowledge tools.
	Integrative framework of effective KT	Elaborate and integrate some of key factors that influence the effectiveness of KT: <ul style="list-style-type: none"> • Technologies used • Organizational culture-leader's role, experiment driven (failed experiment should not be blame) • Support structures-time, cross functional communication, organizational teamwork • Motivation of recipient • Type of knowledge

knowledge (Zander and Kogut, 1995; Szulanski, 1996) and absorptive capacity of knowledge receivers (Szulanski, 1996; Lyles and Salk, 1996; Lane and Lubatkin, 1998; Gupta and Govindarajan, 2000; Lane *et al.*, 2001). Some have measured KT as a number of KTs transpiring during a certain period of time . Others have measured KT by capturing the degree of difficulty experienced during the process (Szulanski, 1996). An attempt by Kim and Nelson (2000) focused on measuring the degree to which the knowledge is re-created in the recipient and many have adopted knowledge internalization approach to measure the outcome variable. The last approach is chosen in this research to develop the effectiveness measurement framework, which motivated by the fact that knowledge may be freely available or accessible in the organization but the recipient of that knowledge has to be able to use it (Szulanski, 1996) but the knowledge can only be used if it is transferred successfully (Joshi *et al.*, 2004).

Several authors claim that a process of KT is deemed effective if it meets certain conditions. These attempts have provided benchmarking factors that influence such process. According to the essence of KT is related to with working out with whom to transfer (agents involved),

what is to be transferred (content and context of knowledge) and how it can best be transferred (mechanism). He also claims that the receiver should have the ability to use the knowledge. Seidman and McCauley (2005) argue that besides having means of transfer, the knowledge to be transferred must be a better knowledge that has impact on improving an organization's productivity and profitability. The sender and receivers must also be both willing and be able to use this better knowledge. Slightly different view given by Goh (2002) is an appropriate infrastructure to reinforce and support the KT as one of the important factors besides type of knowledge and knowledge recipient. Similar with others, Gladwell (2000) lists three factors promoting to effective KT. First is the right person to sell the knowledge, second is the content and third is the behavior. These factors have contributed in a way that may have lead to identify the key factors of KT in the E-Learning environment. By considering the significant of the relationship between KT and the organizational learning, the same factors proposed by are adopted, in line with the focus of this study.

E-learning as a platform for KT: E-learning is a computer-based method that can be used to train and transfer knowledge of information technology applications. It is cost-effective and can be utilized to transfer knowledge to large numbers of people.

Definition of E-learning: E-learning also known as electronically delivered learning is first and foremost about learning. In today's information age, it has become one of the most important and potentially significant new instructional approaches available for supporting the improvement of teaching and learning (Blomeyer, 2002). Some other terms frequently interchanged with E-learning include online learning, online education, distance education, distance learning, technology-based training, web-based training and computer-based training. Simply describes electronically delivered learning, E-Learning is defined more specifically as the delivery of content via Internet, Intranet/Extranet (LAN/WAN), audio and video tape, satellite, broadcast, interactive TV or CD ROM. It covers a wide set of application and processes such as Web-based learning, computer-based learning, virtual classroom and digital collaboration (Kaplan and Norton, 1996). Another well-defined term by Paulsen (2002) is E-learning as interactive learning in which the learning content is available online and provides automatic feedback to the student's learning activities.

E-learning can also be characterized by four situations. First is the separation of teachers and learners, which distinguishes it from face-to-face education. Second is the influence of an educational organization which distinguishes it from self-study and private tutoring, third is the use of a computer network to present or distribute some educational content and fourth is the provision of two-way communication with each other, teachers and staff. In this study, the concept of E-learning is more towards the use of a computer network to present educational content.

E-learning and KT: To bring everything open and out, first is to determine the relationship established between E-learning and KT. Learning and knowledge have a symbiotic relationship; they depend upon each other (Mason, 2005). From a slightly more complex perspective the creation, acquisition, transfer and exchange of knowledge are all activities that are helping to define the character of information and knowledge-based economies in which the primary assets of data, information and knowledge all manifest digitally. The technological tools facilitating much of these interactions are Information and Communication Technologies (ICT). And it is through engaging with ICT that learning defines itself as e learning. In the context of KT in E-Learning, it can be safely described as the delivery of knowledge electronically to potential receivers or learners.

Literature also proves that KT is a teaching and learning process (Verkasalo and Lappalainen, 1998). It describes a situation where the provider teaches the receiver how the new piece of information is linked to the existing of the knowledge base. The transfer is only successful if the receiver understands the relationship. This is called learning. KT is also a key dimension of learning organization (Goh, 1998; Garvin, 1993). The concept of the learning organization has been well articulated by Goh (1998), Garvin (1993) and Senge *et al.* (1994) who describe it by certain attributes. One is the ability to transfer knowledge quickly and effectively from one part of organization to others. If knowledge is just a repository of information in a database, then the organization cannot use it to learn (Goh, 2002). Learning occurs when knowledge in one part of an organization is transferred effectively to other parts and used to solve problems there or to provide new and creative insights.

Therefore it is well understood that teaching and learning are clearly involving KT (KT). Hence E-Learning is clearly a small subset of the fairly new but increasingly important area of Knowledge Management (KM) (Maurer, 2003).

The E-Faculty of UPM: E-Faculty is presented as asynchronous type of Rapid E-learning, which is the most widespread E-learning method that adopting student directed or self-paced learning. More precisely, it is a combination of asynchronous and web-based learning. The method of delivery used in E-Faculty is mainly the e-text and equipped with email and forums as the supporting communication tools for both receivers and providers.

Developed using Lotus Notes 5.0, E-Faculty is basically comprised of two main components as shown in Fig. 2.

Each component consists of several sub components. For Administration and Management component, among the sub components are as follows:

- Graduate unit
- Finance office
- ICT unit
- External education

And for the Learning and Research component, the sub components include:

- Virtual classroom
- Knowledge management research group
- Network, parallel and distributed system research group

The users of E-Faculty are the lecturers as well as the students of the faculty. It is developed to significantly

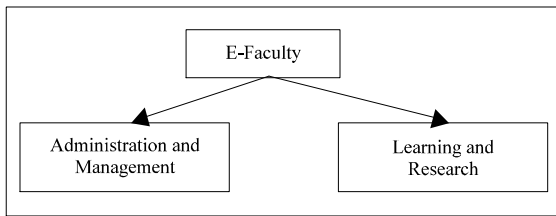


Fig. 2: Components of E-Faculty

complement classroom learning. In this case of research that involves elements of KT; the focus is set to be on Virtual Classroom, which is the sub component of the learning and research component of E-Faculty. The target users are the faculty students who are also known as the knowledge receivers. Whereby, the lecturers are the knowledge providers who deliver the learning materials via the E-Faculty as the essential enabler of KT.

In Virtual classroom, every subject offered for the semester has its own web site, which usually consists of the learning materials of the particular subject. The web site also includes the information of the lecturer responsible for teaching the subject, as well as a forum facility to enable open discussion on the subject matter. Email is another supporting communication tool provided for both the providers and receivers.

The learning materials are usually in the form of lecture notes, modules, reference notes and relevant articles. These learning materials are easily downloadable and accessible upon entering the correct password before the students are given permission to access.

DERIVATION OF THE PROPOSED FRAMEWORK

This section proposes the measurement framework, which is inspired from the following models and framework:

- Cyclical model of knowledge creation also known as SECI model (Nonaka and Takeuchi, 1995)
- The Pull model of KT (Mahe and Rieu, 1998)
- The Online Learning Framework (Phelps and Papaefthimiou, 2003)

Each model will be briefly described before the justification on the proposed framework is made.

The SECI model: Knowledge can be created through conversion between tacit and explicit knowledge by four different modes (adapted from Huang and Liaw, 2004):

- Socialization involves sharing tacit knowledge through face-to-face communication or shared experience. Thus, it is used in sharing learners’ experience and know-how with other learners
- Externalization involves the conversion of tacit knowledge into explicit knowledge. This process attempts to rationalize tacit knowledge and articulate it into explicit concepts and formal models
- Combination converts explicit knowledge into more complex and systematic sets of explicit knowledge. This process involves individuals combining and exchanging different explicit knowledge to explicit knowledge with others
- Through Internalization, explicit knowledge created is shared through an online learning community and converted into tacit knowledge by individuals

As mentioned previously, this research concentrates only on one quadrant of the SECI model, which is the knowledge internalization. Knowledge internalization is chosen as the focal due to several reasons. Internalization itself is related to ‘learning by doing’ (Nonaka *et al.*, 2000). Currently, the most frequent issue being debated in the area of KT is the absorptive capacity of the knowledge receiver, which involves in knowledge internalization. Absorptive capacity is defined as the ability to use or apply the knowledge received by the receiver. This is quite challenging since it involves several other phases before it could actually reach the absorption. The other phases include the reception and adaptation (some authors prefer to use the word interpretation). The other reason is that the characteristic of knowledge internalization itself reflects the outcome or expectation of the common scenario that occurs in a common E-Learning environment.

The pull model of KT: Various researchers have developed several models of KT. Every model is designed to adapt certain environment. Two widely used KT models are the Push and Pull model. Push model is also known as knowledge driven model. It drives the knowledge towards identified audiences. The push strategy has a central provider, who decides what information is to be distributed to whom. In contrast, pull model or problem-solving model motivates the knowledge acquirers to search for the knowledge themselves. In this strategy, it is the user who judges what he needs and is motivated to seek and retrieve the knowledge.

Whilst Push model lessened the motivation possessed by the knowledge seeker/receiver, Pull model

is highly recommended in the online learning environment. Most frameworks show that the process of KT in the E-Learning environment often begins by the knowledge seeker/receiver acquires for the desired knowledge (Phelps and Papaefthimiou, 2003). The inquiring can usually be made through searching or browsing the knowledge database or repository. Roy *et al.* (2003) listed Pull model as one of the KT challenges. Therefore, the Pull model is chosen to develop the effectiveness measurement framework in this study.

The E-learning framework: The E-learning framework by Phelps and Papaefthimiou (2003) is used as the guideline in developing the effectiveness measurement framework as intended in this study. The framework is shown as in Fig. 3.

Phelps and Papaefthimiou (2003) define E-Learning as the provision of learning (opportunities) with the assistance of interactive, electronic technology, whether offline or online. They subdivide the wide range of approaches to E-Learning into four broad categories, which are the administration, e-enhanced, e-enabled and e-essential.

The important part of this framework is the stages of the learning process that the knowledge acquirers/receivers learn through, which are acquiring skills, constructing knowledge and understanding and participation and interaction. Similarly, the KT from the perspective of a knowledge receiver, are also involving similar stages, which are the reception, adaptation and absorption of the knowledge. Literally, the knowledge acquirers/receivers will first inquire for the desired knowledge. After they received the knowledge sent to them, they will begin to adapt and absorb the knowledge. This is what we call the sharing of knowledge through participation and interaction. Thus, it shows that the learning stages shown in the framework are relatively significant to the processes went through by the knowledge receivers in the process of KT.

Figure 4 illustrates the model of KT in the E-Faculty. As the focus of this research gears to knowledge internalization, this model highlights three key factors involved in the KT; knowledge to be transferred, knowledge receiver and KT medium. These factors are recognized in the literature as the main enablers of effective KT in E-Learning environment. The model also identifies five significant stages of learning process including the interaction between the knowledge receiver and provider. A diagram points the key factors in effective KT in E-Learning environment is shown in Fig. 5. Each factor consists of a set of recommended measurement attributes.

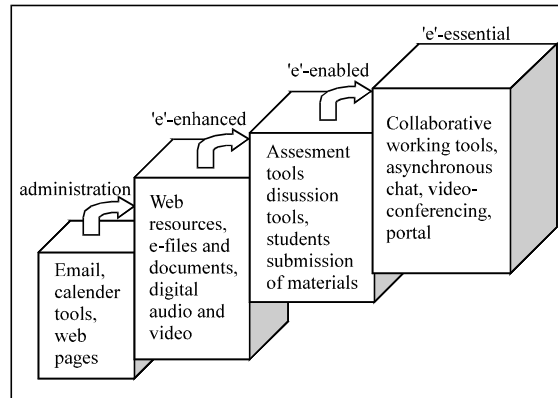


Fig. 3: The Online learning framework

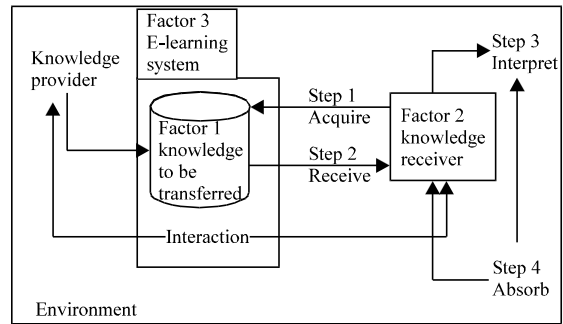


Fig. 4: The model of KT in E-Faculty of UPM

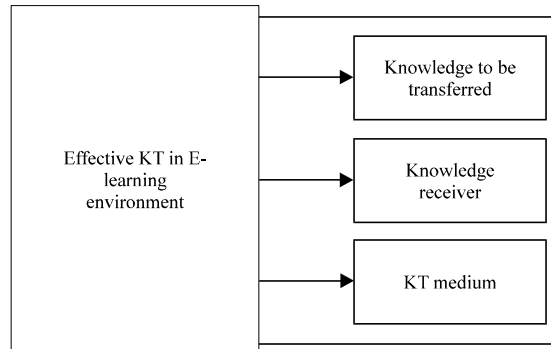


Fig. 5: The Key factors of effective KT in the E-Faculty

KEY FACTORS

The following section describes in brief each of the key factors.

- **Factor 1:** Knowledge to be transferred
This factor describes the explicit knowledge in the repository of the E-Faculty
- **Factor 2:** Knowledge receiver
Factor 2 represents the person who retrieves the knowledge from the E-Faculty

- **Factor 3: KT medium**

This factor represents the E-Faculty in facilitating the process of KT

Measurement attributes: In the context of this research, the measurement attributes are measures to observe to find out if the process of KT in the E-Learning environment is effectively conducted.

When using measurement attributes as a means to determine process effectiveness, there are some characteristics to take into account. The attribute needs to be understandable, valid and sufficiently flexible. Moreover, it is also beneficial if they are possible to influence by the involved people. Furthermore, they need to be in line with the organization and its objectives or goals.

Factor 1: Knowledge to be transferred: Table 2 shows the measurement attributes proposed for the knowledge to be transferred factor. Learning content is variously described as courses, modules or learning objects that have been the subjects of much discussion in the debate over quality. While quality is difficult to define, its importance is universally appreciated. Quality is described as a concept rather than a technique, so its implementation is very much dependent on the process at hand (Babu, 2005). Until today, there is no formal or accurate definition for quality content, in which most of the attempts give definition based on the current situation that is going to be measured. Some claim that quality content is measured in terms of its usefulness. But others agree that quality content represents a quality presentation of appearance. Here, the quality content of knowledge document is defined in terms of how the content is displayed and presented that may have lead to the ease of reading and understanding. It is believed as a strong argument where characteristics of the content are easier and more transparent in terms of appearance (font used, structured paragraph, understandable diagram) rather than judging whether or not the content is useful, reusable or even ‘better’ knowledge. It is argued that to determine these less-transparent characteristics is a bit unnecessary especially in the case of this study, where the knowledge provider are those highly trained lecturers who are supposedly to deliver ‘better’ knowledge to the receivers.

The second proposed attribute for the knowledge to be transferred factor is the reliability of the knowledge document. By definition, this attribute stands for stability,

which explains the extent to which a measure, procedure or instrument yields the same result or repeated trials. In this case, it explains the extent to which the knowledge document is reliable in terms of whether it is sufficiently provided to fulfill the need of the particular course throughout the semester.

Next is timeliness, the third measurement attribute for this factor. Timeliness is defined as the ability of an entity to provide service within the required time. In this research, timeliness is measured to determine whether the content of the knowledge document is being kept updated regularly in accordance to the current needs.

The fourth attribute is the accuracy of the knowledge document. Accuracy is understood as the quality of nearness to the truth or the true value. It simply brings the meaning of the extent to which the knowledge document is relevant to the user’s need and expectation. The ‘true result’ is another description given, which refers to the quality content of the knowledge document.

The measurement attributes are actually adapted and adjusted based on the framework by Resatsch and Faisst (2004). In the context of E-Learning, the content of the knowledge to be transferred plays very significant role in determining effective learning.

Factor 2: Knowledge receiver: Three measurement attributes are proposed for knowledge receiver factor as shown in Table 3. As stated by Kapp (2003), the E-learning market is about the learner, not the instructor. Without a focus on the learner, the learner’s needs and the aptitude of the learner, E-Learning cannot take place. Lian (2000) supports the statement by claiming that a meaningful learning must begin with a question, which makes sense to the learner and not to the teacher. In this category, the knowledge receiver is measured based on the ability to use the knowledge and assimilate new knowledge, estimation on how much the receiver has gained from the knowledge and also the receiver’s attitude towards the knowledge in terms of the self-motivation to acquire and receive the knowledge.

Defined by Cohen and Levinthal (1990) absorptive capacity is the ability to identify, accumulate value, assimilate, transform and exploit knowledge resources to enable learning. Many researchers claim that absorptive capacity has huge influence in determining effective process of KT. This includes a claim by Jackson and Klobas (2002) which called the absorptive capacity as the major determinant of internalization efficiency.

Table 2: Measurement attributes for knowledge to be transferred factor

Measurement attributes	Definition
Quality content of the knowledge document	The quality of the content is measured in terms of how it is presented; prepared and structured that may have lead to the ease of reading and understanding.
Reliability of the knowledge document	The extent of the knowledge document is sufficiently provided to fulfill the need of the particular course
Timeliness of the knowledge document	The extent to which the knowledge documents being regularly updated.
Accuracy of the knowledge document	The content provided matches the user’s need and expectation.

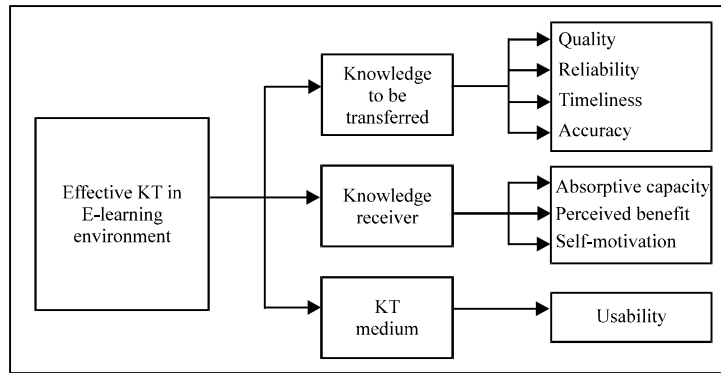


Fig. 6: The Proposed framework for measuring KT in E-learning: A case of E-Faculty of UPM

Table 3: Measurement attributes for knowledge receiver factor

Measurement Attributes	Definition
Absorptive capacity (Minbaeva <i>et al.</i> , 2003)	The extent of the receiver applying the knowledge received
Perceived benefit	The estimation on how much the receiver has gained from the knowledge received
Self-motivation (Goh, 2002; Szulanski, 2000)	The degree of the receiver's willingness to acquire and receive the knowledge

Table 4: Measurement attributes for KT medium factor

Measurement attribute	Definition
Usability	The degree of the e-learning system's usability (Ease of use, provides mechanism to interact during the KT)

On the other hand, perceived benefits are the outcomes associated with integration that is valued by individuals. No literature could be found that attempted to measure perceived benefits although it is frequently discussed. User perceptions have been important in several streams of research. Use of perceptions is a frequent means to gain the cognition of participants regarding the subject matter under investigation. Perceived usefulness and perceived ease of use from TAM (Davis, 1986, 1989) and TAM2 (Venkatesh and Davis, 2000) are probably the best known uses of perception in MIS. In this research, perceived benefit here is meant by how much does the receiver benefited from experiencing the process of KT via E-learning. It is believed that this attribute can give wider indication on the process effectiveness as a whole.

The third attribute is self-motivation or self-willing to acquire and receive the knowledge via the E-learning system. This attribute is proposed to make it aligned with the pull model of KT as described in earlier section of the chapter. Without possessing this attitude, the receivers as the E-learning users cannot possibly achieve the desired expectation.

Factor 3: KT medium: A technical issue to be addressed is usability. Table 4 proposes usability as the measurement attribute for KT medium factor. It is essential to ensure the E-learning is easy to use (Kapp, 2003). If the technology is seen as cumbersome or difficult to navigate, the potential learners (receivers) or instructors (providers) will never use it. It should be easy to find the help menu, easy to move from one section of the course top another and easy to have communication with both the provider

and other receivers. Online communication with real people may or may not be included, but the focus of E-learning is usually more on the learning content than on communication between learners and tutors (Paulsen, 2002).

Nevertheless, the electronic portion of E-learning is critical to the success of the student and to the online courses and the need for usability has been recognized in the web site design literature as a crucial quality criterion when determining user satisfaction with such a system. It can therefore be argued that the usability of an E-learning application can significantly affect learning (Costabile *et al.*, 2005). Figure 6 presents the proposed framework for measuring KT in E-Learning environment.

Proposed relationship factors: Based on the relationship between the key factors and measurement attributes illustrated in Fig. 6 eight proposed relationship factors are formulated as the following.

Key Factor 1: Knowledge to be transferred

- **H1 (a):**Quality content of the knowledge document is significantly correlated to the knowledge to be transferred factor of an effective KT
- **H1 (b):** Reliability of the knowledge document is significantly correlated to the knowledge to be transferred factor of an effective KT
- **H1 (c):** Timeliness of the knowledge document is significantly correlated to the knowledge to be transferred factor of an effective KT
- **H1 (d):** Accuracy of the knowledge document is significantly correlated to the knowledge to be transferred factor of an effective KT

Key Factor 2: Knowledge receiver

- **H2 (a):** Absorptive capacity of the knowledge receiver is significantly correlated to the knowledge receiver factor of an effective KT
- **H2 (b):** Perceived benefit of the knowledge receiver is significantly correlated to the knowledge receiver factor of an effective KT
- **H2 (c):** Self-motivation of the knowledge receiver is significantly correlated to the knowledge receiver factor of an effective KT

Key Factor 3: KT medium

- **H3:** Usability of the E-Learning system is significantly correlated to the KT medium factor of an effective KT

VALIDATION

Section one: The demographic profile: This section presents the demographic profile of the respondents. Table 5 presents a profile of survey respondents with regard to student’s program, experience using E-Learning system and length of usage of the E-Learning system used. Out of 300, 204 questionnaires are returned making the response rate 68%.

Program: Majority of the respondents (77.94%) are first-degree students. This is due to the fact that the first-degree of computer science students dominate the number of students of the faculty. The remaining respondents are the students of diploma in computer science (22.06%).

Experience using E-learning system: Everyone in the sample (100%) is found having experienced using E-learning system and all of them claimed the experience of using E-Faculty. This indicates that all of the respondents are familiar to the E-Faculty and use them as a complement to the traditional classroom daily.

Length of usage: More than half of the respondents (60%) have been using the E-Faculty for the duration between one to two years, followed by 20.49% at less than one year and 14.71% who have been using the E-Faculty for three years. The remaining respondents (4.39%) are those who have been using the E-Faculty for more than three years. These figures show that majority of the respondents have been using the E-Faculty for a quite long period of time and this justifies their ability to evaluate the E-Faculty used in this study.

Descriptive analysis on the measurement attributes: This section describes the result of descriptive analysis conducted on the measurement attributes. The aim of this analysis is to examine the distribution of responses towards the key factors.

Knowledge to be transferred factor: The study used four dimensions to evaluate the knowledge to be transferred factor. The dimensions are quality of knowledge document, reliability of knowledge document, timeliness of knowledge document and accuracy of knowledge document. The respondents are asked the extent to which they agree to the statements related to the four dimensions of this factor using Likert scales with 1 = strongly disagree and 5 = strongly agree. The distribution of the responses is shown in Table 6.

As exhibited in the Table 6, the accuracy of knowledge document had the highest mean with a statistic value of 3.77 and standard deviation = 0.70 followed by the quality of knowledge document dimension (mean = 3.66, SD = 0.74) and reliability of knowledge document (mean = 3.62, SD = 0.74). Overall, the respondents agreed to the extent that knowledge documents in the E-Faculty were in good quality, reliable and accurate (at least to their level of satisfaction). Nevertheless, the respondents seemed to believe that timeliness of knowledge document in the E-Faculty was poorly undertaken based on the mean, which is 3.5. This may be due to some of the knowledge documents were seldom updated and maintained.

Knowledge receiver factor: Three items are used to evaluate the responses towards knowledge receiver factor. Each item represents a construct of a dimension in

Table 5: Respondent profiles: Personal characteristics

Characteristic	Frequency	Percent
Program	159	77.94
Bachelor of computer science	45	22.06
Diploma in computer science		
Experience using E-Learning system		
Yes	204	100.00
No	0	0.00
Length of usage		
Less than 1 year	42	20.49
1 to 2 years	123	60.00
3 years	30	14.71
More than 3 years	9	4.39

Table 6: Descriptive statistics: Knowledge to be transferred factor

Items	Means	S.E.	S.D.	Var.
Quality	3.66	0.052	0.74	0.54
Reliability	3.62	0.052	0.74	0.55
Timeliness	3.39	0.053	0.76	0.58
Accuracy	3.77	0.049	0.70	0.49

knowledge receiver factor. Respondents are asked about their perceptions towards each item using a five-point Likert scales (1 = strongly disagree, 5 = strongly agree).

As shown in Table 7, the mean of the distribution of knowledge receiver variables were more than 3.5. The perceived benefit dimension had the highest mean of 3.70, followed closely by absorptive capacity (mean = 3.60) and self-motivation (mean = 3.52). Majority of the respondents agreed on the use of E-Faculty as a medium of KT, which has benefited them in increasing their learning achievement. They believed that as a complement to the traditional classroom, contribution of the E-Faculty was proven. The respondents also agreed to the extent that they were able to utilize the knowledge received through the E-Faculty. This point is vital since if the knowledge receiver does not put the knowledge received into use, the process of KT is considered unsuccessful. Self-motivation is subjective due to its close relationship with a person's attitude however; the respondents seemed to fairly claim that they retrieved the knowledge through E-Faculty with their own wills and believed it helps them.

KT medium factor: There is only one measurement attribute in KT medium factor, which is usability of the E-Faculty. Usability is evaluated using seven items. Respondents are asked about their perceptions towards each item using a five-point Likert scales (1 = strongly disagree, 5 = strongly agree).

As depicted in Table 8, the result indicates that the respondents were satisfied with the usability of the E-Faculty as the transfer mechanism. Although the mean value shows the satisfaction rate's scale is between neutral to agree, its function as the KT medium facilitated the process of KT itself thus contribute to effective process.

Inferential analysis on the measurement attributes: One of the aims for conducting the inferential analysis on the data is to determine how each variable in every key factor to effective KT correlated with each other. Table 9 shows the result for the knowledge to be transferred factor.

The highest correlation value was between quality and reliability of the knowledge document. This suggests that the respondents may have believed that both quality and reliability of the knowledge document possesses equivalent weight of importance. This is followed by the correlation value between quality and timeliness. This shows the respondents perceived quality knowledge document was supposedly up to date. High correlation value was denoted between reliability and timeliness of the knowledge document but only low correlation value was established between reliability and accuracy of the

Table 7: Descriptive Statistics: Knowledge receiver factor

Items	Means	S.E.	S.D.	Var.
Absorptive capacity	3.60	0.057	0.82	0.67
Perceived benefit	3.70	0.058	0.83	0.68
Self-motivation	3.52	0.053	0.76	0.58

Table 8: Descriptive statistics: KT medium factor

Items	Means	S.E.	S.D.	Var.
Usability	3.57	0.058	0.83	0.69

Table 9: Correlation analyses between variables of the knowledge to be transferred factor

		Quality	Reliability	Timeliness	Accuracy
Quality	Pearson correlation	1	0.878	0.609	0.465
	Sig. (2-tailed)	.	0.122	0.391	0.535
	N	4	4	4	4
Reliability	Pearson Correlation	0.878	1	0.878	0.063
	Sig. (2-tailed)	0.122	.	0.05	0.937
	N	4	5	5	4
Timeliness	Pearson correlation	0.609	0.878	1	-0.139
	Sig. (2-tailed)	0.391	0.05	.	0.861
	N	4	5	5	4
Accuracy	Pearson correlation	0.465	0.063	-0.139	1
	Sig. (2-tailed)	0.535	0.937	0.861	.
	N	4	4	4	4

knowledge document. Finally, a negative correlation was spotted between timeliness and accuracy of the knowledge document. This implies that timeliness had no influence on the accuracy of the knowledge document.

Based on the Table 10, there is only one positive correlation value that is between the absorptive capacity and perceived benefit. Even though the value indicates moderate correlation between these two variables, it can be concluded that the respondents were able to use and receive benefit from the knowledge retrieved from the E-Faculty.

The hypotheses testing: This section presents the research findings of the relationships between the key factors of an effective KT in E-Faculty and the measurement attributes recommended accordingly to each factor.

In order to investigate this relationship, eight hypotheses as earlier are formulated. In an attempt to test these hypotheses, correlation analyses are conducted.

The correlation analysis is used to find the strength and the direction of the relationship between these key factors and the proposed measurement attributes.

Knowledge to be transferred factor: It is the first key factor of an effective KT in E-learning: A Case of E-faculty of UPM. Again, as mentioned in earlier chapter, this factor is actually concentrated on the content of the knowledge document. In this factor, four measurement attributes are proposed.

Quality content of the knowledge document: The first attribute is the quality content of the knowledge document. Quality content is defined in terms of these questions:

- Is the content easy to understand?
- Is the content well documented?
- Is the content presentable?

Table 11 depicts the result of correlation between the knowledge to be transferred factor and quality of the knowledge document.

With a high correlation value of 0.864, it strongly suggests that the respondents were highly satisfied with the quality content of the knowledge document and thus implies that it is indeed a vital measurement attribute of the knowledge factor.

Reliability of the knowledge document: The second attribute is the reliability of the knowledge document. This attribute is about whether the document is sufficient according to the syllabus required in a particular course.

As shown in Table 12, the result of correlation coefficient between reliability and the knowledge factor is extremely high, which denotes a value of correlation at 0.991. This indicates that reliability as a strong dimension for measuring the knowledge to be transferred factor to an effective KT.

Timeliness of the knowledge document: The next attribute is the timeliness of the knowledge document. It is about the up-to-datedness of the knowledge document. Is the knowledge document providing the latest reference? Is the knowledge document is regularly updated? Or is the materials used applicable with today's demand?

Again, the result displayed in Table 13 proves that timeliness is another important dimension of the knowledge to be transferred factor besides quality content and reliability of the knowledge document.

Accuracy of the knowledge document: The fourth attribute is the accuracy of the knowledge document. Questions include whether the document provides correct, relevant and sufficient content define this attribute.

Contrary to the first three attributes, accuracy seemed to have an opposite correlation with the knowledge to be transferred factor. Table 14 shows negative correlation (-0.600) between them. This probably suggests that the respondents are unsatisfied with the accuracy of the knowledge documents provided in the E-Faculty. This

Table 10: Correlation analyses between variables of the knowledge receiver factor

		Absorptive capacity	Perceived benefit	Self-motivation
Absorptive capacity	Pearson correlation	1	0.458	-0.655
	Sig. (2-tailed)	.	0.542	0.345
	N	4	4	4
Perceived benefit	Pearson correlation	0.458	1	-0.856
	Sig. (2-tailed)	0.542	.	0.144
	N	4	4	4
Self-motivation	Pearson correlation	-0.655	-0.856	1
	Sig. (2-tailed)	0.345	0.144	.
	N	4	4	4

Table 11: Correlation analysis between knowledge to be transferred factor and quality content of the knowledge document

		Knowledge to be transferred factor	Quality content of the knowledge document
Knowledge to be transferred factor	Pearson correlation	1	0.864
	Sig. (2-tailed)	.	0.336
	N	3	3
Quality content of the knowledge document	Pearson correlation	0.864	1
	Sig. (2-tailed)	0.336	.
	N	3	4

Table 12: Correlation analysis between knowledge to be transferred factor and knowledge document reliability

		Knowledge to be transferred factor	Quality content of the knowledge document
Knowledge to be transferred factor	Pearson correlation	1	0.991
	Sig. (2-tailed)	.	0.088
	N	3	3
Knowledge document reliability	Pearson correlation	0.991	1
	Sig. (2-tailed)	0.088	.
	N	3	5

Table 13: Correlation analysis between knowledge to be transferred factor and knowledge document timeliness

		Knowledge to be transferred factor	Knowledge document timeliness
Knowledge to be transferred factor	Pearson correlation	1	0.952
	Sig. (2-tailed)	.	0.197
	N	3	3
Knowledge document timeliness	Pearson correlation	0.952	1
	Sig. (2-tailed)	0.197	.
	N	3	5

also suggests that the respondents may have believed accuracy has very little or no impact or influence on the knowledge to be transferred factor. They might be possibly assuming that reliability and accuracy of the knowledge document is the same thing, which is not true.

This also shows that the users are unrealized of the equal weight that the accuracy carries as the other attributes are, as mentioned previously.

Hence, it can be summarized that out of four measurement attributes proposed, only three are significantly correlated with the knowledge to be transferred factor. The attributes are quality, reliability and timeliness of the knowledge document. From the results; the highest correlation value matrix is between the knowledge to be transferred factor and reliability of the knowledge document (0.991), followed by timeliness (0.952) and quality (0.864). This implies that reliability is the prominent measurement attribute of the knowledge to be transferred factor. Apparently, this finding supports the first three hypotheses of the knowledge to be transferred factor. Therefore, it is safe to claim that these three measurement attributes are indeed important when measuring the knowledge to be transferred factor to an effective KT.

Knowledge receiver factor: Knowledge receiver is the second key factor of an effective KT in the E-learning environment. Three measurement attributes are proposed for this factor.

Absorptive capacity: The first attribute is absorptive capacity of the knowledge receiver. Absorptive capacity is defined as the ability of the receiver to use the knowledge received. Just by downloading knowledge document and saving it into the storage device does not mean that the users are practically using the knowledge. Instead, the use of knowledge is by applying it in daily routine, assignment, or even during assessment. In fact, this attribute is the most important when measuring KT. Many claimed that an efficient KT depends on whether KT is utilized or used effectively by the receiver.

Table 15 shows the result of correlation analysis done between the knowledge receiver factor and absorptive capacity. It indicated very high correlation (0.894) thus confirms that absorptive capacity is significantly correlated with the knowledge receiver factor.

Perceived benefit: Although the same result is expected from the next two measurement attributes for knowledge receiver factor, which are the perceived benefit and self-motivation, evidence seemed to prove otherwise. Table 16 and 17 depict the result of correlation analysis between; perceived benefit and the knowledge receiver factor and self-motivation and the knowledge factor, respectively.

A negative correlation (-0.183) is denoted between perceived benefit and the knowledge receiver factor. This

Table 14: Correlation analysis between knowledge to be transferred factor and the knowledge document accuracy

		Knowledge to be transferred factor	Knowledge document accuracy
Knowledge to be transferred factor	Pearson correlation	1	-0.6
	Sig. (2-tailed)	.	0.59
	N	3	3
Knowledge document accuracy	Pearson correlation	-0.6	1
	Sig. (2-tailed)	0.59	.
	N	3	4

Table 15: Correlation analyses between knowledge receiver factor and absorptive capacity

		Knowledge receiver factor	Absorptive capacity
Knowledge receiver factor	Pearson correlation	1	0.897
	Sig. (2-tailed)	.	0.291
	N	3	3
Absorptive capacity	Pearson correlation	0.897	1
	Sig. (2-tailed)	0.291	.
	N	3	4

Table 16: Correlation analysis: Knowledge receiver factor and perceived benefit

		Knowledge receiver factor	Perceived benefit
Knowledge receiver factor	Pearson correlation	1	-0.183
	Sig. (2-tailed)	.	0.883
	N	3	3
Perceived benefit	Pearson correlation	-0.183	1
	Sig. (2-tailed)	0.883	.
	N	3	4

suggests that not every student will find E-learning suitable as a learning style and for that, they might also believe using the E-Faculty did not really contribute to their learning achievement. This might be due to the role of E-Faculty as a complement to the existing traditional classroom, which had not been fully utilized by the respondents. According to Zhang *et al.* (2004) E-learning cannot create the real life on a campus.

Self-motivation: On the other hand, self-motivation seemed to have almost no correlation with the knowledge receiver factor. Table 16 reveals the result. This might be driven by several causes. First, self-motivation is very subjective and so much close to one's attitude. Second, the E-Faculty might have limited features or attractions, which fails to attract the users to learn and retrieve knowledge through it. Some students feel bored or intimidated before a computer (Zhang *et al.*, 2004).

Hence, only one attribute that is the absorptive capacity is significantly correlated with the knowledge receiver factor. Based on the evidence, it is wise to say that to measure the knowledge receiver is by measuring

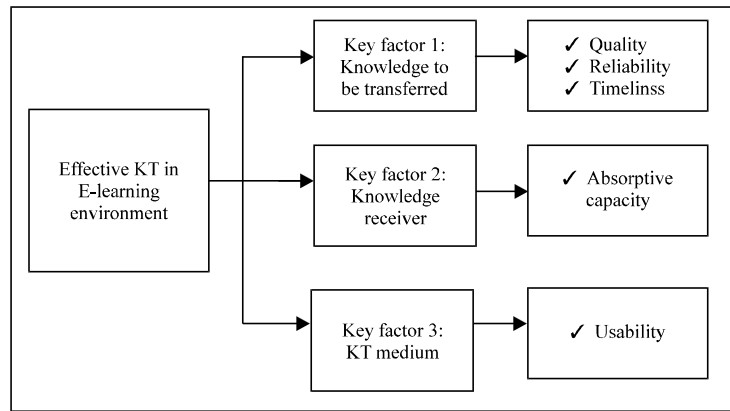


Fig. 7: The Framework for measuring KT in E-learning: A case of E-Faculty of UPM

Table 17: Correlation analysis between knowledge receiver factor and self-motivation

		Knowledge receiver factor	Self-motivation
Knowledge receiver factor	Pearson correlation	1	-0.965
	Sig. (2-tailed)		0.168
	N	3	3
Self-motivation	Pearson Correlation	-0.965	1
	Sig. (2-tailed)	0.168	
	N	3	4

Table 18: Correlation analysis between KT medium factor and usability

		KT medium	Usability
KT medium	Pearson correlation	1	0.985
	Sig. (2-tailed)		0.109
	N	3	3
Usability	Pearson correlation	0.985	1
	Sig. (2-tailed)	0.109	
	N	3	5

the absorptive capacity of the receiver. Therefore, the hypothesis H2 (a) is supported, while the other two hypotheses of the knowledge receiver factor are not supported.

KT medium factor: The third and final key factor of an effective KT in E-Learning environment is the KT medium. In this research, the medium is the E-Faculty, the E-Learning system used in FSKTM. There is only one dimension proposed, which is the usability of the KT medium.

As shown in Table 18, the correlation was almost scored perfectly. This implies the users are highly believed that usability is accounted when measuring the KT medium. They also believed that the E-Faculty scored in facilitating them in the KT. Thus this finding also supports hypothesis H3.

Consequently, it is clear that the significant relationship between the three key factors together with the five measurement attributes (out of eight) evidently indicates the importance of these factors in ensuring successful KT.

Based on the inferential findings discussed above, the effectiveness measurement framework for KT in E-Learning: A Case of E-Faculty of UPM is presented as in Fig. 7. From the framework, we can see that knowledge to be transferred factor is now consisted of three measurement attributes, which are quality content, reliability and timeliness of the knowledge document and has omitted accuracy. For knowledge receiver factor, only one is taken as the measurement attribute, which is the absorptive capacity of the knowledge. Two other measurement attributes proposed for this factor have failed to support. And finally, the usability remains as the measurement attribute for the KT medium as proposed.

Hence, these findings have also successfully verified the following hypotheses:

Key factor 1: Knowledge to be transferred

- **H1 (a):** Quality of the knowledge document is significantly correlated to the knowledge to be transferred factor of an effective KT
- **H1 (b):** Reliability of the knowledge document is significantly correlated to the knowledge to be transferred factor of an effective KT
- **H1 (c):** Timeliness of the knowledge document is significantly correlated to the knowledge to be transferred factor of an effective KT

Key factor 2: Knowledge receiver

- **H2 (a):** Absorptive capacity of the knowledge receiver is significantly correlated to the knowledge receiver factor of an effective KT

Key factor 3: KT medium

- **H3:** Usability of the E-Learning system is significantly correlated to the KT medium factor of an effective KT

DISCUSSION

SECI Model categorizes the knowledge into groups and we take one of it as our focus which is internalization. Our research is significant to Online Learning Framework as they define stages of learning process in online environment. We identified the stages can be look in perspective of knowledge receiver as discussed earlier. E-Faculty use a concept of Pull Model (seeker seek for info), therefore we look for effectiveness in this angle for our measurement framework. Our research is significant to performance evaluation made by Jayanthi *et al.* (2008) but they define five points to make e-learning worked and focus more on usability evaluation of e-learning system. Research from Mahdavi *et al.* (2007) gave multi-criteria methodology using learner satisfaction to evaluate activities occurred in e-learning system. Previous researchers define an evaluation from certain part of e-learning system while our research takes their part as key factors, which is user (knowledge receiver), the medium of knowledge to be transferred (technology) and the knowledge itself and gives attributes to evaluate the effectiveness of e-learning system in each key.

CONCLUSION

Different methods of KT are used nowadays. These include non-electronic methods, such as classroom-based training; simple-electronic methods, such as best practice databases; and complex electronic methods, such as E-Learning and virtual classrooms. The KT within the context of technology-based teaching and learning environments can be interpreted as a holistic phenomenon composed of two related streams: the teaching process (concerning knowledge generation and delivery) and the learning process (concerning knowledge acquisition) (Garcia-Barrios *et al.* 2002). Thus, the significant relationships established between E-Learning and KT has actually brought up several issues mainly on the effectiveness of the process in E-Learning. It is an essential need for determining the effectiveness of a process, however without a proper guideline or framework to conduct the evaluation, there is nothing much that can be done and improved.

Therefore, this research attempts to solve the addressed problem, by developing the measurement framework. An E-Learning system developed by FSKTM of UPM, known as the E-Faculty is chosen as the research setting. Its existence is more than merely complementary to the traditional classroom. Thus in this case, the framework developed is basically based on the process of KT that occurs in the E-Faculty.

The framework can be seen as an integration of several important elements involving both the E-Learning and KT, which in turn facilitates in better evaluating the KT that covers most of all its vital aspects and E-Learning as a whole.

ACKNOWLEDGMENT

This study was supported for two years and 10 months by Ministry of Higher Education (MOHE), Malaysia, under University's Fundamental Research Grant Scheme, code number: 02-01-07-152FR, with title: Developing a Performance Measurement Framework for Knowledge Transfer Process in E-Learning Environment. The project was started in February 2007 until December 2009, at The Faculty of Computer Science and Information System, University Putra Malaysia.

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