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Measuring Knowledge Transfer Success by D&M

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Abstract

DeLone & McLean's success model has been actively used since its first introduction in 1992. In this article the model is extended to describe the success of knowledge sharing in an information system that included a part of the knowledge base of a private educational institute. As the supply of private education is increased it is vital to be aware if the offered educational services support the use of the knowledge base and if the service is perceived satisfactory by the customers. In our descriptive qualitative case study we discuss how the D&M model can be used in assessing educational services from the customerâ s point of view. In the assessment we focus on issues that interested the target organisation.

INTRODUCTION

This paper highlights the need to assess information systems that form the base of a business idea in private educational enterprises. We introduce a descriptive qualitative case study where education with a virtual learning environment was seen as a service by a private organisation. The service was offered to adult students who were seen as customers of the organisation. As the competition between education providers was increasing, it was essential to evaluate the services that were offered in the field. To describe the service, we used the success model originally developed by DeLone and McLean (1992) and later modified and assessed by several researchers (e.g. DeLone & McLean, 2003; Holsapple & Lee-Post, 2006; Lin, 2007; Wang et al., 2007; Petter et al., 2008).

In virtual learning environments the participants typically communicate with other participants (Piccoli et al., 2001). There are electronic services where the product is not a physical ware or digital information product – instead, the services concentrate on producing pure service (Tiwana & Ramesh, 2001). Therefore, it is reasonable to assess the interaction between the participants as an important element of the service. In this paper the focus is limited to describe how knowledge sharing was perceived in the virtual environment.

In this paper knowledge is discussed as hierarchical concepts of data, information and knowledge. Besides concepts, knowledge is seen as a state of mind, object, process, prerequisite of accessing information and in our paper, especially skills. We also look at knowledge as classified into tacit and explicit knowledge and note its cultural, functional, embedded, individual, social and pragmatic nature (Alavi & Leidner, 2001; Blackler, 1995; Choo, 1998; Nonaka, 1994.)

We acknowledged the ambiguous nature of knowledge and we aimed to find out how knowledge is introduced in the literature. As our empirical material was collected from a private educational organisation, we also looked knowledge as a key property of the organization (Becerra-Fernandez & Sabherval, 2001; Nissen, 2002). Among other means, the property was accessed with the help of a virtual learning environment and that set requirements to the information system. However, as the information system was seen as a service its value and usefulness was to be assessed.

The research approach was qualitative and interpretive (Walsham, 2001) and we converged the research problem with the help of a case study (Stake, 2000; Yin, 2003). Before introducing the case, we take a look at prior literature focusing on knowledge management, knowledge transfer and virtual learning environment. We emphasise the role of interaction and service as the case represents a core product of a private organisation.

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PRIOR LITERATURE

In this section we discuss the key concepts in our study. First, the nature of knowledge management and knowledge transfer is discussed. Then, virtual learning environment is presented emphasising its service nature. Finally, we introduce the DeLone & McLean success model and how it is used in prior studies related to virtual learning.

Knowledge Management and Knowledge Transfer

Knowledge can be found in several contexts such as relationships between people, processes, organisational memories and products. Therefore, it is important to understand its nature and value, not to forget its maintenance and transfer in its contexts. Before knowledge can be re-used, it must be stored and transferred for instance in organisational memory. Furthermore, to acquire organisational memory it necessitates that knowledge is acquired and used in the organisation. All storages – man-made databases, online data sources, emails – are explicit knowledge which is created from tacit knowledge. The storages are not useful to other people if the storages are not connected well to the tacit knowledge of the user. (Huysman et al., 1994; Walsham, 2001.)

Nonaka and Takeuchi (1995) defined the creation of tacit and explicit knowledge being affected by processes of socialisation, externalisation, combination and internalisation. According to the definition, socialisation is about sharing experiences. New tacit information is created by shared experience in social interaction. Tacit knowledge, such as mental models and technical skills, can be achieved by spending time in a joint environment by observing, imitating and practising. In externalisation tacit knowledge is expressed by concepts and tacit knowledge is made explicit to be shared with others who can use it as a base for new knowledge. Dialog is a good tool to transfer knowledge to others. Interaction between individuals is used when solving conflicts between tacit knowledge and surrounding context or between several people (Nonaka & Takeuchi, 1995; Nonaka & Toyama 2003.)

To be created, knowledge requires appropriate circumstances. Nonaka and Konno (1998) use the concept of ba to describe a shared space to enable knowledge creation in organisations. In their conception, ba is kind of a platform that includes four types of ba, namely originating ba, interacting ba, cyber or virtual ba and exercising ba. Ba is kind of a mechanism to promote interaction to be used in knowledge creation and knowledge transfer. The mechanisms are seen as a physical space such as a meeting room or a virtual space such as email or even as a mental space such as shared feelings and concepts.

In organisations knowledge is stored and organised in organisational memory, where knowledge is again retrieved to be used. Thus, knowledge is a part of organisational memory. With the development and widespread availability of advanced information technologies, information systems have become an essential part of this memory. Acquiring organisational memory and using it includes its acquisition and use. Organisational memory and knowledge management are related with each other and they influence organisational efficacy. Organisational efficacy is measured by finding out how efficiently the organisation performs the critical activities that produce the product sold by the organisation. (Huysman et al., 1994; Jennex & Olfman, 2002; Stein & Zwass, 1995; Walsh & Ungson, 1991.)

Knowledge is found and shared with the help of interaction between actors. Individual interaction can influence organisational or team-based knowledge base either positively or negatively. Conducive communication reveals all available knowledge and it may enable the actors in the group to easily accept what is pertinent, relevant or useful in the current situation.

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Correspondingly, disruptive communication may discourage actors in the group to see the need to find additional information or the need to change available information into appropriate mode (Propp, 1999.)

Virtual Learning Environment as a Service

Web-based learning is defined as studying and learning using Internet (Wang et al., 2007) whereas virtual learning environment is understood as a computer-based environment that often is relatively open system. In addition, in a virtual learning environment interaction between participants is significant. Similar to computer-based learning, a virtual learning environment enables a student to use learning material independently, to study subjects in different order and to use convenient material. With the help of interaction a virtual learning environment extends the learning process from individual learning experience to more communal direction. Web-based learning can also be seen as a process where study material is delivered to students with the help of Internet, intranet or extranet, as audio or visual recordings, as satellite broadcastings, with the help of interactive television or as CD-recordings. Especially, in a virtual learning environment a student can communicate with other students and teachers. (Piccoli et al., 2001, Holsapple & Lee-Post, 2006.)

E-service is web-based service where interaction between customers and service providers takes place partly or totally in Internet. Customers may also receive the service using Internat directly at their homes. (Rust & Kannan, 2003; Surjadjaja et al., 2003.) As concepts, there are differences between e-service and web-service. Web-service is often seen as software or applications available in Internat and the concept is used when referring to technique whereas the concept of e-service is used either in the meaning of Internet-based versions of legacy services or as a synonym to web-services. E-services are often called as Internet-services or web-based services, too (Baida et al., 2004.)

Furthermore, e-services may be classified according to their business character in three groups: Firstly, e-service can be a part of a process related to selling a concrete ware. Secondly, e-service may concentrate on producing products that are in digital mode, such as software. Thirdly, there are e-services where the product is not a concrete ware nor a digital information product but pure service. Real-time interaction provided by Messenger is a good example of pure services. Thus, e-services can be classified in physical, digital and pure services (Tiwana & Ramesh, 2001.)

Chiu et al. (2005) approached virtual learning as a service and they introduce a concept of e-learning service. Virtual learning can be enabled in serveral synchronic or asynchronic techniques. Synchronic web-based learning includes real-time interaction between students and teachers while asynchronic web-based learning reminds individual studying but includes non-real-time interaction with teachers for example with the help of emails and discussion boards (Chiu et al., 2005.)

In all, one can conclude that virtual learning is defined in serveral ways and it may be realised by using real-time or non-real-time techniques. It also includes tecniques such as Internet but also interaction without Internet.

DeLone & McLean Success Model

In their well-known success model for information systems (in this paper called D&M1992) DeLone and McLean aimed to present influential factors and their relationships. The measure classes in D&M 1992 include several known measures and only relevant measures

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should be chosen in each research case. Since its introduction, the model has been applied and modified in hundreds of studies which proves that a general approach is needed to measure the success. DeLone and McLean modified their model later and instead of five factors ('system quality', 'information quality', 'use', 'user satisfaction' and 'individual impact') that influence 'organisational impact' the new model (in this paper called D&M2003) includes six factors that influence 'net benefits' (Fig. 1). (DeLone & McLean, 1992; DeLone & McLean, 2003; Petter et al. 2008.) The developed model included 'service quality' as a new factor, 'individual impact' was removed, and 'intention to use' was added related to 'use'. In addition, 'net benefits' replaced 'organisational impact' as an output of the measure.

DeLone and McLean applied D&M2003 also in measuring e-commerce success. They note how the measures in the six dimensions of the models are chosen to fit e-commerce and include measures such as download time, relevancy, overall support, easiness in navigation, time saving (DeLone & McLean, 2004).

Holsapple and Lee-Post (2006) extended the evaluation to concern the total process of web-based learning and its total quality. They used both D&M1992 and D&M2003 but they note that especially D&M2003 appeared useful because it had already been developed to serve in assessing Internet-based systems. In their model Holsapple and Lee-Post emphasise the processual nature of evaluation and they included in their model as an approach the development of the web-based learning system and its phases (Holsapple & Lee-Post, 2006.) Wang et al. (2007) explored the use of D&M 2003 in assessing success of web-based learning systems from the organisational approach. They also modified the model to be used from the learner's point of view.
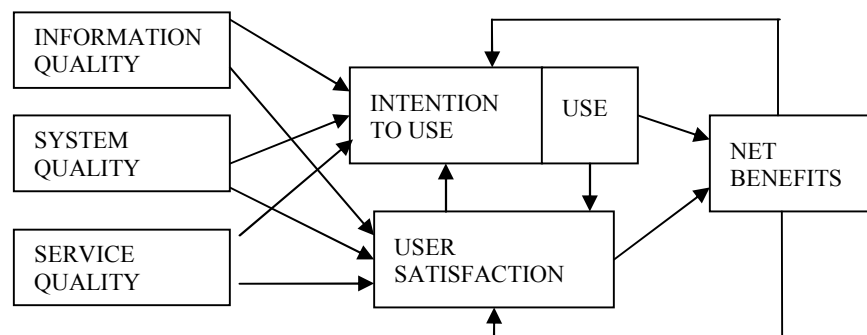

Figure 1. IS success model (DeLone & McLean, 2003, 4)

Lin (2007) used D&M2003 focusing on factors that influence successful use of web-base system ('online learning system'). Lin studied how system quality, information quality and service quality influence use via user satisfaction and intention to use.

In all, one can conclude that the success models developed by DeLone and McLean (1992, 2003) have been used in the context of virtual learning. However, the studies have focused on separate courses or information systems instead of long-term learning.

METHODOLOGY

This study was a qualitative case study (Stake, 2000; Yin, 2003). Eisenhardt (1989) delineates case study as a research strategy that focuses on understanding the dynamics present within single settings. Eisenhardt also supposes that case study research has important strengths

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like novelty, testability and empirical validity which arise from the close linkage with empirical evidence.

The empirical material was collected with a questionnaire that was addressed to a carefully chosen group. Ideally, the questionnaire was addressed to students of basic or vocational examinations in computing or information systems and an essential requirement was that the virtual learning environment was used in the teaching. Four courses were still ongoing and one was ended before the questionnaire was available. Only students who had visited the virtual learning environment in the past 1,5 months were chosen to the respondent group and finally the target group consisted of 64 students. The questionnaire included 29 closed questions and 3 open questions and the used arguments based mainly on questions by Holsapple and Lee-Post (2006) and Wang et al. (2007). Only relevant questions and measures were included as advised by McLean and DeLone (1992, 2003). 25 responses were received and 52 % of them represented long-term studies while only 6 replies (24 %) represented pure apprenticeship studies. Altogether 11 students replied that they had participated in apprenticeships and 14 students had no experience of apprenticeships so far.

While the closed questions based on the frameworks used by Holsapple and Lee-Post (2006) and Wang et al. (2007), the answers were interpreted in the framework (Fig. 2) correspondingly. The open responses were interpreted and themes (see Silverman, 2000) were searched in them. As the focus of the study was to describe knowledge transfer in the environment, we articulated only the questions that were related to the focus. From the 32 questions 8 questions addressed apprenticeship. In addition, responses to questions "What else would you like to have?" and "What has been most difficult?" were interpreted in this study.

EMPIRICAL ILLUSTRATIONS

The case organisation was a private education institution that offered different schooling including basic, further and supplementary vocational education, apprenticeship programmes, labour policy education programmes, and courses designed to meet individual requirements. In 2007 there were 13000 students of who most were working adults who studied for vocational degrees. Typical schooling included contact learning, distant learning and learning in work. In certain programmes, the degree was passed with apprenticeships in individual tasks.

In the beginning of 2008 the institution decided to take actions to evaluate its services as a private provider of vocational education. Therefore, a development project was initiated. The project focused on developing web-based teaching and it aimed to diversify and increase the offering of web-based studies. The current research was to contribute the development project. As the virtual learning environment was one of the core services provided by the organisation we wanted to find out how the service was perceived by its users. In the assessment we used the success model introduced by Delone and McLean (2003). In Figure 2 we described the evaluation model that was used in our study. The measures were classified according to frameworks described by Holsapple and Lee-Post (2006).
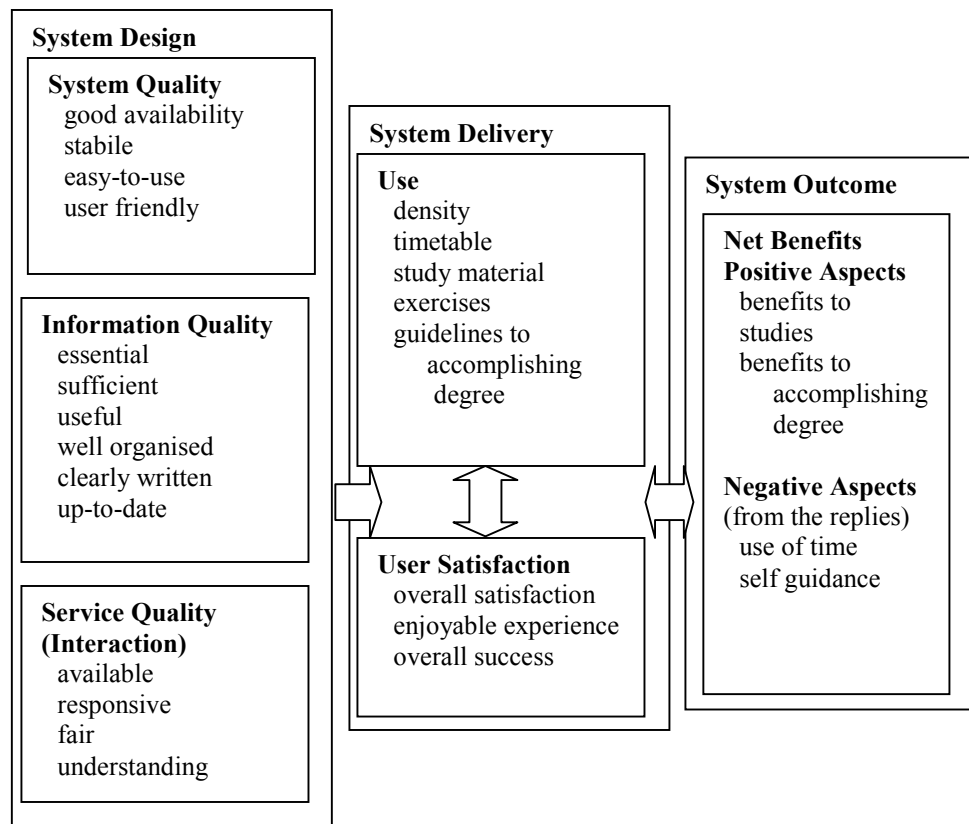
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┌─────────────────────────┐
│ System Design           │
│ ┌─────────────────────┐ │
│ │ System Quality      │ │
│ │   good availability │ │
│ │   stabile           │ │      ┌─────────────────────────┐
│ │   easy-to-use       │ │      │ System Delivery         │
│ │   user friendly     │ │      │ ┌─────────────────────┐ │
│ └─────────────────────┘ │      │ │ Use                 │ │
│                         │      │ │   density           │ │    ┌──────────────────────────┐
│ ┌─────────────────────┐ │      │ │   timetable         │ │    │ System Outcome           │
│ │ Information Quality │ │      │ │   study material    │ │    │ ┌──────────────────────┐ │
│ │   essential         │ │      │ │   exercises         │ │    │ │ Net Benefits         │ │
│ │   sufficient        │ │      │ │   guidelines to     │ │    │ │ Positive Aspects     │ │
│ │   useful            │ │      │ │     accomplishing   │ │    │ │   benefits to        │ │
│ │   well organised    │ │      │ │     degree          │ │    │ │   studies            │ │
│ │   clearly written   │ │      │ └─────────────────────┘ │    │ │   benefits to        │ │
│ │   up-to-date        │ │      │          ⇕              │    │ │     accomplishing    │ │
│ └─────────────────────┘ │      │                         │    │ │     degree           │ │
│                         │      │ ┌─────────────────────┐ │    │ │                      │ │
│ ┌─────────────────────┐ │      │ │ User Satisfaction   │ │    │ │ Negative Aspects     │ │
│ │ Service Quality     │ │      │ │   overall satisfaction│    │ │ (from the replies)   │ │
│ │ (Interaction)       │ │      │ │   enjoyable experience│    │ │   use of time        │ │
│ │   available         │ │      │ │   overall success   │ │    │ │   self guidance      │ │
│ │   responsive        │ │      │ └─────────────────────┘ │    │ └──────────────────────┘ │
│ │   fair              │ │      └─────────────────────────┘    └──────────────────────────┘
│ │   understanding     │ │
│ └─────────────────────┘ │
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Figure 2. Modified evaluation model

In the vocational schooling where the central part of the degree was the accepted apprenticeship, the role of tacit knowing was emphasised. The problem was how to show one's ability that could not be written down. As the individual tasks differed, there was no explicit apprenticeship. Instead, everyone of them differed from earlier ones and it aroused several questions from the students. Further, as the students were adults and already participating in the working life, they pursued at professional qualification and competence.

To find out the experiences on apprenticeships of the students the questionnaire included questions related directly to the apprenticeships such as: What kind of support related with studies and apprenticeships would you like to get in the virtual learning environment?

The responses revealed:

I would like to get more extensive description on how the apprenticeship must be done and carry out. It is really difficult to discover anything if you haven't seen how the others have done and understood it.

A demo about the apprenticeship already in the beginning of the studies could help the student. It would be nice to see a „ready" apprenticeship folder ...

I desire virtual apprenticeship models ... maybe even extracts as a dialog from an apprenticeship session ...

These extracts showed how abstractly the students perceived the apprenticeships. They wanted to have something „concrete" description about apprenticeships shown by their peer students. However, one student announced to be satisfied:

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I've received valuable information concerning e.g. building my apprenticeship folder etc. Thanks!

Related to apprenticeships, Use was measured with two arguments. Firstly, "I look for information concerning apprenticeships in the virtual learning environment." Of those responded, 20 students searched information in the virtual learning environment concerning apprenticeships. Only one student did not use the environment for that purpose. Secondly, "I use the apprenticeship patterns when I plan apprenticeships about my work." 21 students used the offered patterns and nobody contradicted.

Information quality was measured with an argument "Instructions about apprenticeships guide me in making the degree." Only 16 students perceived that they had gained from the virtual learning environment. Seven students did not agree or disagree and one student disagreed.

User satisfaction was revealed with two arguments that were addressed to those students (total 11) who showed their experience with the help of the virtual learning environment. The arguments were responded as follows: "The environment makes it easier to return the apprenticeship or its material." Seven students were satisfied and four of them did not tell their opinions. "With the environment, I get valuable information from the reviewers before the evaluation discussion." Eight students did not tell their opinion, and only of them were satisfied. Despite the small number of respondents, the answers reflect the difficulty of using the virtual learning environment in giving evidence of one's experience.

DISCUSSION AND CONCLUDING WORDS

This study aimed to find out how knowledge transfer success was experienced with the help of the success model developed by McLean and DeLone (2003). As knowledge is a diversified concept (Alavi & Leidner, 2001; Nonaka & Takeuchi, 1995), we tried to find out if it was successfully transferred in a virtual learning environment that formed shared space to enable knowledge creation and transfer (Nonaka & Konno, 1998). In the target organisation, knowledge transfer was an essential part of the schooling where apprenticeship was a central issue. The teachers had to be able to transfer knowledge related to the many professions that the students desired to get degree in. The knowledge was partly saved in the virtual learning environment; partly it was tacit in the possession of the teachers. Correspondingly, the students had to be able to show their ability and transfer knowledge when they had to give evidence of their expertise.

As an environment desired for interaction between students and teachers (Piccoli et al., 2001; Chiu et al., 2005), the virtual learning environment was a place for social interaction that enabled tacit knowledge to be created (Nonaka & Takeuchi, 1995; Nonaka & Toyama, 2003). With the help of the virtual learning environment the knowledge was to be created and shared between members in the environment and to be used by them when they entered the environment with their individual knowledge, as Propp (1999) describes. The empirical material showed that knowledge transfer was not found easy by the students. For instance, somebody wanted to have "*more extensive description on how the apprenticeship must be done*".

From the organisation's point of view, it was important to get the knowledge stored in the organisational database to be used later (Huysman et al., 1994; Jennex & Olfman, 2002). When the virtual learning environment was used, the written text was stored in the database. This was not experienced easy as can be drawn from the poor output to the argument of getting valuable information from the reviewers before the evaluation discussion. Only one student was satisfied with teachers' input.

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In our research we studied a virtual learning environment as an enabler of transferring knowledge. The evaluation was made by the success model originally introduced by McLean and DeLone (2003). Among other IS evaluations, D&M2003 has been in use in several evaluations concerning virtual learning (Holsapple & Lee-Post, 2006; Linn, 2007; Wang et al., 2007). Therefore it was a natural choice in our study.

In this paper, we discussed only the issues and measures related to knowledge that was in close connection with apprenticeships in the organisation. In so doing, we also showed that D&M2003 is usable also in evaluations that are difficult to put in explicit form. In our research we evaluated how knowledge was transferred between students and teachers in a case where both teachers and students had to be able to save and transfer knowledge.

We asked students how they perceived the environment especially associated with apprenticeships and we got elucidating responses. As apprenticeship was a central part of the degree, students told that they really looked for information concerning apprenticeships from the virtual learning environment. They also used the offered models of apprenticeships when designing their ones. The responses also revealed that the students desired more explicit information about apprenticeships.

Finally, it would be interesting to enquire teachers' responses on the same issues, namely how they perceived the use of the virtual learning environment in their challenging work with students who perform studies especially emphasising apprenticeships.

ACKNOWLEDGMENTS

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