Information Systems Quality Issues to Consider when Developing and Implementing Web Based Teaching Environments

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ABSTRACT:. *This paper discusses how information systems (IS) quality literature suggests that certain quality factors are important to consider when developing and implementing systems. This paper then identifies how these IS quality factors are relevant to web based teaching environments, and what could happen if information systems quality is not considered. Lastly, this paper provides web based teaching practitioners and developers with practical guidelines on how to incorporate IS quality factors into the development and implementation of web based teaching environments.*

Keywords: Information Systems Quality, web based teaching environments

INTRODUCTION

Purpose

With the growth of the Internet, continual advancements in technology, and the need to cut costs, many education institutions are adopting the concept of web based teaching environments. However, as this new form of teaching develops into a worldwide phenomenon, it becomes increasingly important to address quality issues associated with these systems.

The purpose of this paper to discuss how information systems (IS) quality literature suggests that certain quality factors are important to consider when developing and implementing systems. This paper also discusses how these IS quality factors are relevant to web based teaching environments (especially IS cost effectiveness, IS use quality, and IS work quality), and what could happen if quality issues like IS quality are not considered. Lastly, the purpose of this paper is to also provide practical advice for system developers on how to incorporate IS quality factors into the development of web based teaching environments.

The practical outcome of this paper is advice for web based teaching environment developers, who will (1) gain an awareness of IS quality issues; and (2) become more mindful of how a poor level of IS quality could create a negative affect on the effectiveness of a web based teaching environment. The theoretical outcome of this paper is a critical evaluation of IS quality issues in relation to web based teaching environments.

It is important to note that this paper has adopted a tight focus on the IS quality issues. This paper does not aim to make any assumptions about the nature of educational design and hence provides only a brief introduction to web based teaching environments, and how they are used.

Scope

This paper has been divided into four sections. The first section - "Terminology" briefly defines web based teaching environments, and outlines why they are different traditional teaching environments. This section also introduces the topic 'information systems quality', and provides definitions for the various elements of IS quality.

The second section - "Aspects of IS quality that are relevant to web based teaching environments" outlines why IS quality is relevant to web based teaching environments.

The third section of this paper outlines how IS quality can be incorporated into the development and implementation of web based teaching environments. This section also discusses their implications of

what could happen if certain elements of IS quality are not incorporated into the development of a web based teaching environment. Lastly, this section briefly introduces the SOLE quality model, which can be used by developers as a guideline for the incorporation of IS quality into the development of web based teaching environments.

   The fourth section of this paper – "Recommendations and Conclusions" provides recommendations for the readers, and sums up the major points of this paper.

Research Methodology

In order to provide a comprehensive coverage of why IS quality issues need to be considered when developing web based teaching environments, a critical review of existing literature was undertaken. Literature reviews on both web based teaching and information systems quality were conducted in order to provide answers to the following research questions:

1.   What is web based teaching?

2.   How is web based teaching used?

3.   What is information systems quality?

4.   What aspects of IS quality are relevant to web based teaching environments?

5.   How can IS quality issues be incorporated into web based teaching environments?

THE TERMINOLOGY

Web Based Teaching Environments v's Traditional Teaching Environments

Web based teaching, (also known as web based learning, and virtual learning/teaching) can be defined as a computer based environment which allows interaction with other participants, and access to a wide range of resources, via the Internet (Ahmad and Piccoli 1998). According to Chao (1998), web based teaching implies that students and academics participate in lectures and lab activities over the Internet/ Intranet. This implies that unlike traditional learning environments, where the students and academics are physically present in a classroom, web-based teaching allows educators to teach some subjects over the Internet, which Chao (1998) feels is especially important for campuses with remote teaching sites. This makes it easier on educators who teach at several campuses which are great distances apart, as it is no longer necessary for them to travel in order to teach their students. Lastly, Hadidi and Sung (1998) suggest that the purpose of education is to facilitate life long learning, and that the use of the Internet, and the World Wide Web (WWW) will aid this purpose, and therefore, the Internet can be utilised to disseminate information and knowledge.

   According to Hadidi et al. (1998), the major problem with traditional teaching and learning technologies like videotapes, television, and compressed video is that they lack interactivity. They feel that overall student performance can potentially be improved by replacing or complementing traditional classroom-based teaching with the use of the Web for course delivery, on-line discussion group and conferencing, and e-mail. The Web also has the potential to be used for interactive and self-grading assignments, which would then provide instant feedback to students, which Hadidi et al. (1998) advise would be especially beneficial to distance learning students.

Information Systems Quality

According to Eriksson and Törn (1991), quality can not be considered an objective characteristic, but is linked to each unique situation, where the individuals involved are dealing with the information systems in their every-day work practices. They also state that in order to identify all of the important quality characteristics, it is necessary to identify the concerns of each group of individuals. Eriksson et al. (1991) also advise that it should be expected that quality characteristics might differ between different groups, or individuals. They suggest that even if the quality characteristics are the same across several groups of people, the importance of each individual characteristic may be dissimilar.

Eriksson et al. (1991) have proposed that there are roughly three parties involved with information systems, and that their primary concerns about the performance of information systems is as follows:

1.   management: profitable investment;

2.   users: helpful in work;

3.   IS personnel: efficient realisation.

Eriksson et al. (1991) have defined three IS quality factors, based on the above-mentioned classification of the parties involved with information systems. These quality factors can be broken down into IS cost effectiveness, IS use quality, and IS work quality. IS cost effectiveness is utilised in order to cover the overall advantage of using a system. It takes into account the acquisition costs, updating costs, and the costs of resources needed to use and operate the system. IS work quality deals with any aspects relating to the domain of responsibilities of the IS personnel. Lastly, Eriksson and Törn (1991) state that information systems use quality covers all aspects of how well the information system serves the purposes of the users. They claim that all three factors are to some extent dependent on each other, for example, IS cost effectiveness is of little benefit to the company if the information system has no use quality.

ASPECTS OF IS QUALITY THAT ARE RELEVANT   TO WEB BASED TEACHING ENVIRONMENTS

According to Alter (1992), an 'information system' (IS) is a system that consists of people, work practices, technology, and information, which interact in order to accomplish organisation goals. The Internet can be considered to be a global network of information supported by technology, and utilised by people to accomplish some form of goal, whether it is to find information, communicate across great distances, or to create an on-line business. According to Alter's (1992) definition of an information system, the Internet can be perceived as a global information system, and hence web based teaching environments (which utilise the Internet) can be viewed as large information systems. This implies that IS quality issues are relevant to web based teaching environments. Quality is an important characteristic of any education system as it increases the level of quality of information, which in turn leads to a higher level of quality of learning. As web based teaching systems are large information systems, the most relevant type of quality to consider becomes IS quality. IS quality elements like cost effectiveness, use quality, and work quality will increase the economical feasibility, useability (or fitness-for-purpose), and technical quality of the web based teaching environment

Braa (1995) gives an example of why IS quality is such an important factor to consider in the development of web based teaching systems. She explains that a web based teaching system was developed and implemented at a university. Its purpose was to provide information services to students. However, she illustrates that whilst the technical quality was quite good, the use quality was poor, and that this was due to an information overload (students were bombarded with too much information at one time). This situation implies that the students would have found it difficult to find relevant information. This problem suggests that the system did not meet the users' (in this case the students) needs, and that had these needs been considered, the web based teaching system would have facilitated the students' learning processes instead of hindering them.

Another example which demonstrates the importance of some form of quality in a web based teaching environment can be taken from a small-scale case study analysis conducted at a new campus of an Australian university which has developed and implemented a form of web based teaching. Research revealed that the technical quality (ie. the reliability, and accessibility) of the system was poor. In many instances, both students and academics were forced to revert to more traditional learning and teaching practices as the web based teaching environment was too unreliable, and too difficult to access from remote terminals. From an IS quality perspective, this system displayed poor IS work quality (the technical quality). This in turn directly impacted on the level of IS use quality. The research revealed that because of the system's poor technical quality, the system's ability to facilitate teaching and learning, was very low, and hence the web based teaching environment's level of use quality (or useability) was also very poor.

Problems with the level of useability, cost effectiveness and technical quality of a web based teaching environment can be avoided through the consideration of quality factors. Information systems quality

literature suggests that certain quality factors are important to consider when developing and implementing information systems, and that these IS quality factors will address the above mentioned problems. As this form of quality helps avoid problems that could occur in web based teaching environment a logical conclusion is that this form of quality is most suited to the development and implementation of web based teaching environments.

INCORPORATING IS QUALITY INTO THE DEVELOPMENT AND IMPLEMENTATION OF WEB BASED TEACHING ENVIRONMENTS

Use Quality, or 'Fitness-for-Purpose'

A relevant quality element to consider when developing and implementing web based teaching environments is information systems use quality, that is, will the web based teaching environment meet the 'fitness-for-purpose' category? It is possible that if the web based teaching system doesn't meet the fitness-for-purpose category, the system will not perform to the best of its ability. This could in turn impinge on the cost effectiveness, or IS work quality of the information system. This implies that it is necessary to consider who the users of the system are (eg the students and academics), and whether or not the web based teaching environment will meet the needs of the students and academics who are to learn and educate in this atmosphere.

   To incorporate use quality into a web based teaching environment, it is necessary to look at the level of systems useability, and the level of 'fitness-for-purpose'. In order to ensure fitness-for-purpose, developers must consider the needs of the users, in this instance the students and academics. According to Braa (1995), this implies that it is necessary to conduct subjective assessments in order to evaluate the useability of the system. As stated earlier, it is extremely important that the web based teaching environment meets the needs of the users (students and academics) of the system. A web based teaching system of poor use quality implies that the users' needs have not been met. This in turn suggests that if a web based teaching system does not meet its 'fitness for purpose', it will not be used in the way it was intended (ie the system should be used to facilitate teaching and learning instead of being used as a resource).

IS Work Quality

It is also important to consider the IS work quality issues. Eriksson and Törn (1991), suggest that there are three sub components of IS work quality, these being evolution quality, operation quality, and efficient IS management.

   In the case of developing and implementing web based teaching systems, it is extremely important that the evolution quality of the system is very high. This means that all aspects of the web based teaching system are correct in design, implementation, and ease of maintainability. Evolution quality can be incorporated into the development of web based teaching environments by firstly ensuring that the system is correct in design. This implies that it is necessary to clearly identify the user requirements by identifying the needs of the students and academics (the users). In order to achieve correct implementation, and ease of maintainability the systems developers should follow the systems development lifecycle. If the evolution quality of a web based teaching system is poor, it is possible that this factor will impinge on the system's use quality by not meeting the user requirements. This in turn suggests that the potential would then exist for a reduction in the IS cost effectiveness of the system.

   If the operation quality of the web based teaching system is poor, this implies that the work performance of the operating staff will be poor (Eriksson et al. 1991). Eriksson et al. (1991) suggest that the work performance of IS operating staff is critically important for the use of the information system (in this case the web based teaching system). To incorporate operation quality into the web based teaching system, systems developers must ensure that the system is operable, resilient, and resource-efficient.

   Efficient IS management implies that it is necessary to use the available resources, personnel, software and hardware, in a way that ensures that the total cost effectiveness in developing, maintaining and running the web based teaching system is as high as possible (Eriksson et al. 1991). This is

extremely important in the case of educational institutions as often they are working to a tight budget. To incorporate efficient IS management into the development and implementation of a web based teaching environment, the institution must accurately plan the allocation of all teaching resources including hardware, software, lecturers, and systems development personnel.

IS Cost Effectiveness

Lastly, Eriksson et al. (1991) propose that perhaps the most important IS quality element is information systems cost effectiveness. This is because they imply that low quality in this factor will mean low overall quality. According to Eriksson and Törn (1991), the IS cost effectiveness concept applies to whether or not it is economically feasible to develop and implement a web based teaching environment within an education institution. Although it this area is primarily the education executives' concern, it is important to note that if IS cost effectiveness is not considered, the potential exists for development and implementation costs of a web based teaching environment to go beyond the budget the institution has assigned it. Low quality in this area also implies that if it is not economically feasible for the education institution to develop and implement a web based teaching environment, it is quite possible that the IS work quality will be low. This could be due to the university's inability to provide enough personnel and technical resources. This also suggests that the IS use quality would be poor because without the required resources, it would be very difficult to provide a complete set of reliable facilities for staff and students at the institution, and hence the web based teaching would not meet the needs of the users.

The SOLE Quality Model

According to Andersson and von Hellens (1997) the SOLE quality model represents quality by considering three levels, these being business quality, use quality, and IS work quality (refer to Figure 1. for model). These quality attributes are identical in definition to the IS quality elements identified earlier in this paper (ie cost effectiveness, use quality, work quality). At each level, the hierarchical quality factors relate to a group of individuals who are primarily interested in the quality of the respective quality factor.   According to Andersson et al. (1997), the model allows developers to utilise the criteria, and metrics of existing software quality models when evaluating whether or not the desired level of quality for each of the factors has been achieved. The purpose of the model is to provide guidance on how to incorporate quality improvement programs.
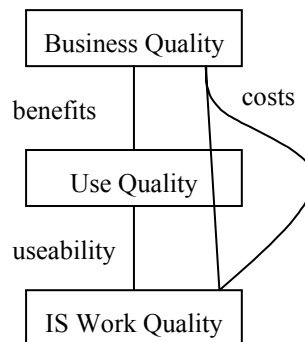
Figure 1: The organisational hierarchy of IS quality factor classes (Andersson and von Hellens 1997).

   The SOLE quality model is one of the more prominent models that systems developers could utilise to aid the incorporation of IS quality attributes into the development and implementation of web based teaching environments. The model provides a structured approach to the incorporation of these quality attributes, and the collection of information about the factors to assess the level of business quality, use quality (or fitness-for-purpose), and work quality. Andersson et al. (1997) suggest that the SOLE quality model provides developers with information which supports decisions regarding how to organise in-house systems development activities. This in turn suggests that developers of web based teaching systems would benefit from the use of this model as it also provides guidance on decisions regarding what actions to take to improve the quality of web based teaching development activities, and what the cost implications are for the educational institution.

RECOMMENDATIONS AND CONCLUSIONS

This paper recommends that systems developers incorporate IS use quality by identifying the needs of the students and academics who are to interact with the web based teaching environment. This paper also recommends that developers incorporate IS work quality into the development of web based teaching systems through the implementation of evolution quality, operation quality and efficient IS management.

This paper recommends that IS cost effectiveness be incorporated into the development of any web based teaching environment. This is because poor IS cost effectiveness implies that the system will also have poor IS use quality, and poor IS work quality levels, as this factor effects all other quality elements.

Finally, this paper recommends the use of the SOLE quality model. It provides the developers of web based teaching environments with information, which aids decision making in relation to the organisation of development activities, quality improvement, and the cost implications for the education institution.

Based on the quality issues highlighted in this paper, it can be seen that education institutions and systems developers need to consider IS quality issues when developing and implementing web based teaching environments. This paper has demonstrated how IS quality literature suggests that there are certain quality factors that should be incorporated into systems development. This paper has also identified what aspects of information systems quality are relevant to web based teaching environments, and how these quality characteristics can be incorporated into the development of web based teaching environments. It is also important to note that if these quality factors are not addressed when developing and implementing web based teaching systems, the education institution risks incurring problems like poor useability (or fitness-for-purpose), low cost effectiveness of the system, and inoperable, unreliable, and resource-deficient teaching facilities.

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