



Knowledge hoarding and user acceptance of online discussion board systems in eLearning: A case study

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ABSTRACT

This paper aims to reveal the determinants of the effectiveness of online discussion board systems (ODBSs) in eLearning environments to foster the interactions among the learners and/or instructors. A case in which an ODBS failed to foster the interactions among learners/instructors for knowledge sharing is introduced and hypotheses to explain the failure are developed based on thorough literature review in technology acceptance model (TAM) and knowledge hoarding. The hypotheses are tested via statistical analysis on the data collected from a questionnaire survey against the students who actually involved in the case study. The result shows that the low perceived usefulness of the ODBS by the students played major role in the failure of the system. Also it is hinted that network externalities as an intrinsic motivator is more effective than extrinsic motivators to increase the students' activities on the ODBS. Finally the paper provides the designers of eLearning systems with advice for successful operation of ODBS in eLearning.

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1. Introduction

“The more interaction between learners–learners/instructors, the higher learning outcome” is well supported by many studies (Fredericksen, Pickett, Pelz, Swan, & Shea, 2000; Jiang & Ting, 1998; Lytras, Damiani, & Ordóñez de Pablos, 2008; Lytras & Garcia, 2008; Lytras & Ordóñez de Pablos, 2007, 2009; Ordóñez de Pablos, 2002; Phielix, Prins, & Kirschner, 2009; Swan et al., 2000; Zhao & Ordóñez de Pablos, 2010a, 2010b).

It is vital to integrate mechanisms to facilitate the interactions among students/instructors within teaching sessions. As a result, many teaching methods that incorporate the interactions among students like a small group discussion have been well adopted in the classes in many educational institutes.

However, most of the Internet-based eLearning systems are based on asynchronous interactions among the learners/instructors and this provides a different learning context from that of physical teaching sessions in which synchronous interactions are possible. One of the most common interaction support system in today's eLearning is online discussion board system (ODBS) which supports asynchronous interactions among students and instructors. However, it is debatable if the provision of an ODBS is an en-

ough condition to derive the promise (higher learning outcome). Considering many studies on behavioural issues for the adoption of information systems (ISs) in IS literature (see the papers published in MIS Quarterly Journal), an ODBS as an information system needs to be designed and operated in consideration of the behavioural characteristics of the learners and instructors for its success in eLearning context. However, despite of the needs there have been very few studies made to reveal the determinants of effective ODBS implementation and operation in the literature.

This paper aims to find the determinants of the effectiveness of ODBSs via a case study in which an ODBS failed to deliver its participating students with higher learning outcome. Furthermore, it provides eLearning designers with strategies to integrate ODBSs in eLearning for its effective use.

This paper employs the technology acceptance model (TAM) and knowledge hoarding as theoretical context to explain the failure of the ODBS in the case study. Based on theoretical review, we develop hypotheses as the explanation of the failure and test them via questionnaire survey against the students who were involved in the eLearning sessions in the case study. The findings suggest that the perceived usefulness of the ODBS played major role in the failure while their attitude toward and the easy-of-use of the system were positive. On the other hand, knowledge hoarding was not detected from the students. Finally, intrinsic motivator such as network externalities or critical mass effect turned out to be more effective than extrinsic reward as an enabler to increase the perceived usefulness of the ODBSs.

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The finding suggests that designers of eLearning system aiming ODBSs as an effective interaction supporting tool should pay special attention to acquiring and maintaining enough number of users of ODBSs via more active involvements in learner's interactions until the learners have high perceived usefulness of the ODBSs and thereafter they can maintain the interactions by themselves.

The organization of the paper is as follows. Section 2 will provide a case in which an ODBS failed to deliver higher learning outcome to its participants. That is followed by theoretical context section that derives hypotheses to explain the failure in the case. Sections 4 and 5 are then followed to explain how the data is collected and analysed to test the theoretical model. Section 6 is given to discuss theoretical and practical implications of the findings of the paper and, finally, Section 7 summarises the paper.

2. An ODBS case

This section introduces a case wherein ODBS failed to deliver higher learning outcome. The target module was designed based on an eLearning system and offered to level-1 students in the Brunel Business School, Brunel University in West London. The total number of registered students was about six hundreds and it provided both virtual class sessions (students could visit the online sessions any-time they want) for gaining theoretical knowledge on information technology and statistics and physical lab sessions (students should attend the sessions at the same place at the same time) for obtaining practical knowledge on how to use HTML script language and a statistic-software.

Fig. 1 shows the example screenshot of a virtual lecture session. In the module, students were asked to attend the virtual lecture on the Internet to obtain new knowledge and they were tested at the online testing system during their physical lab sessions. As a result, the physical sessions consisted of two sub sessions: online testing and computer lab session. The web site for virtual lecture sessions provided an ODBS (see Fig. 2) to allow the students post any questions with regard to the new topic of the theories in the virtual lectures.

As the physical sessions were dedicated to the computer labs, the ODBS was supposed to be the major place in which students and instructors could interact with each other to discuss about topics to prepare the online exams. And the proposition was that the more students participate to the ODBS, the higher learning outcome (the online exam marks) they will achieve.

To investigate above proposition, data has been collected and analysed. The result is shown in Table 1. Firstly, all the participants of the ODBS have been listed and their markings of the online exams have been collected. Total 78 students posted articles on the ODBS and their average mark of the online exam was 14 while the total average mark of the whole class was 13.74 showing no difference between the two groups.

Also the failure of the ODBS to deliver higher learning outcome can also be seen in terms of the number of postings and users. At the time the data were collected, there had been 4 online exams since the beginning of the academic term and the number of postings on the ODBS had been decreased as the time went. For example, as shown in Fig. 3, before the first exam, total 173 postings were made on the BBS and the number decreased into 28, 13, 49, and 25.

3. Theoretical context

This section aims to identify theoretical context to explain the failure of ODBS in the case in Section 2.

While many different factors may involve for the success of ODBSs in eLearning, the paper derives the theoretical model focus-

ing on the technology acceptance model (TAM) (Davis, 1989; Davis, Bagozzi, and Warshaw, 1989) and knowledge hoarding perspective.

TAM has been widely adopted in Information Systems research area to identify any behavioural issues of end users in the acceptance of new technologies (Lu, Yu, Liu, & Yao, 2003; Naarmala, 2004; Venkatesh, 2000; Venkatesh, Morris, Davis, & Davis, 2003). TAM emphasizes three major variables that play major roles in the acceptance of new technology by users: users' attitude, perceived usefulness, and perceived ease of use as shown in Fig. 4.

According to Davis, the actual use of a technology is affected by the intention to use it. Intention to use a technology is affected by both attitude and perceived usefulness of the technology. Again attitude is affected by perceived usefulness and perceived ease-of-use.

Following the theory, we can infer that any of the three variables were not satisfied by the students of the ODBS in the case. According to this inference, we define three hypotheses for the three variables of the TAM.

H11: The negative attitude of the students led to the low usage of the ODBS.

H12: The low perceived usefulness of the ODBS led to the low usage of the ODBS.

H13: The low perceived easy-of-use led to the low usage of the ODBS.

The above hypotheses are centred on the acceptance of new technology while ignoring the knowledge exchange perspective within the ODBS. As the major intended use of ODBS in the module was to facilitate the knowledge exchange among the students or students and instructors, it is vital to investigate the attitude of the students on the ODBS from knowledge exchange perspective.

Cabrera and Cabrera (2002) assert that sharing knowledge causes cost to the knowledge-sharer which suppresses the knowledge sharing in organizational context. Their assertion is in line with Husted and Michailova (2002) who claims that individuals and organizations are basically hostile on knowledge sharing and how to fight against the hostility is crucial for successful knowledge sharing in organizations. They also suggested five reasons of knowledge hoarding by organizational members: protection of individual competence, reluctance of spending time, fear of hosting "knowledge parasites", avoidance of exposure, uncertainty aversion, and compliance to hierarchy and formal power. As the major reason of using ODBS by the students was to prepare online exams and broaden their knowledge in eLearning context, the paper derives hypotheses based on only three reasons among the five for knowledge hoarding in ODBSs.

H21: The reluctance to share their knowledge with others due to the competition in the online exams led to low usage of the ODBS.

H22: The reluctance to bother to reply to any queries on ODBSs led to low usage of the ODBS.

H23: The reluctance to be exposed in public led to the low usage of the ODBS.

While above hypotheses are used to explain why the ODBS in the case study was not linked with higher learning performance, we are also interested in what would make the students use ODBSs. In motivation theories, there are two types of motivator: extrinsic and intrinsic motivators (Bénabou & Tirole, 2003). For this purpose, we are developing hypotheses with regard to the incentives to the participation to ODBSs.

In education, external rewards such as best-student award have been widely used to improve learners' learning performance (Deci,

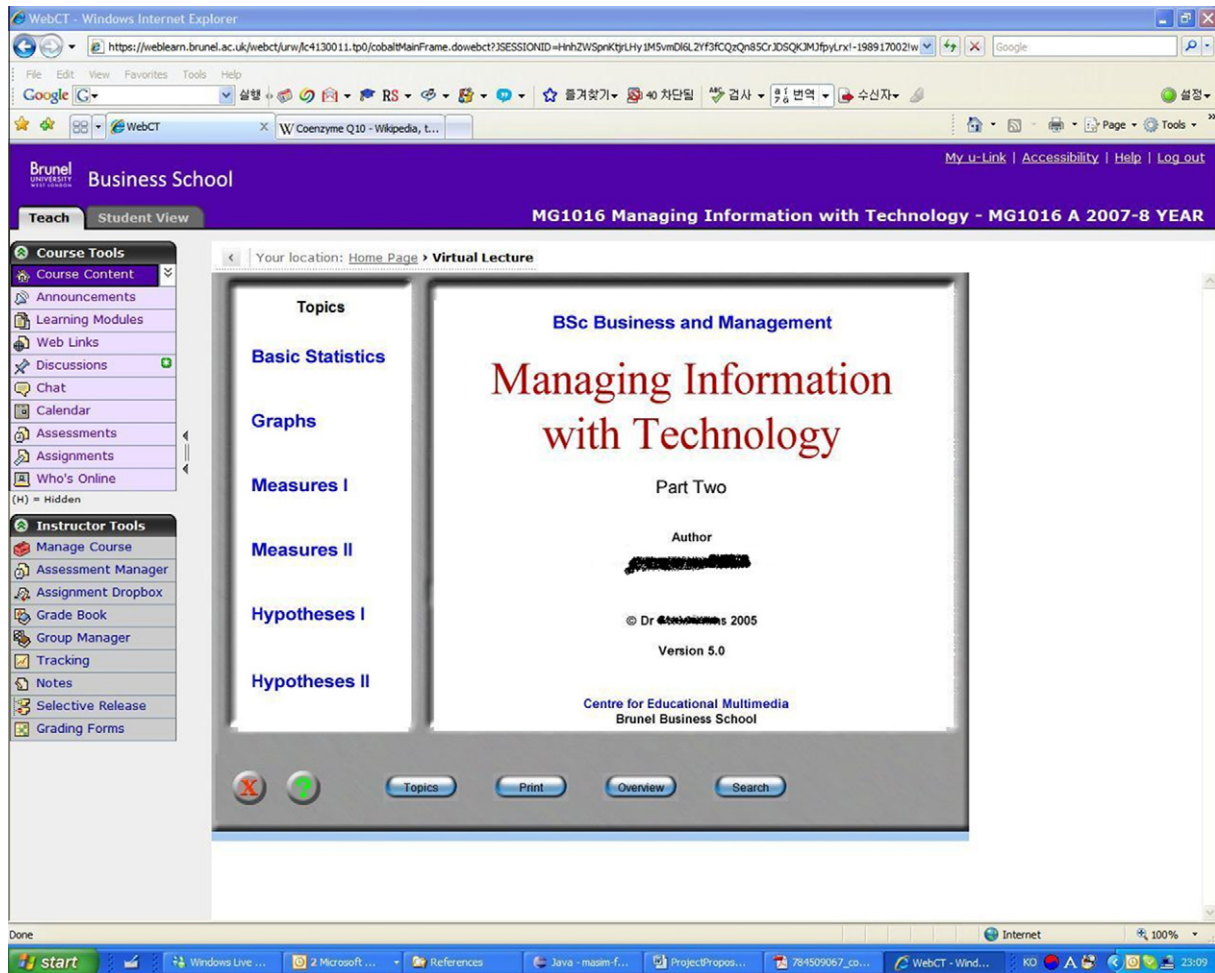


Fig. 1. The screenshot of the virtual lecture room.

Koestner, & Ryan, 2001). In eLearning context, the performance can be interpreted as their final grade. As a result, it is a natural incentive to link students' activities with their final grades. This leads to:

H31: Students will be willing to participate to ODBSs if their activities in the ODBSs are linked with their final grades.

On the other hand, as an intrinsic motivator of an ODBS, we are focusing on network externalities (Katz and Shapiro, 1986). Shapiro and Varian (1999) defines network product as follows:

“When the value of a product to one user depends on how many other users there are, economists say that this product exhibits network externalities...”.

The representative example of such product is communication services like telephone, email, fax, and Internet. One of the major characteristics of such products is that the adoption of the products in the market is accelerated by positive feedback: as the install base of users increases more users feel it is worth to use the products. As an ODBS also seems to be affected by network externalities, we can make a hypothesis that the increased and maintained number of student base of an ODBS will attract more students. Furthermore, in Luo, Luo, and Strong's (2000) study, critical mass effect showed positive impact on perceived usefulness and perceived easy-of-use in the TAM.

H32: Students will be willing to participate to ODBSs if most of their friends or colleagues are participating to the ODBSs.

Fig. 5 shows the theoretical context of this paper that summarises the above hypotheses. Our assumption is that the more interactions are made among students or between students and instructors the higher the learning outcome will be derived. This hypothesis (the two black boxes linked with a bold arrow in Fig. 5) has been tested in other studies and as a result not included in this study. On the other hand, this study focuses on identification of factors that affected (negatively) the knowledge exchange activities of students in the ODBS in the case study in Section 2. The hypotheses H11, H12, and H13 will be tested to see if the ODBS was not accepted by the students and if so which variable was particularly affected to the non-acceptance by the students. The hypotheses H21, H22, and H23 will be used to test if any knowledge hoardings played a role in the failure of the ODBS. Finally, the hypotheses H31 and H32 will be tested to test if extrinsic or intrinsic incentive will motivate the students for more pro-active use of the ODBS.

4. Method

A questionnaire to test the hypotheses in Section 3 has been designed to have 24 five-scaled questions. The questions have been

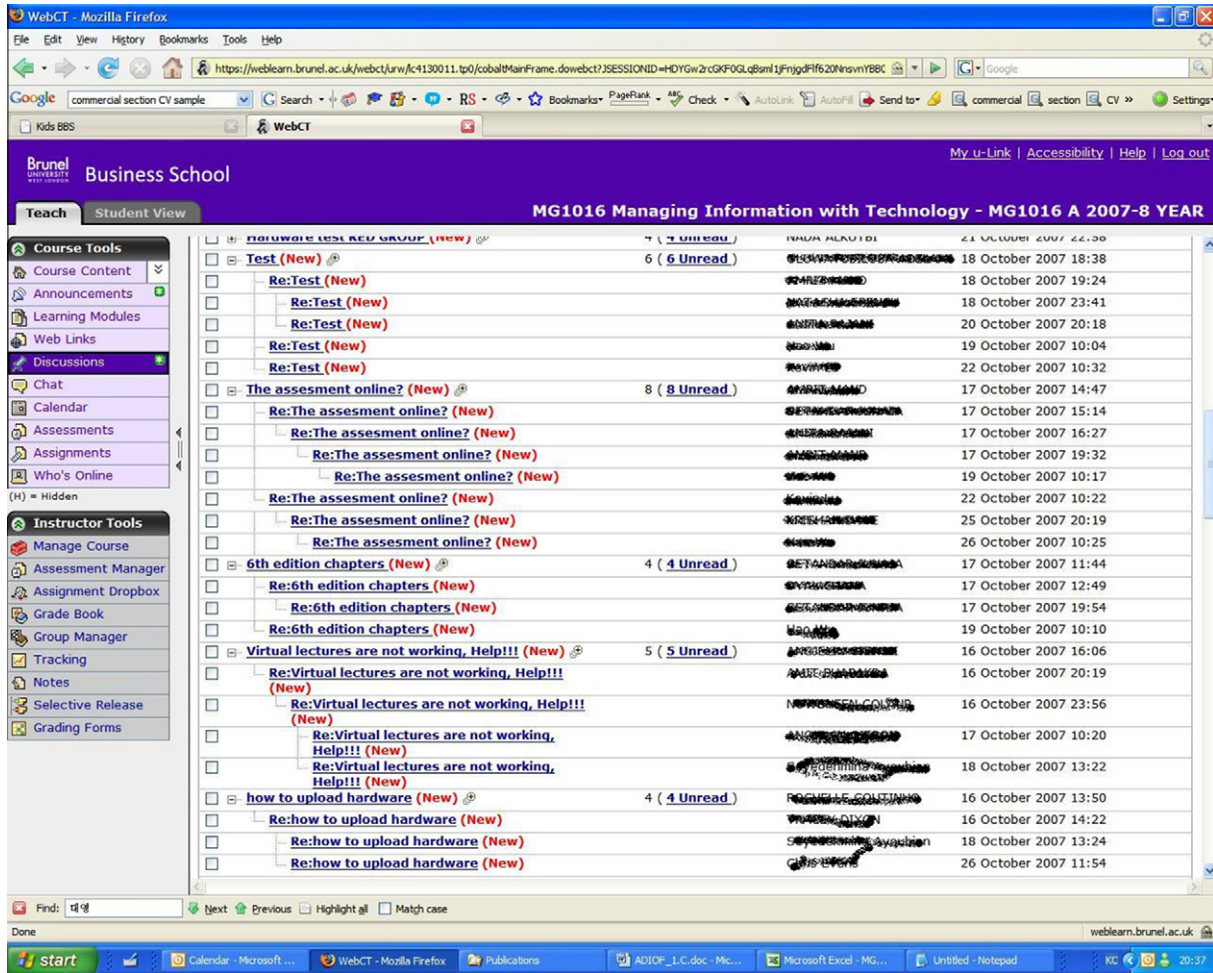


Fig. 2. The screenshot of the ODBS in the virtual lecture room.

Table 1
The comparison of exam performance of ODBS participants and total population.

No. Participants	No. total students	Average mark of participants	Average mark of population
78	600	14	13.7

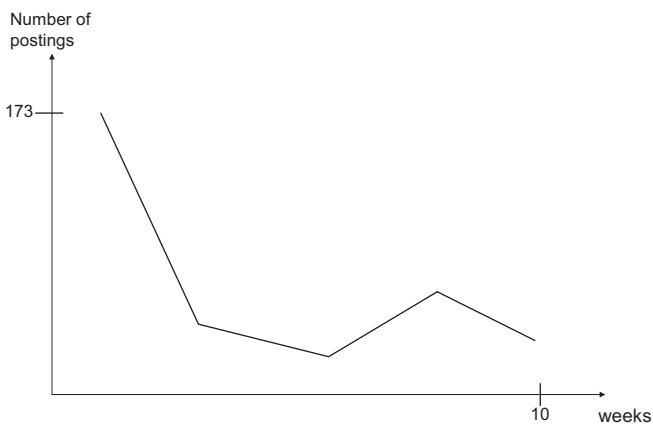


Fig. 3. The trend of the number of postings in the ODBS.

grouped into three categories. The first part of the questionnaire was devoted to collect basic information about the respondents

such as sex, the number of visits to and postings on the ODBS. Second part consisted of questions with regard to the first group of hypotheses while the third part the second group of hypotheses. Thorough literature review was done to identify operational variables to test each hypothesis. The operational variables have been translated into questions in the questionnaire.

In the module, 600 students were divided into 20 groups making each group consist of about 30 students. The questionnaires were distributed during randomly selected three groups. Total 62 have been collected among 74 questionnaires.

Among the 62 questionnaires, 13 unreliable questionnaires have been aborted. The unreliable questionnaires have been filtered if they violated the instructions of the questionnaire. For example, the questionnaire has been designed to guide the respondents through different routes according to their response in the early stage questions. If they did not go through as instructed, then the questionnaires have been aborted. This is expected to improve the reliability of the responses as the respondents had to read the questions and instructions carefully to answer to the questions.

The questionnaires have been distributed at the beginning of the physical lab sessions and collected at the end of the same ses-

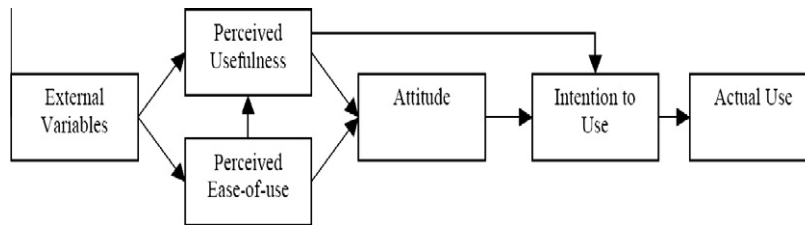


Fig. 4. Technology acceptance model (source: Davis, 1989).

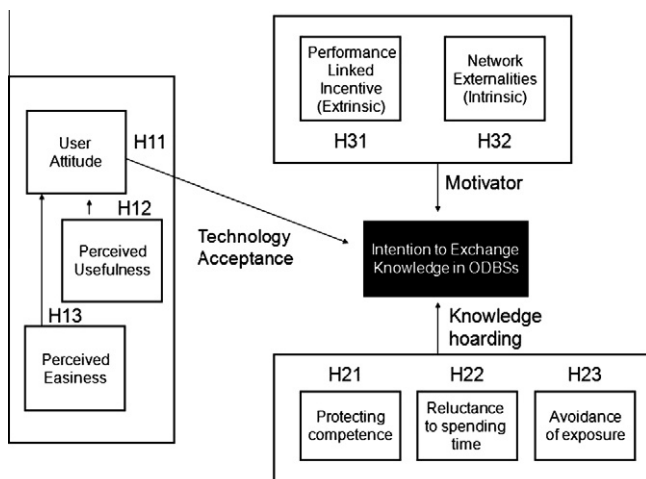


Fig. 5. The theoretical context of the study.

Table 2 The basic statistics on the respondents.

Sex	Percentage of ODBS visitors	Number of visits	Number of postings
Male: 22 (37%)	88%	1–5: 35%	0: 50%
Female: 37 (63%)		6–10: 23%	1–5: 49%
		11–20: 23%	6–20: 1%
		>20: 19%	

sions during January 2008 (after 5 virtual sessions have been completed from the beginning of the school term in September 2007; Table 2).

Table 2 shows the basic statistics on the respondents. About 88% of the respondents ever visited to the ODBS during 5 sessions from the beginning of the school term and the other 12% of the respondents never visited to it. About 35% of the visitors visited to the ODBS less than 6 times and 46% between 6 and 20 times. About 20% visitors visited to the ODBS more than 20 times. Compared to the frequency of visit to the ODBS, the frequency of posting article turned out relatively low. Fifty percentage of the visitors did not post any article on the ODBS and other 49% of the visitors posted to the ODBS less than six times. Only two visitors posted between 6 and 10 times and the other two visitors between 10 and 20 times during the five sessions.

5. Data analysis and result

The reliability of the collected data has been tested by calculating Cronbach’s alpha value. Table 3 summarises the Cronbach’s alpha values of the variables used in the questionnaire. The result shows that the alpha values of the collected data are bigger than 0.8 (or close to 0.8) and the collected data can be used to measure the qualitative variables.

Table 3 Reliability test of the data.

Measurement variable	Number of items	Cronbach’s alpha
Intention to use	2	0.865
Perceived usefulness	2	0.818
Perceived ease of use	2	0.909
Protecting competence	3	0.798
Reluctance to spending time	2	0.802
Avoidance of exposure	2	0.910
Link to performance	2	0.812
Network externalities	2	0.805
Intention to visit ODBS	2	0.770

The major reason why the 12 respondents did not visit the ODBS was because they thought the ODBS would not helpful to prepare their online exams. Most of them responded that they knew the existence of the ODBS and how to use it (Table 4).

t-Test has been adopted to test the hypotheses against the collected data. Even though it is difficult to say that the samples were collected from a population that follow normal distribution, the scatter diagram shows mound shape and the t-values can be used as meaningful indicators (Mendenhall & Reinmuth, 1971).

The result shows that among the three variables in TAM, students did not perceive that the ODBS was useful while they perceived that it was easy to use and they have positive attitude against the ODBS. The perceived usefulness of the ODBS by the students turned out the major factor explaining the failure of the ODBS in the case study.

The three hypotheses related with knowledge hoarding of the students have all been rejected indicating that the students did not have any objection for sharing their knowledge on the ODBS.

Finally, network externalities turned out the major motivator to increase the intention of using ODBSs. On the other hand, the explicit reward (linking the activities in ODBSs with final grade) was not fully supported by the students.

6. Discussion

Table 4 summarises the result of the statistical test of the hypotheses. The result in Table 4 is in line with the findings by

Table 4 The result of statistical test of the hypotheses.

H ^a	H11	H12	H13	H21	H22	H23	H31	H32
N	59	59	51	57	57	55	56	55
m	2.5	2.83	2.06	3.82	3.53	3.98	2.77	2.64
s	0.8	0.85	0.83	1.09	0.95	1.01	1.19	0.99
SE	0.1	0.11	0.12	0.14	0.13	0.14	0.16	0.13
Null H.	<3	<3	<3	<3	<3	<3	<3	<3
A	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
df	58	58	50	56	56	54	55	54
t-Value	-4.26	-1.52	-8.05	5.72	4.20	7.22	-1.46	-2.73
LCV	-1.67	-1.67	-1.67	-1.67	-1.67	-1.67	-1.67	-1.67
Decision	Acc	Rej	Acc	Rej	Rej	Rej	Rej	Acc

^a H, hypothesis; N, sample size; m, mean; s, standard deviation; SE, standard error; df, degree of freedom; LCV, lower critical value.

Naarmala (2004) and Venkatesh and Morris (2000) who revealed that perceived usefulness play more important role than perceived easy-of-use. Also, the result from this study support Naarmala who asserted that there is no difference between genders on the assertion while Venkatesh and Morris insist that is male dominant way of thinking. The average and standard deviation of responses from male for the usefulness of the ODBS were 3 (neutral) and 0.97 while female 2.96 and 0.91. This result indicates that module designers who are intending to implement eLearning should have special attention on how to increase perceived usefulness of ODBSs by their students beforehand. With regard to this, it is worth to note the result on the additional questions from the questionnaire. Students were asked if they would contact their friends, the module leader/tutors via email, or the ODBS. The students responded in following order: friends, module leader/tutors, and ODBS putting ODBS as the last place to visit to ask a question. Combined with the low perceived usefulness of the ODBS, this may indicate that the timeliness of the response is one of the important factors for the usefulness of ODBS in eLearning context.

While many knowledge hoarding cases are reported in the literature (Disterer, 2001), it seems not the case in the case study. This may be explained by the special characteristic of the ODBS in eLearning context. In eLearning context, students may recognize ODBS as a place of bi-directional knowledge transferring rather than a unidirectional. As a result, they may have felt that it is a fair knowledge market (give and take). This would be also another future research direction of this study.

The preference of network externalities to reward as the motivator of using ODBSs by students in this paper supports Deci, Koestner, and Ryan (2001) cognitive evaluation theory (CET). There have been debates on the relationship between extrinsic reward and intrinsic motivation in education. While Deci and Ryan (1980) were asserting that extrinsic reward had positive and negative effects on intrinsic motivation in their CET, some researchers like Cameron and Pierce (1994) concluded that the external reward did not decrease intrinsic motivation based on a meta-analysis. This has been reconsidered by Deci et al. (2001) insisting Cemeron and Pierce's research methodology had flaws. According to the result of this study, students do not like extrinsic reward (linkage between the activities in the ODBS and final grade) but prefer network externalities. The network externalities can be considered as an implicit motivator. According to CET, an external event becomes an extrinsic or intrinsic motivator depending how it is perceived by the actor: control or information. It is reasonable to consider that the link with final grade is perceived by students as control while network externalities as information. While the literature insists that external reward may affect intrinsic motivator negatively, this is supported by the students' perspective. On the other hand, this result is different from the findings from Lee, Cheung, and Chen's (2005) study which reported that both extrinsic and intrinsic motivation have positive relationship with user's intention to use the Internet-based learning medium. This may be due to the fact that an ODBS is a secondary tool rather than primary tool for eLearning. Students may feel that it is not fair that their final grade is affected by the activities in a secondary tool.

The above discussion gives us an important hint about the determinants of the effectiveness of ODBSs in eLearning context. Firstly, enhancing the perceived usefulness of ODBSs by students is the first mission of eLearning designers. This may be achieved by the design of the module. For example, the module leader or tutors may announce the students that they cannot directly contact the module leader or tutors before they post their questions on the ODBS. Secondly, once enough number of users is installed at the ODBS, then the eLearning designer should make more efforts to maintain the initial user base or increase the number of users until the society within the ODBS can survive by themselves. For

this, tutors and module leaders need to respond promptly to student's queries in the ODBS to give the students a message that the ODBS is the place to get information or knowledge with regard to any potential queries. Revisiting the case study in Section 2, the number of postings and students in the ODBS in the beginning was good enough.

7. Conclusion

This paper analysed a case in which an ODBS failed to mediate active interactions among learners and instructors to deliver higher learning outcome. Motivated by technology acceptance model and theories with regard to knowledge hoarding, the survey via questionnaire revealed that the low perceived usefulness of the ODBS led the failure of the ODBS. Furthermore, intrinsic factors such as network externalities or critical mass effect turned out to be more effective motivator than extrinsic reward such as the linkage between the activities in ODBSs and final grades to increase the perceived usefulness.

To authors' knowledge, this paper identified the importance of network externalities for the acceptance of groupware based eLearning system. Existing TAM or extend TAM models have been mainly focused on the acceptance of single user based information systems. However, the interaction between learners/instructors or learners/learners are the major feature for the success of eLearning and this interaction mainly can be fostered when there are enough number of users within the groupware systems like ODBSs.

The findings from the case study showed conformance and disparity with other studies and further research using qualitative approaches such as focus group interview will be helpful to clarify the reasons of the disparity.

The result provides us with important implications for open knowledge society. Various types of group supporting system (GSS) have been considered as a key tool to facilitate knowledge sharing among organizational members (Hoogenboom, Kloos, Bouman, & Jansen, 2007). ODBS is one of the mostly used GSS for sharing knowledge in virtual world. However, despite of some efforts to find success factors of group decision support systems in 1990s, there was no study to reveal the success factors of knowledge exchange within ODBS environments. This study suggests that obtaining and maintaining enough level of network externalities is one of the success factors. For this the managers of ODBSs need to consider mechanisms to increase the perceived usefulness of the systems and once initial level of user bases are obtained, they need to provide systematic approaches to maintain the user bases for a while in particular in the beginning of the deployment of the systems. Furthermore, governments need to disseminate the implications into their societies when they facilitate knowledge exchange via the Internet technology.

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