SUPPORTING INTERACTION AMONG PARTICIPANTS OF ONLINE LEARNING USING THE KNOWLEDGE SHARING CONCEPT

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ABSTRACT
In education business, proper interaction is a crucial factor for learning effectiveness. However, it is difficult to successfully guide the participants to achieve the appropriate interaction in an online learning environment. That is, the interaction as well as internal dialogue should be systemically performed under a valid control. In this paper, the concept of knowledge sharing is applied to achieve the appropriate interaction among participants in an online learning environment. By evaluating and integrating the differences between interaction considerations and knowledge sharing, the proposed methodology transforms the interactions into knowledge flows to easily apply the concept of knowledge sharing. Then, the corresponding activities can be acquired following the conformable analysis. According to experimental results, the learners assigned with interaction supported by knowledge sharing flows have better success in terms of learning effectiveness. That is, the concept of knowledge sharing significantly influences the interaction throughout the use of a learning platform and is a way to enhance the learning effectiveness.
Keywords: online learning, knowledge sharing, online learning interaction, learning effectiveness.

INTRODUCTION

Generally, interaction among participants is crucial for study effectiveness, since wisdom exists not only at the individual level, but is also acquired through interactions among participants (Beauchamp & Kennewell, 2010; Hernández, Pardo, & Kloos, 2007; Hwang & Yang, 2008; Koretsky et al., 2008; Reilly, 2008; So, Seah, & Toh-Heng, 2010). Accordingly, the interaction is an important concern, whether being considered in traditional study environments or digital study environments (Hakkarainen, 2009; Lau & Woods, 2009; Liu & Wang, 2010).

For digital study environments (online learning), the research of Hrastinski (2009) presents that the kind of learning is a complex process of participating and maintaining relations with others. The issue regarding interactions for online learning needs more attention. Since the activities of online learning are carried out on the go, without face-to-face discussions (Benbunan-Fich, Hiltz, & Turoff, 2003), the interaction among participants is limited in a digital environment. The interactions of the parties in an online learning environment are undoubtedly crucial for the learning objective and learning effectiveness. Therefore, it is necessary to successfully guide the participants to achieve the appropriate interaction to ensure the learning objective, thus accomplishing the learning effectiveness. That is, the interaction as well as internal dialogue should be systemically performed under a valid control.

As described in (Chou, Penga, & Changa, 2010; Jou, Chuang, & Wu, 2010; Park, 2008; Roblyer & Wiencke, 2003), there are several parties involved in an online learning system: learner, instructor, and content. The relationships among those participants are classified as Learner-Instructor, Learner-Learner, etc. (Lee, Kimb & Hackneya, 2010; Lau & Tsui, 2009; Moore, 1989). While the interactions among these parties are well-defined and kept, the learning objective can be thus arrived at. However, the possible interactions are complicated and are difficult to be distinguished since the scope is comprehensive. Hence, the learning effectiveness depends on the provision that the interaction among participants is formatted. For instance, the interaction between two learners should be publicly performed following a formal method to prevent any meaningless chatting. A

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practical solution, which models the interaction processes, is reasonably useful to overcome the issue. Clearly, it is the basis to share the advantages provided by the interaction among participants and the online learning system. To construct the solution, a design which developed the interactions process with a systemic construction is preferred. Unfortunately, to our knowledge, the previous approaches (Arbaugh & Benbunan-Fich, 2007; Gaetaa, Orciuoli, & Ritrovatoa, 2009; Sherry & Yamashita, 2004; Vandaie, 2008) concerning of the aspect of interaction and learner participation lack the presence.

In this paper, a solution for the concern is proposed in an integrated design. To organize the interaction formally, the concept of knowledge sharing (KS) seems to give a workable way according to the facilitation of transferring or disseminating knowledge from one individual or group to another. Since the KS was not proposed for interactions of online learning, three questions must be addressed:

1. What is the relationship between the roles of KS (the knowledge sources and receivers) and the online learning environment (the instructors, learners and contents)?
2. How can the tacit knowledge sharing for each participant be effectively handled?
3. How can the interaction as well as the activities of online learning be mapped into the framework of KS?

For the first question, knowledge is usually shared from a source to a receiver (Du et al., 2007; Zhuge, 2002). That is, instructors, learners and contents are the source or receiver depending on the kind of interaction process. However, in reality, the interactions of online learning are not absolutely performed in this assumption because the roles may be a source and a receiver simultaneously in some cases. For example, when a learner discusses a controversial issue with another, the knowledge is mutually shared and the role cannot be clearly bounded.

Next, the concerns for tacit knowledge are vital in a KS online learning system since the tacit knowledge is crucial and is difficult to be effectively shared. Nonaka and Takeuchi (1995a) and Polanyi (1974) stated that the unique way to learn tacit knowledge relies on costly and slow knowledge flow methods, like through apprenticeship, imitation and personal experience transfer.

In addition, the application of KS with interaction depends on the analysis of communication among the learners, instructors and contents. Thus, the procedure that transforms interactions into the form of knowledge sharing flow is no longer a choice, but a necessity. If the relevant behaviors of the participants for online learning can be precisely summarized, the corresponding KS flow derived from their interactions becomes searchable.

The main objective of this paper is to present a methodology for achieving the appropriate interaction among participants in an online learning environment. As claimed, the knowledge sharing mechanism should be a workable way for the purposes, but it is not originally designed for online learning. Our contribution in this paper is towards bridging the gap between knowledge sharing and online learning interaction. To validate the work, an experiment from a learning course of a Taiwanese private junior college is performed. In addition, a complete evaluation is discussed to show the feasibility.

The rest of this paper is organized as follows. Section 2 briefly describes related works to facilitate the understanding of the article. In Section 3, the methodology to support interaction among participants of online learning using knowledge sharing is delineated. Then, the experiment and discussion are opened to demonstrate the correctness and practicability in Section 4 and Section 5, respectively. Finally, the conclusion is given in Section 6.

RELATED WORKS

Interactions of Online Learning

The interaction, a social process, is indispensable for the achievement of teaching and learning. In such a principle, the flow of information between participants is important to the quality of learning processes (Thomassen & Ozcan, 2010). There are four types of interaction: learner-content, learner-instructor, learner-learner, and learner-interface defined in the articles (Hillman, Willis, & Gunawardena, 1994; Moore, 1989). The improvement to effectively support the interaction among these types is, therefore, a crucial issue for higher learning effectiveness.

Knowledge Sharing (KS)

Knowledge sharing (KS) is defined as the activities of transferring or disseminating knowledge from an individual, a group, an organization or a society to another, which includes both tacit and explicit knowledge broadly (Nonaka & Takeuchi, 1995a; Nonaka & Takeuchi, 1995b). Generally the mechanism is accomplished in the form of knowledge flow including at least two participants, one who offers knowledge and the other who

receives it (Hendriks, 1999). However, the sharing of tacit knowledge has a complex nature since the tacit knowledge is difficult to extract from the owner (Fernie et al., 2003). Hence, the efforts for the sharing of tacit knowledge are deserved.

THE METHODOLOGY

The Framework

The KS concept is used to facilitate the appropriate interaction, which is one of the crucial factors for learning effectiveness. In other words, the learning effectiveness is not only achieved based the KS infrastructure, but also influenced by the interactions among participants. The primary relationship is shown in Figure 1.

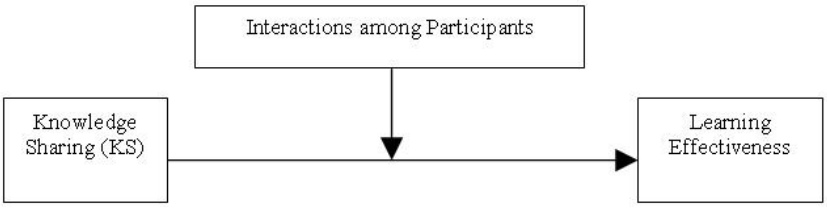

Figure 1. The Primary Relationships among KS, Interactions and Learning Effectiveness

The participants in an online learning system are learners, instructors, and contents, which can be divided into three groups, G_L, G_I and G_C. Generally speaking, each learner has to register at the system to become eligible for the teaching services provided by G_I. The G_C made by G_I is used to represent the study material, and is one of the major media to connect G_I and G_L.

Furthermore, the interactions proposed in the framework among each group are defined as the interaction between contents and learners ($Inte_{C\text{-}L}$), instructors and learners ($Inte_{I\text{-}L}$), and learners and learners ($Inte_{L\text{-}L}$), respectively. In Figure 2, the extension framework including the involved interactions is depicted.

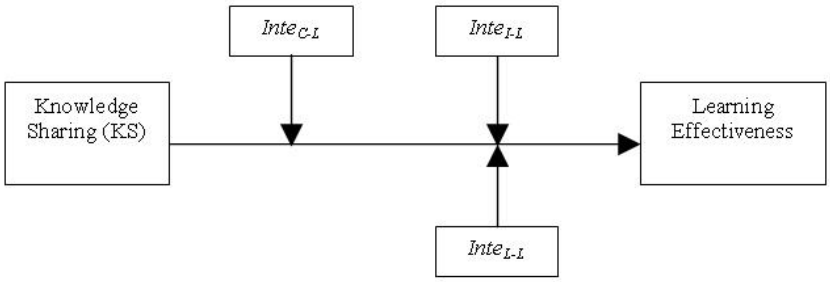

Figure 2. The Relationships among KS, Interactions and Learning Effectiveness with Extension of the Interactions

The Interactions

The interactions for each relationship involved in this paper are explored as follows:

The Interactions between contents and learners ($Inte_{C\text{-}L}$)

The G_L learns from the content (i.e. learning material) prepared according to the teaching objectives. If G_L can easily search for meaningful content instead of receiving packaged lectures, the knowledge flow between G_L and G_C becomes two-way communication, thus enhancing the effectiveness. Therefore, this consideration is necessary for the $Inte_{C\text{-}L}$. On the contrary, the interaction from G_L to G_C is not involved in this research since the G_I cannot influence the details of G_C unless the G_I provides the help.

The Interactions between instructors and learners ($Inte_{I\text{-}L}$)

The interaction between G_I and G_L is established in two-way flows of knowledge sharing. First is the knowledge flows from G_L to G_I. Due to the importance of G_L's comments, a way used to achieve the channel for G_L's comment feedback during the teaching period is essential. This work should be carefully designed since the degree of openness and the average waiting time for useful response determine its success. Next, the knowledge flow from G_I to G_L is a part of teaching instruction. It is a procedure to provide G_L student counseling in terms of lecture issues. The individual problems can always be directly solved in the operation. Hence, some useful mechanisms for the knowledge flow from G_I to G_L are also important.

The Interactions between learners and learners ($Inte_{L\text{-}L}$)
As claimed in various approaches (Chang, Wang, & Chen, 2009; Chao, Hwu, & Lee, 2009; Liang, 2009; Liaw, Chen, & Huang, 2008; Beauchamp & Kennewell, 2010; Lee et al., 2010), significant wisdom does not only exist in an individual, but, rather, is acquired through the interactive relationship from learners with each other. When two or more learners exchange subject matter, they are said to share their knowledge. The more vital the $Inte_{L\text{-}L}$ is, the better the learning effectiveness would be gained. Therefore, the success for $Inte_{L\text{-}L}$ not only relies on the fluency of communication among learners, but is also established on the learners' enthusiasm. As a result, the enhancement of emulation among learners is the way to better learning effectiveness while considering this subject.

Overall
To realize the discussion, the evaluated requirements for each interaction are summarized in Table 1. In addition, the corresponding parties of each KS flow are also presented to clarify the relationships.

Table 1: *The Requirements for Each Interaction*

Requirement	Interaction	Flow Source of KS	Flow Receiver of KS
two-way communication	$Inte_{C\text{-}L}$	G_C	G_L
comment feedback channel	$Inte_{I\text{-}L}$	G_L	G_I
student counseling	$Inte_{I\text{-}L}$	G_I	G_L
subject matter exchange	$Inte_{L\text{-}L}$	G_L	G_L
fluency of communication	$Inte_{L\text{-}L}$	G_L	G_L

The Teaching Method
The teaching method includes three major aspects: content phase, teaching procedure and evaluation. According to the requirements, the methods and their corresponding activities are respectively discussed as follows.

Content Phase
Since the two-way communication between $Inte_{C\text{-}L}$ is the objective, the content is designed to be selected. That is, G_L is allowed to select the content which they require. In addition, the content should be totally kept and shared for the participants, since that is an appearance of knowledge. Therefore, for this phase, not only the selective content is conducted, but also the deployment of keeping history content and discussion is required.

The Activities
1. Content Digitization: This activity is basically needed to achieve the online learning. The whole entirety of the teaching material are firstly made or transformed into the digital form. Then, the functionalities in terms of adding, deleting and updating are offered to facilitate instructors' maintenances.
2. Searching: In order to achieve the functionality of selective content, the index is appended while content is added or updated. The indices are generated according to the semantic and meaningful portion of content, such as subject title, chapter name, keyword, etc., so that the content can be searched using an easy, rapid operation.

Teaching Procedure
The considerations for the teaching procedure significantly affect the learning effectiveness. The aim for this phase is to strengthen the interactions of $Inte_{I\text{-}L}$ and $Inte_{L\text{-}L}$, which is difficult in an online learning environment. As such, not only the presentations of G_I have to be received by the G_L, but also the issue regarding the discussion of G_L should be addressed. In addition, the method involves the keeping of whole discussion records, which is a well-established knowledge-base for further sharing.

The Activities
1. Initiative Raising Issue: The course related issues are initiatively shared and raised for G_L and G_I by each participant. In addition, the sharing of experiences as well as and feedback responses is achieved in this activity.
2. Problem Solution: During the teaching procedure, the course problems can be issued on a public bulletin or discussion board. Then, instructors give the relevant hints which lead to thinking and growing. Furthermore, the G_L is able to solve the announced problems, as well. It is helpful for the satisfactions of G_L, derived from the sentence: "to teach is to learn".
3. Painting: In addition to textual interaction, the drawing and painting functionality regarding thought and interesting events are provided. Moreover, it can be applied as a simple e-whiteboard for G_I. Thus, the interaction between instructors and learners is fulfilled by this function.

4. Voting: According to public balloting, the favorite trend of all learners can be anonymously and statistically understood. The special manner results in invisible interactions, since it facilitates the integration of all participants' consensus.

Evaluation
The evaluation involves two major aspects: the learning effectiveness and feedback responses. The examination is a direct method to control learning effectiveness. Moreover, once the feedback responses are continually allowed, the student counseling throughout the learning duration can be finished.

The Activities
1. Examination: This activity is performed at the end of a semester, and can be designed in various types depending on instructor decisions and real conditions.
2. Feedback and Investigation: Those works are arranged without a fixed schedule. Then, the collected results are kept and shared online to assist the advancement of teaching operations.

Experiment
To validate the contribution of the paper, an experiment which measures the learning effectiveness based on the proposed framework is introduced. Its details include several major parts and are described as follows:

Experimental Participants
128 students between sixteen and nineteen years of age are recruited from a Taiwanese private junior college. These students are randomly divided into three teams (Team A, B and C), which is useful for eliminating the differences of learner motivation and background. The students in Team A make use of the proposed system for assisted learning. Then, Team B is allocated to using a common learning platform with an existing tool, the blog system, for example. Team C employs the fundamental learning system without any external help.

Experimental Design
It is necessary to perform a pretest/posttest nonequivalent control-group experimental design structure (Gravetter & Forzano, 2005), which takes place before and after measuring each team, as shown in Table 2. The pretest and posttest are required to assess the learner's fundamental concept of computers as well as their familiarization with the current teaching subject, respectively.

To minimize the error variances within groups and function-elimination of systematic bias, the experiment analysis of covariance (ANCOVA) (Fan, 1992) are taken. It is one of the statistical techniques which are widely employed for researches, since it not only supports the statistical control, but also reduces the error variance.

Table 2: *Experimental Design*

Team	Pretest	Independent Variable	Posttest
A	O	X_1	O
B	O	X_2	O
C	O	X_3	O

Note. X: Experimental Treatments, O: Pretest or Posttest

The Intervention of Learning Program
For precise results, the learning programs designed in the experiment eliminate the possible condition regarding learner, instructor, and content, besides the learning tool. In Table 3, the learning schedule is given to clarify the details of the learning process for this experiment. Since Team C is incapable of feedback response, only Team A and Team B can execute comment feedback partially, and the complete feedback can be received in the final team reporting. The occasion of feedback response is set throughout weeks 2 to 7.

Table 3: *The Learning Process Schedule*

Week	Process	Team A	Team B	Team C
Week 1	Instruction Guide	○	○	X
Week 1	Pretest	○	○	○
Week 2 ~ 7	Learning Feedback Response	○	○	X
Week 6 ~ 7	The Final Team Reporting	○	○	X
Week 8	Posttest	○	○	○

Note. O: Treatment, X: Control

DATA COLLECTION

In this experimental course, the international certification examination of the Microsoft Office application is one of the crucial assessments for learning effectiveness. The official examination system developed by the Taiwan Computer Association is reliable and fair. Thus, the achievement of passing though this examination implies that the learning effectiveness is a success because the major teaching objective is in this aspect.

The examination is separated into the standard level and professional level. The professional level consists of the questions of the standard level with multiple items, and is more suitable for whoever has passed the standard level. In the past, after learning the relevant course for three months, thirty percent of the students in a class could pass the standard level test; only a few students were able to pass the professional level.

DATA ANALYSIS

As listed in Table 4, the success of the examination of Team A is obviously better than that of Team B and Team C at the end of learning. There are six students in Team A passed the professional-level examination, and only three students from Team A failed the standard-level examination. Clearly, the team aided by the proposed system demonstrates better learning effectiveness than other teams. In other words, the activities derived from appropriate interactions among participants are provably helpful for better effectiveness.

The level of significance is set at α=0.05. The covariate is the pretest scores, and the dependent variable is the posttest scores. As summarized in Table 5, the result confirms the condition for operating ANCOVA. The experimental process eliminating the effects of the protest scores reaches statistical significance (F=21.85, p<=0.05), listed in Table 5, after applying ANCOVA. According to posterior comparisons, the learning achievement and effectiveness of Team A are significantly higher than those of Team C.

Table 4: *Examination Result*

Team	Sample Number (Persons)	Success Amount		Average Score
		Standard Level (Persons)	Professional Level (Persons)	
A	40	37	6	78
B	46	14	0	43
C	42	15	2	59

Table 5: *The ANCOVA for Overall Achievements (Dependent Variable: Posttest; Covariate: Pretest)*

Variance	*SS*	Freedom Degree	*MS*	*F*	Sig.	Estimated Effect Size	Observed Power
Covariate (Protest)	705.09	1.00	705.09	7.23	0.01	0.06	7.23
Between Teams (Instruction)	4263.05	2.00	2131.52	21.85	0.00 ***	0.26	43.71
Within Team(Error)	12095.10	124.00	97.54				
Overall	395073.36	128.00					

Note. ***p<0.001

Clearly, the learners in Team A have better success in terms of study effectiveness. The major inference is the arrangement which provides the opportunity of knowledge sharing and interactive learning. Compared with Team C, the learners in Team A have many more knowledge sharing operations, regardless of the spatial and temporal restriction. Although Team B has some general online learning platforms for learning, the study effectiveness is slightly poorer than the accomplishments of Team A. It is clear that the influence of the knowledge sharing concept and interaction is crucial during the use of a learning program.

DISCUSSION

Researches in online learning interactions are constantly discussed (Bekele, 2010; Capponi et al., 2010; Liu & Wang, 2010). Most of the relevant approaches reveal the positive influence of information technologies, but the consideration regarding the participants is lacking. The participant is undoubtedly necessary and is the kernel in the system. That is, the behavior, experience, requirement as well as the possible reaction of participants are important while applying online learning systems. Consequently, instead of the technology aspect, the paper poses the idea derived from participants and establishes the framework from participants, interactions, methods and activities. The KS concept is introduced to support the interaction among participants in an online learning

environment, it is essential to discuss the achievement of KS and interactions. The relationship among knowledge sources and knowledge receivers is shown in Figure 3. It shows that a participant can be a source and a receiver simultaneously. The proposed interactions of G_L, G_I and G_C comply with the concept of the simultaneous roles depending on the activity which is encountered.

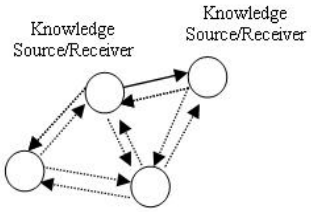

Figure 3. The Knowledge Sharing Concept

There are several relevant activities in the proposed system, and are discussed in terms of KS aspect as follows:

Searching:
For G_L, this is the way to effectively obtain the required content instead of single receiving. The consideration is helpful to achieve the sharing of useful knowledge.

Initiative Raising Issue:
The issue raising process is treated as a knowledge sharing request from others. Specifically, the requests are broadcasted to all participants and thus the knowledge in the domain can be vastly collected. It, therefore, increases the depth and width of the discussion.

Problem Solution:
The conduction of G_I is a kind of knowledge flow to G_L. That is, the clues used to solve the issued problem are streamed from G_I to G_L in KS form.

Painting:
To support the interactive multimedia, this activity is applied to facilitate the sharing process of thought and knowledge in a direct way. Its receiver can be the G_I or other G_L, so that the interaction is unlimited.

Voting:
Since the voters are anonymous, the knowledge can be shared without possible misgivings.

Examination:
The G_I takes the examination when a learning stage is finished. The flow of learning effectiveness of a complete perspective can be received. Although the interaction is passive for G_I, it is a fair way to hold the circumstances of learning effectiveness under the control systemically.

Feedback and Investigation:
Compared to the activity of "Examination", this activity is processed casually. Aside from the event, the KS flow is totally identical to the flow in the activity of "Examination". In Figure 4, the overview depicting the mapping of proposed activities and KS concept is presented.

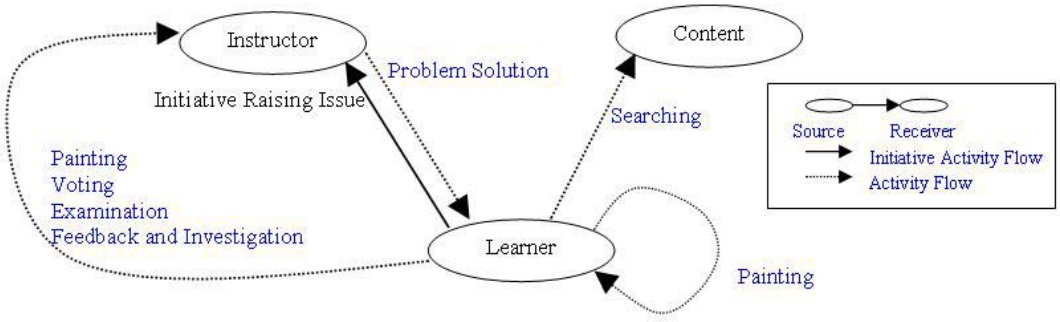

Figure 4. The Mapping of Proposed Activities and KS Concept

CONCLUSION

Due to the increased development of computer and internet technology, online learning is not only viable but also a tendency in educational business. The interaction among participants is surely one of the crucial factors for learning effectiveness. To achieve appropriate interaction among participants, we have built an online learning framework through the use of the knowledge sharing concept, which is a way to organize interaction formally. The major contribution is to evaluate the differences between interaction considerations and knowledge sharing, thus systemically binding these two mechanisms. The proposed methodology transforms the interactions of whole participants into knowledge flows, so that the knowledge sharing concept can be applied easily. The experiment, which has eliminated the possible factors of correctness influence, is involved for evaluation. According to the result, it is concluded that the appropriate interaction among participants is supported using knowledge sharing, and thus the learning effectiveness is enhanced under the design.

Furthermore, some of the interaction flows are not described in this study because the kinds of relationships are complicated and require more affects. For example, neither the interaction between two or more instructors nor the interaction flow from learners to contents is considered. In order to establish a comprehensive infrastructure of interactions, those provisions have to be seamlessly integrated into the proposed system. That is also a crucial issue of online learning and is the direction of our future work.

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