Applying a Hybrid Learning Model and Cooperative Learning for Engaged Learning in Chemical Education

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Knowledge and skills necessary for today's students are becoming increasingly complex based on the changing economy and the current and future industry needs. Apparently, the students need to possess not only the individual achievement test score but also a variety of social skill, team working skill, and multimedia skill if they are to be successful. For such purpose, teachers play an important role in training the students with a mixture of new and different teaching techniques and methodologies to enhance their skills. Learner-centered Learning approaches for example, Cooperative Learning has been found to be effective for teachers to equip the students with various skills. In addition, TSOI Hybrid Learning Model whose theoretical construction is based on the combination of the Piagetian science learning cycle model and Kolb's experiential learning cycle, has also been known to promote active cognitive processing in the learner for engaged learning proceeding from inductive learning to deductive learning. This hybrid learning model will be used to design the lessons for a lecture group of the first year Chemical Engineering students from a local polytechnic. Cooperative Learning strategies, for example Numbered Heads Together will be employed for the tutorial group to promote team working skill. The applications of hybrid learning model and cooperative learning approach will be illustrated for engaged learning on the topic of physical thermodynamics. Issues on crafting of authentic tasks to enhance engaged

learning, feedback & implications will also be discussed further in this context of engaged learning.

Introduction

Recent changes in world's economy have demanded for schools to train its students who are the future work force of industry to possess various skills and knowledge for the tougher challenges ahead. As such, there is an increasing need for schools to introduce curricular changes which will allow the students to engage, think, act, and reflect via their own learning experiences in the classroom and in the lecture theatre. These meaningful learning experiences could be introduced using videos, playing simulation software, through real life problems, and conducting activities in the classrooms followed by effective questioning by the teacher to stimulate meaningful discussion among students. A systematic way of designing these meaningful learning components could be accomplished by using various learning models and new pedagogy approaches. In this paper, designing the lessons by applying TSOI hybrid learning model and cooperative learning approach will be illustrated for meaningful engaged learning on the topic of physical thermodynamics.

Framework of TSOI© hybrid learning model

TSOI Hybrid Learning Model's theoretical construction is based on the combination of the Piagetian science learning cycle model and Kolb's experiential learning cycle (Tsoi, 2007; Tsoi, 2008a; Tsoi, 2008b). The term "hybrid" represents the mixing of the two different learning models. The hybrid learning model has been known to promote active thinking process in the learners for engaged learning. Since this hybrid learning model encompasses the characteristics of the two models, namely, the Piagetian learning cycle model and the Kolb's experiential learning cycle model, it has not only able to promote active cognitive processing in the learner for meaningful learning proceeding from inductive to deductive but also has an added advantage of addressing the individual learning style for the learners. The TSOI© hybrid learning model primarily consists of four phases, namely the Translating phase, the Sculpting phase, the Operationalizing phase, and the Integrating phase. These four stages were crafted as a learning cycle to represent the hybrid model as an innovative learning model which is able to facilitate learning as a meaningful cognitive process. During this learning cycle, the learner will go through from concrete knowledge to the abstract which leads to concept formation. In the first two phases, multiple activities are designed for preliminary awareness of the concept to be learnt as well as for concept construction of its critical attributes. This is then followed by concept internalization through various practices and eventually to concept application for real life situations and problems solving. Figure 1 shows the four stages of the hybrid learning model.

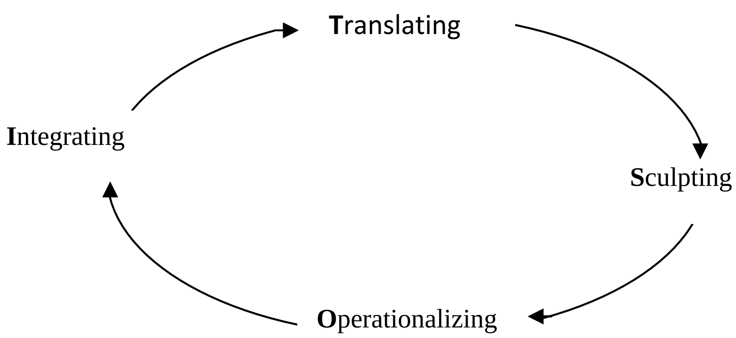

Figure 1. TSOI© hybrid learning model

Redesigning the lessons based on the framework of hybrid learning model

For the Translating phase, it is important to introduce interactive experiences to the student which can be translated into beginning ideas or concepts of the subject. From the author's past experience, learning internal energy concept appears to be a difficult concept for the students while learning it through the traditional lecture setting, i.e., listening to teacher's explanation based on the PowerPoint slides presentation. As such, in order to help the students for understanding the internal energy concept better, the students will be instructed to watch a video based on a laboratory experiment by a group of students from the YouTube website and to explore more about internal energy concept thereby improve understanding on the First law of Thermodynamics which is the most important core concept of the subject. It is not possible to comprehend the First Law of Thermodynamics fully if the students do not understand Internal energy concept. Therefore, this activity is designed for the first stage of hybrid learning model which is the Translating phase and the original lecture slides were revised and redesigned in order to fit into the framework of the hybrid learning model.

Next, for the Sculpting phase where the concept formation and the reflective observation will occur, the author has designed ten thinking questions for the students to think, and observe actively and reflectively. These questions are related to the internal energy video and they are launched continuously through the blackboard's discussion forum. The students are allowed multiple viewing of the video before answering the questions and post their answers in the discussion forum. After watching the video, the teacher will facilitate a short questioning session to encourage the students to explain what they meant by "heat" , "work", and " internal energy" in the context of the video by asking some questions to help students think and identify the critical characteristics or attributes of the concept (Scott, Mortimer, & Aguiar, 2006). The evidence of students' engagement to teacher's questioning will be captured via Blackboard's discussion forum. Figure 2 shows a screen shot from blackboard's discussion forum about internal energy concept.

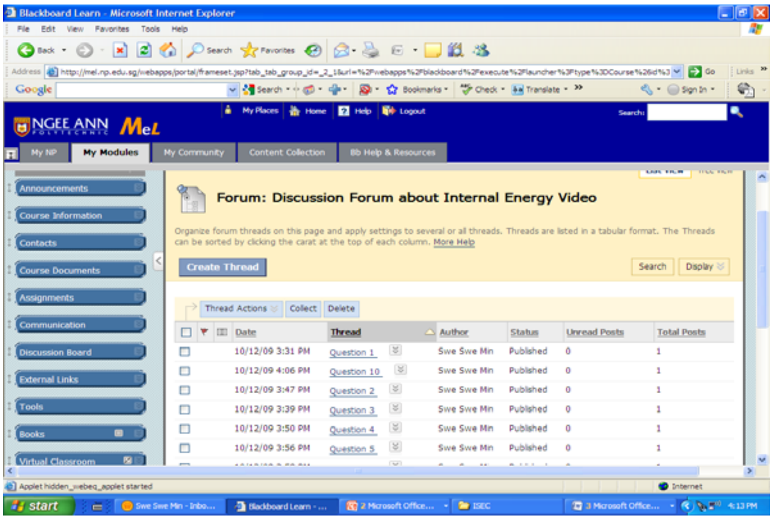

Figure 2. Blackboard's discussion forum about internal energy

The relevant questions to the internal energy video (Question 1 -10 in the above screen shot) are presented as follow (Scott, Mortimer, & Aguiar, 2006):

1. What happens when we heat up the air in the conical flask? How do you explain it?
2. What are the changes/interactions between the system and surrounding? Temperature or heat or work or all of them?
3. Is there is a change of temperature? Why?
4. Is there is a change of volume? Why?
5. Why the volume of the balloon changes?
6. Is there heat transfer? What's that? Can you explain more about this?
7. Is there work transfer? What's that? Can you explain more about this?
8. Is there a change in internal energy? Why?
9. Please justify your ideas/answers.
10. Please take a look at the other answers in this forum and if you think differently, explain your ideas here.

For the third stage of the hybrid learning model, the Operationalizing phase, it is important to promote the understanding of the relationship between thinking and concept acquisition to the learners as well as to operationalize the newly acquired concepts together with the existing ideas or concepts. For such purpose, the students will be instructed to watch a second video about the First Law of Thermodynamics from YouTube website. After that, they will be given simple practice problems and examples for linking the various concepts of “heat”, “work”, and “internal energy” to the First Law of Thermodynamics. For this stage, a complete understanding of the First Law of Thermodynamics which is based on the various concepts will be obtained via a concept map which helps students to link all the critical attributes or characteristics for the meaningful internalization of the concepts. The students will be asked to log into the Blackboard’s discussion forum and submit a concept map as a group assignment after watching the video and solving simple problems. Figure 3 shows a screen shot of Blackboard discussion forum for the First Law of Thermodynamics.

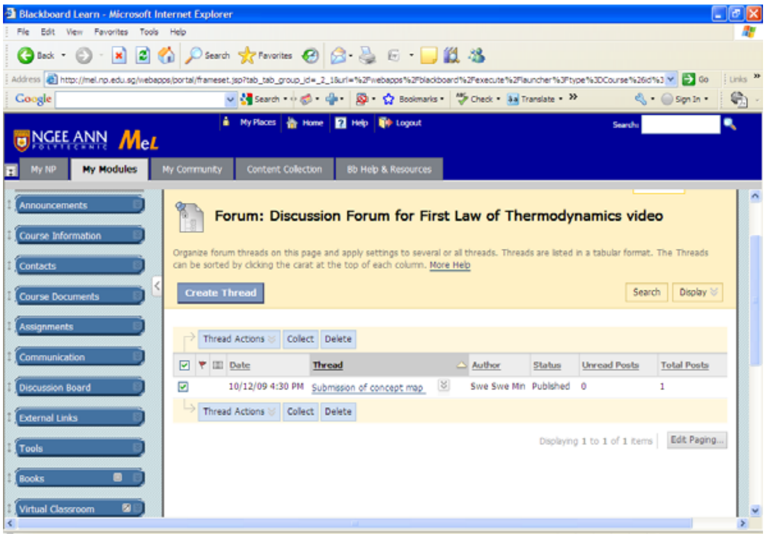

Figure 3. Blackboard’s discussion forum for First Law of Thermodynamics

For the fourth stage of hybrid learning model, the Integrating phase or the Concept application stage where the learners applied the concept to new domains in which the transfer of learning is practiced, the students will be given more real life practice problems, examples and online quizzes in Blackboard so that they are able to integrate the knowledge, transfer it to different situations and be able to master the skills for solving the problems.

Cooperative Learning Approach

Based on numerous studies (Blignaut & Venter, 1998; Ghaith, 2002; Slavin, 1996;), Cooperative Learning, one of the engaged learning approaches, is proven to be an effective teaching and learning approach for teachers to equip the students with effective team work. Cooperative Learning, in general, introduces learners with instructional methods to the context they will work as an effective team. It also helps the learners to acquire the ability to think actively and reflectively as well as to cooperate effectively from their experiences on social interactions and discourse in a group. There are four basic components for the Cooperative Learning approach. They are positive interdependence, individual accountability, equal participation, and simultaneous interaction. When any one of four components is not implemented, it was noted that there is no Cooperative Learning (Kagan, 1994). In this exploratory study, apart from applying the hybrid learning model to the lecture group, Cooperative Learning with a Structure Approach will be used for the small Tutorial group, i.e., using Numbered Heads Together approach for teaching tutorials to the students and the feedback from the students will be recorded from the students' responses to a questionnaire. It was noted from the literature that students' experiences in a small group cooperative classroom climate were strongly positive if it is implemented well. (Hanze & Berger, 2007; Ghaith, Shaaban, & Harkous, 2007; Gillies, 2003; Siegel, 2005; Tan, 2004; Tan, Sharan, & Lee, 2006).

Discussions

This paper has proposed the applications of hybrid learning model and cooperative learning approach for designing engaged learning process to obtain a better achievement outcome regarding to students' results as well as improvement for students' study attitude in a meaningful learning climate. The use of a learning management system, the Blackboard has also been incorporated in the lessons design. The richness of the contents provided by the students in the discussion will also serve as another valuable source for finding out the extent of learning outcomes in terms of their understanding of the concept and knowledge acquisition. Further to this, a future study will be conducted to answer the following research questions "Is there a significant difference between pretest and posttest achievement means with or without TSOI Hybrid Learning Model in the lessons design?" and "Are the students' learning attitudes positive with or without Cooperative Learning Approach in the tutorial sessions?" Issues and implications for implementing stages shall be further discussed in the future work.

References

Blignaut, R. J. & Venter, I. M. (1998). Teamwork: can it equip university science students with more than rigid subject knowledge? *Computers & Education*, 31, 265-279.

Ghaith, G. M. (2002). The relationship between cooperative learning, perception of social support, and academic achievement. *System*, 30, 263-273.

Ghaith, G. M., Shaaban, K. A., & Harkous, S. A. (2007). An investigation of the relationship between forms of positive interdependence, social support, and selected aspects of classroom climate, *System*, 35, 229-240.

Gillies, R. M. (2003). The behaviors, interactions, and perceptions of junior high school students during small-group learning. *Journal of Educational Psychology*, 95(1), 137–147.

Hanze, M., & Berger, R. (2007) Cooperative learning, motivational effects, and student characteristics: An experimental study comparing cooperative learning and direct instruction in 12th grade physics classes, *Learning and Instruction*, 17, 29-41.

Kagan, S. (1994). *Cooperative Learning.* San Clemente, CA: Kagan, c1994.

Scott, P. H., Mortimer, E. F., & Aguiar, O. G. (2006). The tension between authoritative and dialogic discourse: A fundamental characteristic of meaning making interactions in high school science lessons. *Science Education*, 90, 605-631.

Siegel, C. (2005). An ethnographic inquiry of cooperative learning implementation. *Journal of School Psychology*, 43, 219-239.

Slavin, R. E. (1996). Research for the future-Research on cooperative learning and achievement: what we know, what we need to know. *Contemporary Education Psychology*, 21, 43-69.

Tan, G.C.I (2004). Effects of cooperative learning with Group Investigation on secondary students' achievement, motivation and perceptions. Unpublished doctoral dissertation, Nanyang Technological University, Singapore.

Tan, G. C. I, Sharan, S. & Lee, K. E. C. (2006). *Group Investigation and Student Learning: A Cooperative Learning Experiment in Singapore Schools,* Singapore: Marshall Cavendish.

Tsoi, M.F. R. (2007). Development and Effects of Multimedia Design on Learning of Mole Concept. Unpublished doctoral dissertation, Nanyang Technological University, Singapore.

Tsoi, M. F. R. (2008a). Designing for engaged e-learning: TSOI hybrid learning model, *The International Journal of Learning*, 15 (6), 223-234.

Tsoi, M. F. R. (2008b). Designing e-learning cognitively: TSOI hybrid learning model, *International Journal of Advanced Corporate Learning*, 1(1), 48-52.