

# Journal of Technology Management and Entrepreneurship

*Volume 6 Number 1, 2007*



A Publication of the Institute of Technology Management and Entrepreneurship,  
Universiti Teknikal Malaysia Melaka



## APPLYING HYBRID PROBLEM BASED LEARNING APPROACH IN DEVELOPING C<sup>2</sup>HADAM

<sup>1</sup>Faaizah Shahbodin

<sup>2</sup>Halimah Hj. Badioze Zaman

<sup>3</sup>Norasiken Bakar

<sup>1,3</sup>Fakulti Teknologi Maklumat dan Komunikasi,  
Universiti Teknikal Malaysia Melaka

<sup>2</sup>Fakulti Teknologi dan Sains Maklumat,  
Universiti Kebangsaan Malaysia

### ABSTRACT

This paper highlights the design and development of the prototype C<sup>2</sup>HADAM, a multimedia courseware intended for the teaching and learning of the Science subject for Form Two in the Malaysian secondary schools. This prototype has been developed using the Hybrid Problem Based Learning (PBL) approach. The discussion involves the development life cycle of the software application consisting of the analysis, design, development, implementation and evaluation. The researcher also highlights some of the learning theories referred to in developing the C<sup>2</sup>HADAM prototype namely PBL, contextual, collaborative and constructivism. The concepts of inquiry learning, contextual education, simulation, exploratory learning and student-centred learning are also incorporated in C<sup>2</sup>HADAM. This paper also aims to show some of the screen snapshots taken from C<sup>2</sup>HADAM prototype. The findings from the preliminary reliability test are also discussed.

**Keywords:** *Problem based learning, hybrid, constructivism, contextual, collaborative approach*

## INTRODUCTION

Learning is one of the most important necessities of life. With a high demand for changes to the current teaching and learning theories, Problem Based Learning (PBL) has become a popular new paradigm of teaching and learning. The advancement of Information Communication Technology (ICT), innovative use of multimedia technology and Internet has been a major factor in impacting the current trend of education worldwide. In Malaysian secondary schools, Science is one of the core subjects and which is included in the national Secondary School Evaluation Examination (PMR). ICT and specifically the C<sup>2</sup>HADAM can improve the way Sciences are taught and enhances students' understanding of basic nutrition topic especially human digestion process.

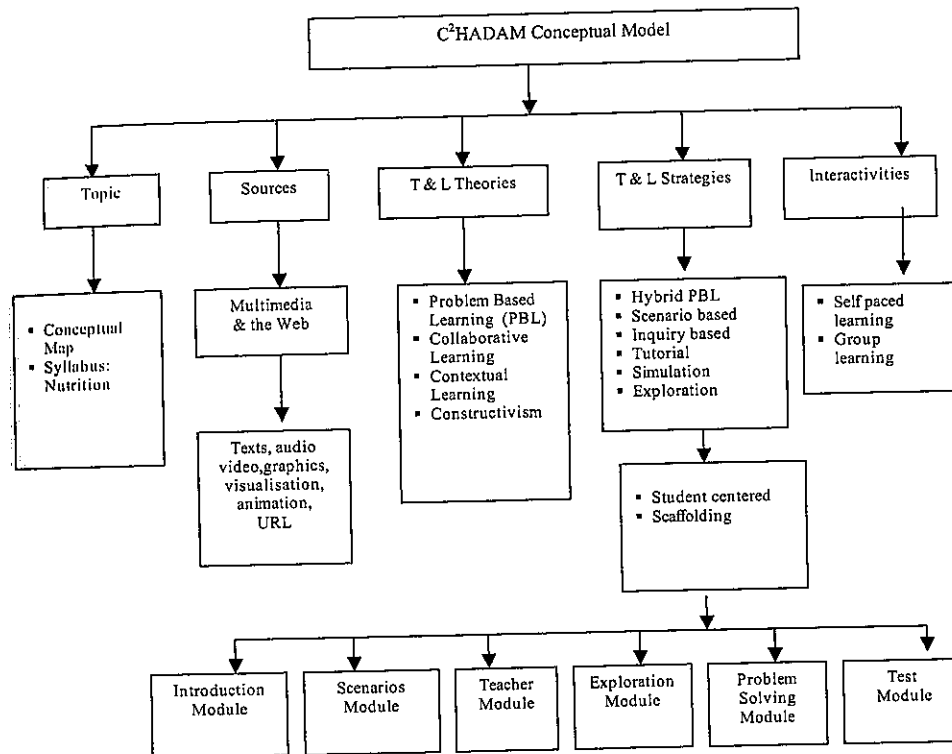
This paper describes the development of an interactive multimedia courseware known as C<sup>2</sup>HADAM, a courseware created especially for PMR students, incorporating the hybrid Problem Based Learning approach. This courseware was developed to provide a new approach in the teaching and learning of Science subject. Activities in the C<sup>2</sup>HADAM are based on PBL principles with the objective to enhance the understanding of nutrition as well as to provide problem solving skills for the students to solve problem scenarios given.

This paper will:

- Briefly present the Conceptual model designed for C<sup>2</sup>HADAM;
- Discuss the popular learning theories applied in the design and development of C<sup>2</sup>HADAM. These theories are Problem Based Learning, Constructivism, Contextual approach, and Collaborative approach;
- Provide examples of the modules and screen snapshots taken from C<sup>2</sup>HADAM;
- Present some of the findings from the preliminary reliability test.

## CONCEPTUAL MODEL FOR C<sup>2</sup>HADAM

Figure 1 shows the Conceptual model for C<sup>2</sup>HADAM which has been developed not only by incorporating various learning theories based on Problem Based Learning approach but also various modules created for C<sup>2</sup>HADAM.



**FIGURE 1**  
*C<sup>2</sup>HADAM Conceptual Model*

There are five components identified in the Conceptual model as shown in Figure 1.

(1) Component 1- Topic

Science plays an important role in our life. Science is a core and compulsory subject in the curriculum for students in Malaysian secondary schools. Currently, a lot of students feel that Science is one of the difficult subjects to learn. The traditional method of teaching whereby teachers give information and students receive information is a one way communication which is not suitable. Due to this, the interactive courseware called C<sup>2</sup>HADAM has been developed which covers nutrition topics including Food Class, Balance Diet, Human Digestive System, Food Absorption and Defecation. The materials included in the courseware are from text books and have been adapted with the help of Science teachers in several schools.

(2) Component 2- Sources

The multimedia elements such as hypertext, video, graphics, 3D animation and video clips have been blended together to produce an effective courseware. C<sup>2</sup>HADAM courseware for Science is developed using Multimedia tools such as the Macromedia Flash and Director.

(3) Component 3 and 4 -Teaching & Learning Theories and Strategies

Various instructional theories and strategies highlighted in the Conceptual Model of C<sup>2</sup>HADAM are described below:

**I. What is Constructivism?**

Constructivism is more learner-oriented and less content-oriented; and the educator's goal is to create an information-rich object and meaningful learning environment. Mekhalft (1997) stated that an educator acts as a facilitator who helps create a collaborative problem solving environment. Sanford (2001) agreed that constructivism is an alternative epistemology of how students learn and assimilate new knowledge. They assimilate new knowledge by producing cognitive structures that are similar to their past experiences. Learning is a quest for meaning. To attain that meaning, students must interact with the environment and focus on concrete situations and understand both facts and the contexts as suggested by Fosnot (1992).



Learners need some opportunities to define for themselves the goals and objectives of the course; collaboration and interaction is important to motivate students to share ideas and knowledge. The communication and dialogue that result from this interaction provides learners with the opportunity to test and refine their understanding of the learning process. The learning goals and objectives are not fixed but subject to negotiations between learners and educators. The learning process focuses more on the process and interaction, and less on what is specifically to be accomplished as a result of the lesson; learners are motivated by a common interest in some real-life problems or issues.

The following elements are important to create a constructivist environment within the instructional system:

- Learning occurs in authentic learning environment in which students use real world information and make decisions in a learning environment
- Learning occurs within the context of a social experience
- Learners are provided with experiences from multiple perspectives
- Learners are provided with experiences in a knowledge construction process
- Learners are aware of their knowledge construction process

## II. What is Problem Based Learning (PBL)?

PBL originated in medical education, in the Faculty of Medicine at McMaster University in Canada in the mid 1960's. Currently many medical schools in almost every country in the world are implementing PBL in their curricula. PBL is an education tool used in classrooms around the world, from grade schools through professional institutions. It has been used not only in medical and nursing field, but in other fields such as Information and Communication Technology, Engineering, Social Science, Law, Mathematics, Arts and Science as shown in Table 1- Problem Based Learning Examples.

**TABLE I**  
Problem Based Learning Examples

INSTITUTION	FIELD
Hawaii, McMaster, Linköping, Glasgow	Medical schools
Ohio, Maastricht, Breda, Plymouth	Business and Management
Monash, Coventry, Stanford, Manchester	Engineering
Sydney, Maastricht	Law
Manchester	English
Melbourne, East London	Architecture

According to Gary and Max (2004), PBL is a pedagogy drawn from constructivism and considered to be one of the best examples of a constructivism approach. PBL has been among the curricular innovations most widely discussed in the education field over the last 30 years. The PBL definition that is being used here is that it is a subset of problem-centered learning methods which is easily identifiable by the use of typically ill-structured problems which precede and motivate learning, and acts as a vehicle for encouraging student ownership of the learning environment. Usually there is an emphasis on the contextualization of the learning scenario. The learning process is accompanied by reflection as an important meta-cognitive aspect of PBL.

According to Liu (2005) PBL is a learning process where students are presented with a problem and are asked to apply reasoning, questioning, researching, and critical thinking techniques to find a solution to the problem. Thus the essential characteristics of PBL include:

1. Learning is student-centered
2. Authentic problems is a focus for learning
3. Learning is self-directed
4. Learning occurs in small groups
5. Teachers act as a facilitators

PBL is a curriculum approach, which helps students frame their experiences through a series of problem-solving activities. Learning occurs through the application of knowledge and skills to find solutions to real-life problems. PBL uses ill-structured problems to encourage the students to acquire knowledge rather than extracting and regurgitating it from the existing sources. PBL is the complete opposite of the traditional lecture in which the teacher presents all the information to the passive student (Kowalczyk and Leggett, 2005).

### **III. What is Contextual Learning?**

Hardy (2003) found that the use of Contextual Learning in class help students gain knowledge and increase their performance. Sears (1999) found that teaching and learning approach based on contextual learning is one concept that helps teachers explain the content of learning and also acts as a motivation for students to relate the knowledge gained with real life situation in a more meaningful way. According to Shana and Bettye (2006), contextual learning will motivate students to make connections between knowledge and its applications to their lives.

### **IV. What is Collaborative Learning?**

Collaborative learning is not a new learning theory. It focuses on learning in a group to achieve academic goals. This learning method will provide an opportunity for students to get actively involved in any discussion throughout their learning process. Students will have more fun and become responsible for their own study. According to Wiersema (2000) collaborative learning is an educational principle whereby it will help and encourage students to work together to be successful.

#### **(5) Component 5- Interactivity ?**

The concept of interactivity which is one of the PBL characteristic is applied throughout the courseware.



## **C<sup>2</sup>HADAM MODULES**

C<sup>2</sup>HADAM is developed using Macromedia Director and Flash, the commercially available multimedia programming tools. This hybrid C<sup>2</sup>HADAM is available in digital, web-based and paper-based formats. A web-based format is particularly suitable for the learning of applied science subject. However, web-based learning has also been widely applied to the life sciences to reinforce whatever the students have acquired in the classroom, laboratory, or class activities (Chan et al., 2003). With emphasis on learning the concept of nutrition, the use of visual representation is critical in creating real-life experience that allows students to relate the materials with their daily food intake. In addition to learning content, the access to digital resources such as online nutrition courses also allows the exploration of different information resources. C<sup>2</sup>HADAM has been developed as menu-driven, which allows students to enter the information stream at a variety of points, rather than being forced to follow a predetermined path. With the help of various multimedia development tools, the visual representations of nutritional topic aim to foster potential learning interest and stimulate student's attention. The use of animation, simulation, clickable diagrams and pictures help to clarify concepts that a static textbook image simply cannot. The use of images, motions, video and problem scenarios as a trigger make a scientific phenomenon to be easily comprehended by students.

For this prototype version of C<sup>2</sup>HADAM, it focuses only on one of the more difficult Form Two science topics namely 'Nutrition'. It is developed for a basic nutrition course. The learning materials cover the introduction to food classes, human digestion process, and the importance of healthy diet.

The food sources, the nutritional compositions of various foods and BMI calculation are also provided with visual information. By viewing the animation of how food (like an apple) gets digested in the stomach of a person, students would be able to relate the visual materials with the food processing process that takes place in a human body. In addition to digital learning material, the C<sup>2</sup>HADAM also provides students with an online discussion features called "C<sup>2</sup>HADAM Forum" where students are encouraged to pose their questions or responses related to a certain nutrition-related topics.

Some of the PBL features have been applied in the design of C<sup>2</sup>HADAM such as the use of scenarios and simulations as a trigger for problem-solving discussion and the

creation of Learning Resources feature to support student learning process. Faaizah (2006) highlighted that the use of ill-structured problem as a trigger to start the learning process will help students appreciate and understand the said process. There are six modules already built into the courseware:

### 1. Introduction Module

The function of this module is to introduce students to the C<sup>2</sup>HADAM courseware. It starts with a montage, followed by information about PBL and a short description of C<sup>2</sup>HADAM courseware. The last part of this module is the registration screen for students to register to become user of the courseware. After successful registration process, the main menu screen for the courseware will be displayed as shown in Figure 2.

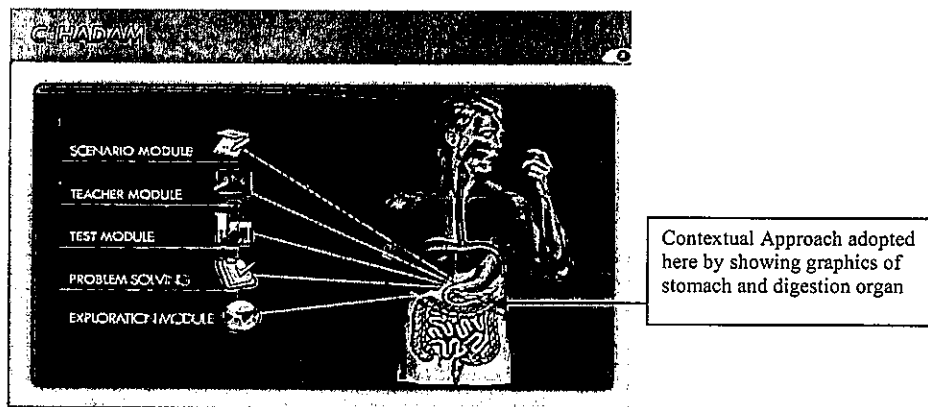
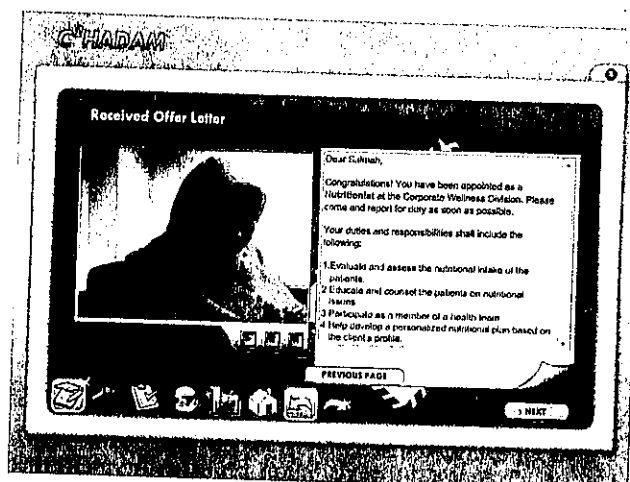


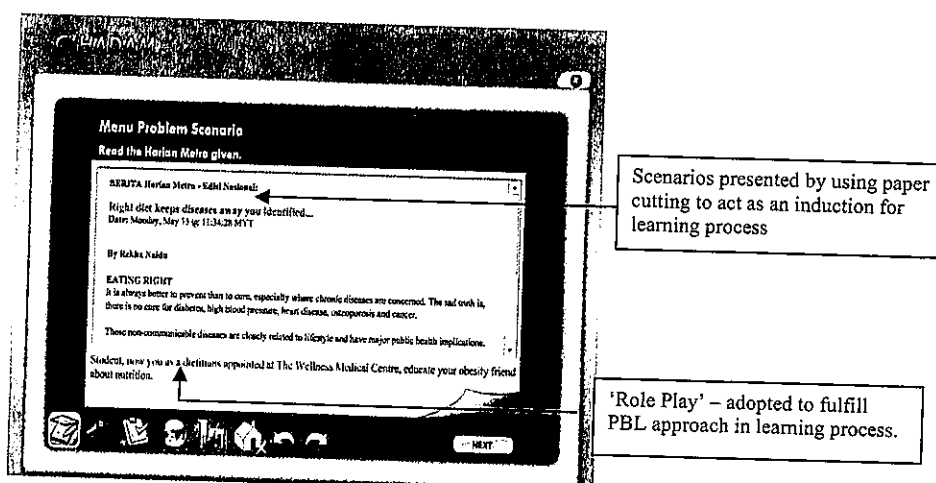
FIGURE 2  
C<sup>2</sup>HADAM Main Menu

### 2. Scenarios Module

The function of this module is to help students understand the problem which has been presented using simulation techniques. The students have to act as a dietician to help solve a dietary problem as shown in Figure 3. Students are given access to the on-line Learning Journal and Forum to discuss and share their findings. Students will be guided to use the problem solving chart called the FILAS tables. FILAS is an acronym for Facts, Ideas, Learning Issues, Actions, and Solutions. The purpose of developing the Scenario Module is to present a problem which acts as a trigger for the topic discussion as shown in Figure 4.



**FIGURE 3**  
*Simulation Screen*



**FIGURE 4**  
*Problem Scenarios Screen*

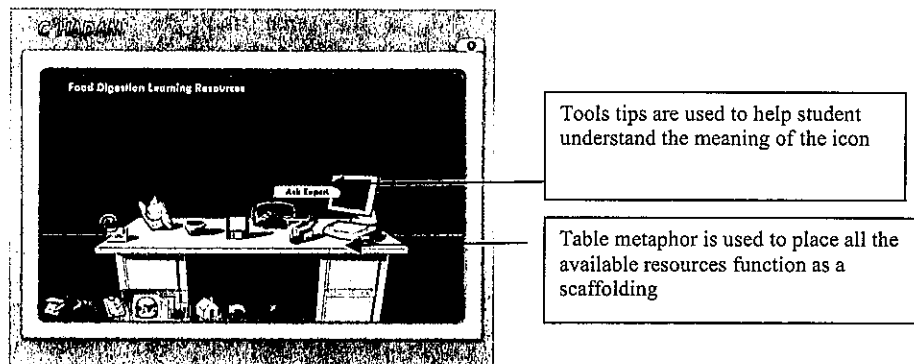
### 3. Teacher Module

The function of the Teacher Module is to scaffold or guide students to understand the topic of Nutrition. This module acts as a tutorial for the students. There are three components in this module namely Learning Outcome, Explanation, and Exercise. This module can motivate students

because of the multimedia approach and the scaffolding, self-explanation, and hyper-linking tutoring strategies it provides. The integration of various media elements such as graphics, audio, video and animation in this module adds more value to this courseware.

#### 4. Exploration Module

The function of the Exploration Module is to help or guide students to get more information by clicking on the Learning Resource button created in the courseware. Some of the features available in this module are 'Ask Expert', Forum, Nutrition notes and web sites, E-mail capability, Glossary and Multimedia Gallery as shown in Figure 5.



**FIGURE 5**  
*Learning Resource Screen*

#### 5. Problem Solving Module

The function of the Problem Solving module is to enrich the learner's understanding through problem solving activities. In this module, students can improve their problem solving skill using inquiry technique known as FILAS Chart. Since the approach used in developing C<sup>2</sup>HADAM courseware is PBL which is quite new to Malaysian secondary school students, the researcher has decided to use hybrid PBL by combining paper-based and digital forms. Some groups of students will work using the courseware and some others will use paper-based worksheet called C<sup>2</sup>HADAM Sheet. In this prototype, only four sample problems are available.



## **6. Test Module**

The function of the Test module is to test the learner's understanding through the set of multiple-choice questions, Filling in the blanks, and Labelling. Some of the questions here are Penilaian Menengah Rendah (PMR) clone taken from reference books recommended by school teachers so that students can get used to the questions during their real examinations.

### **PRELIMINARY RELIABILITY TEST**

Preliminary reliability test is a testing method used for two reasons namely to ascertain the validity of the instrument (the questionnaire) and also the effectiveness of the courseware itself (the prototype C<sup>2</sup>HADAM) at the same time. At this stage, the researchers used three types of instruments to measure the courseware effectiveness:

- a) Questionnaire for students called 'Soal Selidik Pakej C<sup>2</sup>HADAM Pelajar' (SPHP)
- b) Questionnaire for students called 'Soal Selidik Kemahiran Pakej C<sup>2</sup>HADAM Pelajar' (SKHF)
- c) Questionnaire for teachers called 'Soal Selidik Pakej C<sup>2</sup>HADAM Guru' (SPHG)

A pilot test was conducted. Analysis of the answers to the questionnaire and interviews of selected students made during the pilot test clearly revealed that a majority of students consider the C<sup>2</sup>HADAM prototype as very challenging.

During the pilot test conducted at one of the secondary schools in Shah Alam, 9 Science-subject teachers and 5 Form 2 students were asked to have a run-through and experiment with the courseware and complete the questionnaires.

Table 2 below shows the preliminary findings of the reliability test which prove the acceptable Alpha values for the research construct.

**TABLE 2**  
Alpha values

No	Construct	Cronbach Alpha
1.	Performance Effectiveness	0.862
2.	Learnability	0.834
3.	Ease of use	0.907
4.	Flexibility	0.709
5.	Attitude	0.741

## CONCLUSIONS

We have presented a background review of four learning theories namely constructivist, contextual, collaborative and Problem Based Learning which have been referred to and applied in developing the prototype C<sup>2</sup>HADAM multimedia courseware. The prototype which focuses on the topic of Nutrition for Form 2 secondary school has been developed to test the effectiveness of PBL in the learning of Science subject. The use of simulations and problem scenarios as a trigger for discussion play a major role in the understanding of a scientific concept which in this case is nutrition. Interviews and questionnaires were used to obtain the feedback on the overall effectiveness and the reliability of the courseware design. Generally, the respondents have given positive feedback on the courseware and it is hoped that the principles used in C<sup>2</sup>HADAM can be applied to any other scientific concepts.

## ACKNOWLEDGEMENTS

The writer is grateful to Prof. Halimah Hj. Badioze Zaman, her PhD supervisor cum co-author of this paper for her helpful comments, ideas and inspiration throughout my study at UKM.

## REFERENCES

- Chan Lin L., Huang S., and Chi Chan K. 2003, *Web Based Instruction in Learning Nutrition. Journal of Instructional Psychology*: 30(1) : 12 ProQuest Education Journal 12
- Faaizah Shahbodin & Halimah Badioze Zaman. 2006, *Introducing a Problem Based Learning (PBL) Approach into a Science Curriculum, Konvensyen Teknologi Pendidikan ke 19, Malaysia*, 565-568
- Fosnot, C.T. 1992, *Center for constructivist teaching/teacher preparation project. Paper presented at the Association of Teacher Educators' Annual Conference, Orlando, FL.*
- Gary C. & Max E. 2004, *Introduction to the Special Issue: Problem Based Learning as Social Inquiry- PBL and Management Education, Journal of Management Education*, 28 (5) : 523-535
- Hardy, T.C. 2003, *Contextual Teaching in Science*. Available at:  
<http://www.kennesaw.edu/english/ContextualLearning/2003/Bartow/TeraHardy.pdf>.  
[viewed 25 January 2006]
- Kowalczyk, N. and Leggett, T.D. 2005, *Teaching critical thinking skill through group based learning (PEER REVIEW). Radiologic Technology* 24(8) : 77
- Liu, M.J., 2005, *Motivating students through Problem Based Learning*. Available at:  
<http://center.uoregon.edu/ISTE/uploads> [viewed 15th March 2007]
- Mekhalfi, A. 1997, *Constructivism*  
Available at:  
<http://seamonkey.ed.asu.edu/~mcisaac/emc703old97/spring97/7/mekh7.htm>  
[viewed 3rd December 2003]
- Sanford, G. 2001, 'A Constructivist approach to online training for online teachers.' *JALN* Volume 5(1)

Sears, S.J.1999, *What Is Contextual Teaching & Learning?* Available at:  
<http://www.contextual.org/>. [viewed 15 December 2005]

Shana, K. and Bettye, P. 2006, *Using Contextual Teaching and Learning in Foods and Nutrition Class*. *Journal of Family and Consumer Science*, 28(1) : 82

Wiersema, N.2000, *How does Collaborative Learning actually work in a classroom and how do students react to it? A Brief Reflection*. Available at: <http://www.city.londonmet.ac.uk/deliberations/collab.learning/wiersema.html> [viewed 27 November 2006]