The virtual classroom: A catalyst for institutional transformation

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This study explores the use of the virtual classroom which has been created in *myVLE*, a learning management system used by the Open University Malaysia (OUM). The virtual classroom in *myVLE* is an asynchronous-based online learning environment that delivers course materials to learners and provides collaboration and interaction using an asynchronous-based forum as the main platform to support the learners' independent study. It also provides a learning environment with learning tools, learning materials, opportunities for contextual and collaborative discussions, and individual learning and assessment. OUM uses this virtual classroom to deliver the subject *Object-Oriented Programming* (CS1) and in this paper the impact of this delivery system is explored. The study aimed to elicit students' perceptions of the virtual classroom, based on their learning experiences, how well it supported their self-managed learning, and their personal preference for this compared with face to face interactions. Findings obtained using a questionnaire indicated moderate responses (average value for the items was between 2.0 to 3.6 on a five point Likert scale) for the use of the virtual classroom, and some possible reasons for this are discussed in this paper.

Introduction

Distance learning is a major contributor in meeting the educational requirements of the 21st century through the use of online learning. Online learning with its egalitarian environment of open access provides greater opportunities for learners, particularly adult learners. Learner-centreed educational opportunities through the use of virtual classrooms could satisfy learners' need for convenient offerings and at the same time optimise the use of online learning. This will invariably reduce the physical presence in a classroom environment. Virtual classrooms also imply that there is less dependence on rote learning, repetitive tests and a 'one size fits all' type of instruction, and more use of experiential discovery, engaged learning, differentiated teaching and the building of character through innovative and effective teaching approaches and strategies (http://www.moe.gov.sg/about/yearbooks/2005/teach.html). In doing so, the elements of content, interactivity, collaboration and assessment become the pillars to realise the concept of the virtual classroom. Capitalising on these elements, Open University Malaysia (OUM) with its 47 learning centres currently caters for about 89,000 learners throughout Malaysia. Besides the national learners, OUM has established partnerships with Yemen, Bahrain, Maldives, Ghana and Sri Lanka to carry out its programs in those countries. Thus, it is very appropriate for the university to consider creating the virtual classroom concept, using its very own virtual learning platform known as *myVLE* for the adult learners.

Overview of Open University Malaysia (OUM)

As epitomised by its name, OUM has embarked on offering lifelong opportunities for self-development while focusing on education, training and development activities. OUM has today adopted the role of a catalyst in the provision of pedagogical and andragogical techniques, while imparting the relevant fields of studies. The philosophy, vision and mission of OUM have been thus developed in ensuring a better future for Malaysians while at the same time striving to attain global recognition and a competitive edge. OUM started its operations in August 1999 as an institution ready to embark in the business of an education, training and development provider of remarkable standards. OUM then became the first open and distance learning institution in Malaysia to target working adults who had missed on opportunities to attend public universities.

OUM started off with an initial cohort of 753 learners in August 2001. To date, OUM's cumulative enrolment has reached 89,000 learners. It is now the largest open and distance learning institution in Malaysia. Thirteen thousand learners have graduated from OUM since its first convocation in December 2004. Within this decade, OUM aspires to become a "mega university" with its numbers of learners exceeding 100,000.

The university's slogan, *University for All: Opening Minds Transforming Lives*, illustrates the university's commitment to reach out to the working adults who want to improve their academic qualifications in order to upgrade their quality of life. In line with its mission and vision to be the leading provider of ODL, OUM also offers educational opportunities to those who live in the remote areas, senior citizens, physically challenged persons and prison inmates.

Blended learning at OUM

Blended learning in OUM encompasses face to face tutorials, online learning and self-managed learning (Mansor Fadzil & Latifah Abdol Latif, 2010). The face to face tutorials allow learners to interact directly with their tutors in physical classrooms made available at OUM's learning centres. Online learning requires learners to learn through *myVLE*, which augments the face to face interactions (Mansor Fadzil & Latifah Abdol Latif, 2010). Self-managed learning is learners' independent study at home. Self-managed learning is an important component at OUM as the learners spend about 70% of their study time in this way. Online learning is provided to support learners' self-managed learning (Mansor Fadzil & Latifah Abdol Latif, 2010).

Virtual classroom

Advances in technology have been used to propagate distance education as a system of choice especially for adult learners. Virtual classrooms provide one example. A virtual classroom is an online learning environment that contains all course materials (http://www.elearnportal.com/resources/getting-started/how-do-virtual-classrooms -work). Hsu, Marques, Khalid Hamza and Alhalabi (1999) defined the virtual classroom as a system that provides the same opportunities for the teaching and learning process, beyond the physical limits of the traditional classroom walls (Hsu et al., 1999). Virtual classroom implementations via an online learning mode are typically web-based (Hsu et al., 1999).

The creation of the virtual classroom has made it possible for learners to harness the features of the Internet to create meaningful and constructivist learning environments (Gabriel, 2004). In this regard, physical classroom features have been transferred into a virtual classroom with enhanced features. Unlike a physical classroom, a virtual classroom is learner-centred. It gives the learners the flexibility of attendance at their convenience. The features that are prevalent in the virtual classroom include tools such as the online calendars, online help guides, online grading books, examinations and quizzes as well as emails, instant messages, chat rooms, discussion boards and file transfers. It supports active learning by providing an environment with the learning tools, learning materials, and opportunities for contextual discussion (Yang & Liu, 2007). This allows the learners to engage in learning activities by more than simply reading through the contents provided in the virtual classroom (Phillips, 2005).

A virtual classroom not only delivers course materials to the learners, but also provides a live, contextual and interactive environment for them. In addition, teachers can control the learning and teaching process as they do in the traditional classroom (Yang & Liu, 2007). However, there is no one, fixed way to implement a virtual classroom. There are many mechanisms that can be employed to implement a virtual classroom as done by educators. Bower (2006) has used the *Macromedia Breeze* meeting platform to implement the virtual classroom. The platform provides the following facilities:

- General Presentation Delivery – *PowerPoints*, general documents converted to *Flash Paper* format
- Screen Sharing – entire desktop, application or window, with remote control capabilities
- Webcam – multiple speeds, ability to stream
- VoIP – adjustable broadcast quality to suit connection
- Text Chat – send to all or selected individuals
- Whiteboard – various colours/fonts/transparency levels, drag and drop, undo, document overlay capabilities
- File Upload/Download – selected from computer or *Breeze* content repository
- Polling – with presenter access to individual responses
- Attendee List – including status indicator ('fine','slower', etc)
- Web Launcher – launches all users to the same URL
- Notepad – to summarise and provide instructions.

Hiltz and Wellman (1997) used asynchronous learning networks (ALNs) to implement the virtual classroom. On the other hand, Koppelman and Vranken (2008) used synchronous technology to implement the virtual classroom. Hiltz (1988) emphasised collaborative learning in implementing her virtual classroom. The idea of deploying group work activities in synchronous online classroom spaces has been investigated by Bower (2007). Virtual classroom could also be manifested as shared 3D virtual worlds (Bailey & Moar, 2002).

An online learning environment such as the virtual classroom has advantages which include stretching the spatial and temporal barriers, flexibility, interactivity and interoperability (Curran, 2002; Huang & Hu, 2000; Khalifa & Lam, 2002; Kinshuk & Yang, 2003; Wheeler, 2000). Although online learning systems have many advantages over traditional face to face learning, they have certain limitations that hinder the learning process. These limitations include no human teacher expression and explanation, most of existing learning materials are combinations of text and graphics,

and it lacks oral presentation by the instructor, no synchronisation and match between course materials and their explanations, and lack of contextual understanding as well as just in time feedback and interactions (Chou, 1999; Leidner & Jarvenpaa, 1995; Lim & Benbasat, 1997; Sloane, 1997; Weeler, 1998; Wulf, 2000).

For the purposes of this study, a virtual classroom is an asynchronous-based, online learning environment created in *myVLE* that not only delivers course materials to learners, but also provides collaboration and interaction, using an asynchronous-based forum as the main platform to support learners' independent study (http://olc.spsd.sk.ca/de/pd/instr/indepen.html) and indirect instruction (http://olc .spsd.sk.ca/de/pd/instr/indirect.html). It supports student's self-managed learning by providing an environment containing learning tools, learning materials, and opportunities for contextual and collaborative discussions.

Asynchronous-based online learning

Numerous researchers have highlighted the effectiveness of asynchronous communication as a learning source. Prominent research in this field has been conducted by Harasim (1990), who concluded that asynchronous environments can be used to enhance learning. This can be achieved through the combination of active learning and knowledge construction. Environments that have the interactive and asynchronous aspects enable active learning. According to Harasim, knowledge is constructed through generation, linkage and structuring of ideas through online modes of communication.

Research on the use of asynchronous tools such as discussion forums shows that participation and interaction in the discussion is at least on a par with discussion that takes place in the classroom (Hiltz, 1990; Pena-Shaff, Martin & Gay, 2001, Pena-Shaff & Nicholas, 2004). Studies using content analyses of electronic messages show that online discussions support collaborative learning, accept the use of collaborative skills, and promote knowledge construction in a social manner. Hiltz and Wellman (1997) in their studies found that asynchronous-based discussion is sufficient to support the development of a learning community, in which the students establish both the elements of cognitive growth and emotions needed for effective learning. Blanchette (2001) investigated the interactions of students in asynchronous discussion and found that students in this category attained a higher order of cognitive interactivity compared to students in face to face meetings.

Dewiyanti, Brand-Gruwel, Joachems, and Broers (2007) conducted an explorative study to gain responses from distance students on their experiences with learning in an asynchronous-based environment and the results revealed an appreciation of the opportunity to work collaboratively in this mode. Nevertheless, the study by Ocker and Yaverbaum (1999) showed that collaboration in the asynchronous learning environment is as effective as face to face tutorials, even though there were situations in which the students were not happy with the interaction process and quality of the group discussion. This could be attributed to the fact that merely providing an asynchronous-based environment, such as forums for the students' discussions does not necessarily lead to productive discussions. The forum itself needs to be designed in such a way that it promotes learning.

Research aim

The overall aim of this study was to explore students' perceptions of the virtual classroom in terms of any impact they considered it made on their learning and preferences. Another aim of this study was to elicit learners' perceptions about the extent to which the virtual classroom supports their self-managed learning.

While acknowledging the fact that the design of this study was not experimental, it nevertheless offers a means through which the researchers can assess the value of using the virtual classroom in an online teaching environment, to promote quality learning and ascertain how it influences learners on any preferences for face to face tutorials.

Research questions

The following research questions guided the data collection process for this study. They were used as the basis for developing the questionnaire instrument. The research questions were:

Learning	1.	Do the learners experience a higher level of learning/understanding of the lesson through the virtual classroom?
	2.	Do the learners manage to achieve the learning outcomes at the end by using the virtual classroom?
	3.	Do the learners experience learning the subject in a new way through the virtual classroom?
	4.	Has the learners' knowledge increased after going through the virtual classroom?
Self-managed learning	5.	Does the virtual classroom support the learners' self-managed learning?
Preference	6.	Is it possible for the virtual classroom to become the primary learning environment?
	7.	Is it useful to learn the subject through the virtual classroom?
	8.	Can face-to-face interaction be eliminated as a result of having the virtual classroom?

Research methodology

This study adopted an interpretive case study methodology approach. Erickson (1986, pp. 119-161) described interpretive case studies as:

> … the intensive investigation of a single object of social inquiry such as a classroom … and that it holds major advantages in that it allows the immersion of oneself in the dynamics of a single social entity and enables the uncovering of events or processes that one might miss with more superficial methods.

Burns (1997) further commented that the case studies have a number of purposes or functions within educational research. Due to their intense and subjective nature, he stated that they are particularly suited to acting as preliminaries to major

investigations by providing a "source of hypothesis for future research" (Burns, 1997, p. 365) or by assisting in developing deeper understanding "of the class of events from which the case has been drawn". The methodology in this instance allowed the researchers to gain deeper insights into any value the virtual classroom held from the students' perspective. Interpretive case study approach had also been used by Falloon (2011) for his study concerning the virtual classroom.

The virtual classroom was implemented for the subject *CBOP3203 - Object Oriented Programming* (CS1 subject) in the May 2011 semester at OUM. It is a highly technical, IT-based subject. A total of 129 learners studied this subject in that semester using the blended learning approach. All learners were given access to the virtual classroom for their online learning and a limited number of face to face tutorials (8 hours). Self-managed learning (SML) constitutes the largest portion of study time followed by online learning and face to face tutorials. Online learning that occurs through the virtual classroom is an important component in the support for learners' SML.

Data collection

At the end of the semester, questionnaires were distributed to all the 40 learners taking this subject in the Klang Valley (Central Region), Kuala Lumpur, Malaysia using convenience sampling. This represents 31% of the population of 129 learners registered for the course throughout Malaysia. Twenty-three learners (18% of the population) responded to the survey. The questionnaire had three sections, with the first eliciting students' perceptions of their learning experience in the virtual classroom. There were four items in this section, all based on the courseware assessment instrument developed by the Center of Instructional Design and Technology (CIDT) at OUM. The second section had one item which measured students' perception of the extent to which the virtual classroom helped their self-managed learning. The third section elicited students' perceptions of their preferences for the virtual classroom over the face to face interactions. There were three items in this section. All the items in the sections on self-managed learning and preferences were based on the work by Nantha Kumar Subramaniam (2011). Data was analysed using descriptive statistics of mean scores. All items were measured on a Likert scale from 1 (strongly disagree) to 5 (strongly agree).

Virtual classroom framework

The virtual classroom was implemented using *myVLE*. Figure 1 shows the framework for implementing the concept of the virtual classroom in OUM. In this regard, the virtual classroom is a subset of *myVLE*.

Independent study is supported by individual learning. In one's individual study, the contents in the form of *iBook, iLecture, iTutorial* and *iHelp* facilities play an important role. On the other hand, the indirect instruction is supported through collaborative learning in *cForum, iForum* and in *Smart Forum*. Assessment is an integral part of learning. A good learning environment should allow the learners to test their knowledge after performing learning activities or at intervals. In *myVLE's* virtual classroom, assessment is supported through self-assessment and *Flash*-based activities.
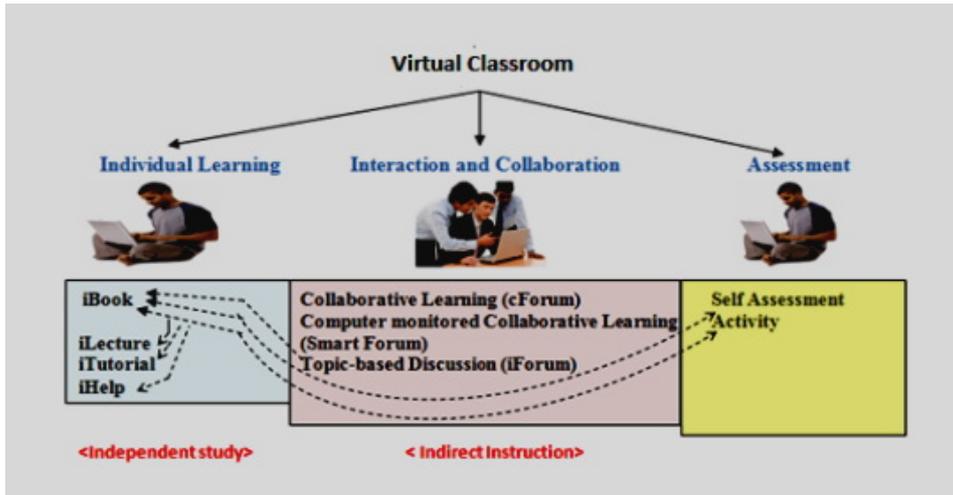
Figure 1: The framework of the virtual classroom
Note: The dashed arrows show the tagging of the contents

Many experts do not believe that a unilateral approach to using technology to support learning will be successful. Instead, based on the authors' own experiences in conducting online courses for almost 10 years and through reference to the work done by Jochems, Koper and Merrienboer (2003), and Garrison, Anderson and Archer (2001a), online learning in the form of the virtual classroom will be effective if it is implemented in an integrated manner that incorporates the following six critical principles, so that it empowers the students' learning:

1. The virtual classroom has to take pedagogical and technical aspects into account.
2. The virtual classroom has to be learner-centred, whereby learners become the primary focus of attention, as opposed to the traditional emphasis upon the instructors.
3. The best approach to teaching and learning is the bi-instructional method where e-learning is utilised for *independent study* to support self-managed learning (SML) and *indirect instruction* to support peer collaboration, interaction and eliminate isolation.
4. Assessment must become an integral part of the virtual classroom so that the learners would be able to self-assess themselves and think of ways to improve their assessment.
5. A successful virtual classroom must support instructor presence, social presence and cognitive presence as proposed in the community of inquiry (CoI) model (Figure 2).
6. A successful virtual classroom must support learner-learner, learner-instructor and learner-content interactions.

The experiences of some open and distance learning institutions have indicated that an overwhelming emphasis on pedagogy, such as constructivism, problem-based learning and others, without adequate technological support will not achieve the desired result (Anuwar Ali & Ramli Bahroom, 2008). On the other hand, heavy reliance on technology without well-defined pedagogy will result in an ineffective learning process (Anuwar Ali & Ramli Bahroom, 2008). The six principles given above are

essential so that all the aspects of online learning be incorporated, in order to attain the goals of an education system. In addition, for virtual classroom to be effective, it must be combined with various forms of interactions which include student-student, student-content and student-instructor interactions. In the next section, the framework of the virtual classroom is described based on these six principles listed above.
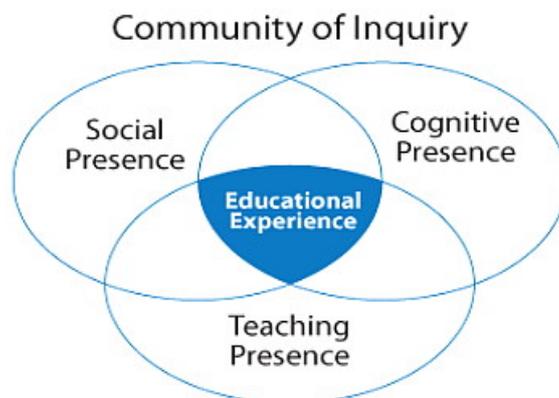

Figure 2: Community of inquiry for successful online learning
(Garrison, Anderson & Archer, 2001b)

Through this framework, maximum learning opportunities are provided via integration of recorded *iTutorials* and *iLectures* for problem-based learning and knowledge learning respectively, a discussion forum for opportunities to formulate and articulate higher order questions, enriched *iBook* for knowledge learning, self assessment for multiple timely feedback, as well as other supplementary resources such as *iLecture, iForum* and *iTutorial*. Using this approach, learners can access the content anytime and anywhere, enabling them to enjoy the learning experience.

Tools in the virtual classroom

All the components or tools used to realise the virtual classroom concept for CS1 are discussed in the following sections.

iBook

One critical factor contributing to the success of the virtual classroom is the content. First, there must be sufficient content and it should be in varied formats to cater for diverse learners. It goes without saying that the contents should be interesting and engaging to learners to sustain their learning interest. The *iBook* (Figure 3a) is the online module used at OUM, which has become more engaging and interactive as compared to static PDF-print modules. This change is anticipated to bring about a major enhancement of e-learning and create a more enriching learning experience for learners. *iBook* in the virtual classroom has lesson tracking (Figure 3b) to enable the learners to keep track of their learning and be in control of their lessons.

Figure 3a: A page from the *iBook*

Figure 3b: Lesson tracking of the contents in the *iBook* that appear in a popup window

iLecture

The *iLecture* (Figure 4) enables the learners to learn from subject matter experts, but at their own pace. *iLecture* focuses on the difficult and important topics in the subject and supports both audio and video components. It also has screen captures of difficult concepts explained through live demonstration.
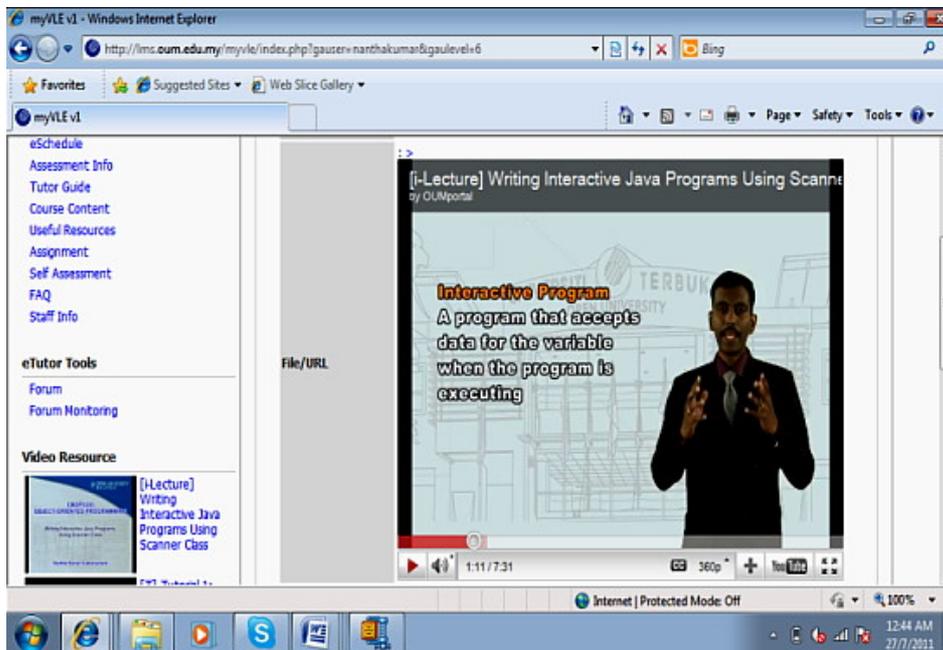

Figure 4: Sample of *iLecture* for one of the topics

iTutorial

The *iTutorial* (Figure 5) enables the learners to experience the 'feel' of an actual classroom without having to attend one. It has both audio and video components. *iTutorial* focuses on task-based learning so that learners can acquire problem-solving skills. *iTutorial* is the recording of actual classroom interactions from a previous semester, focusing on problem-based learning using a task.

iForum

Many higher education institutions are looking to asynchronous discussion forums as a versatile medium for the delivery of educational programs. Discussion forums enable a high degree of interaction among peers and between learners and the instructor. *iForum* in the virtual classroom (Figure 6) is the asynchronous discussion forum for the topics included for the subject. Each topic has different folders so that the discussion will be more focused on the appropriate topics. Here, the instructor acts as the formal authority for this subject by answering the learners' questions in the text-based forum. To support the social presence, a "General" folder has been included so that the learners can have non-academic discussions. This increases their sense of belonging and enhances their visibility in the group.
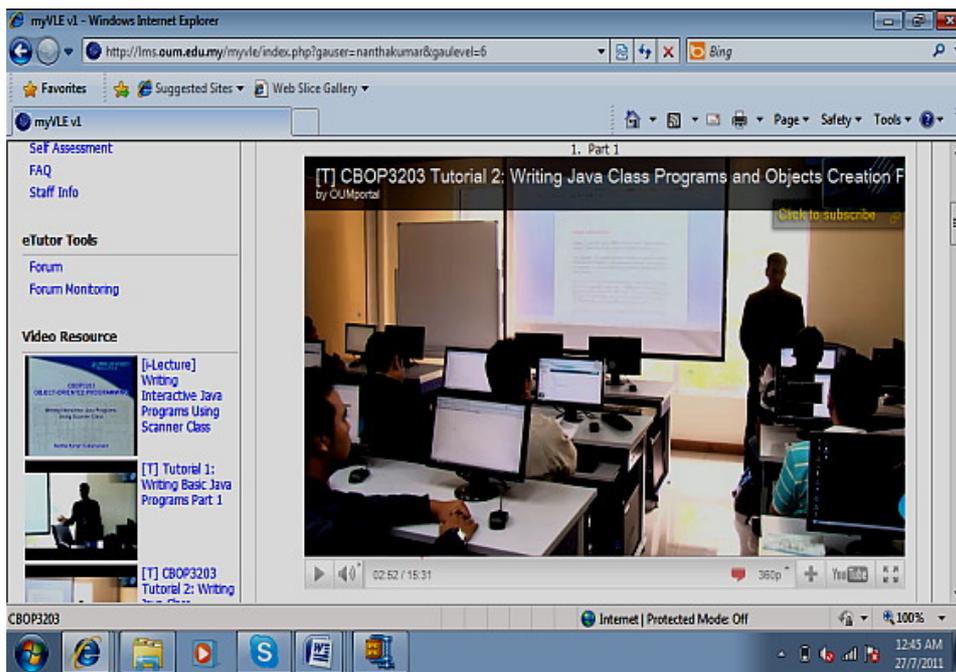
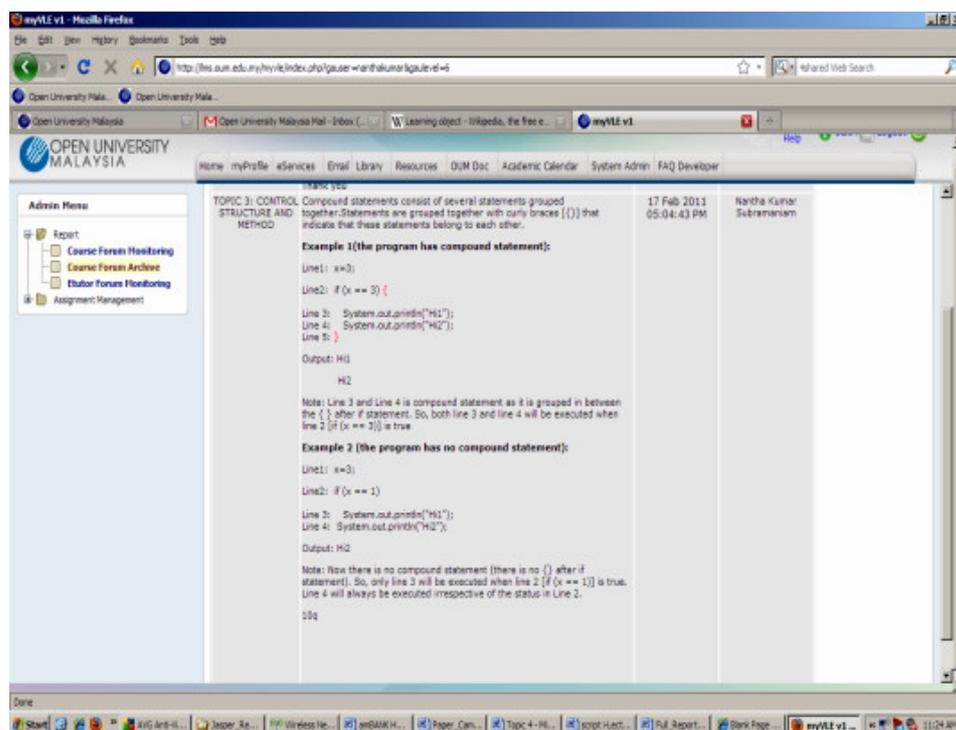Figure 5: One of the *iTutorials* available in *myVLE*'s virtual classroom

Figure 6: Learners discussion in *iForum*

cForum

Collaborative learning is an established technique for teaching and learning (Preston, 2005) in which the learners in a group have their learning responsibilities for each other and for themselves. According to Preston (2005), this is a social process in which the learners learn from their peers by participating interactively with learning material, observing the solution approach adopted by their peers, thus ensuring each learner is focused towards the task and motivated in highlighting issues and decisions. In implementing collaborative learning in the virtual classroom, learners are required to practise collaborative learning using the threaded forum (*cForum*) in *myVLE*'s virtual classroom to solve a problem given to them. The task is developed in such a way that it demands critical knowledge, problem solving skills and self-managed learning strategies on the part of the learners. Thus, the problem in the task acts as a stimulus for the learning to take place and represents a platform for the learners to develop collaborative critical skills. The instructor will play the role of the moderator. The following guidelines on preparing a good task have been applied in order to ensure an effective collaborative learning environment (Johnson & Johnson, 2001).

- The task is conceptual
- The task requires problem solving approach
- The task requires higher-level reasoning and critical thinking
- The task emphasises mastery
- The quality of performance is needed

The collaborative discussion in *cForum* is based on the premise that the learner's learning is not simply building up correct responses or eliminating incorrect responses, it is an opportunity for learners in a group to test the adequacy of their ideas.

Smart Forum

The *Smart Forum* uses the same modus operandi as the *cForum* but capitalises on seven 'smart agents' coupled with problem-based learning, collaborative learning pedagogy, community of inquiry, scaffolding (in the form of sentence openers) and critical thinking. Figure 7 shows the general architecture of the Smart Forum in the virtual classroom.

In the *Smart Forum*, students are given a task to be solved through collaborative discussion in a small group. To engage in the discussion, the students post their messages in the asynchronous forum using sentence openers provided in the forum. Only one sentence opener can be used per posting to start the discourse. Subsequent sentence(s) in the same posting should not use any sentence opener. There is no restriction on the number of words per posting but each posting (which may consist of more than one sentence) must highlight a *single issue*. This will enable the agents to do their tasks efficiently. Sentence openers have pre-defined approaches to start a conversation using menu or buttons. The sentence opener that has been adopted is based on the *Collaborative Skills Network* (CSN) proposed by Israel (2003). Here, each message typed by the students using the sentence openers will first be analysed by the *Message classifier* agent based on the following steps:

i. Identify which sentence opener has been used by the students and the tutors.
    Tutors and students are given a separate set of sentence openers (Figure 8).
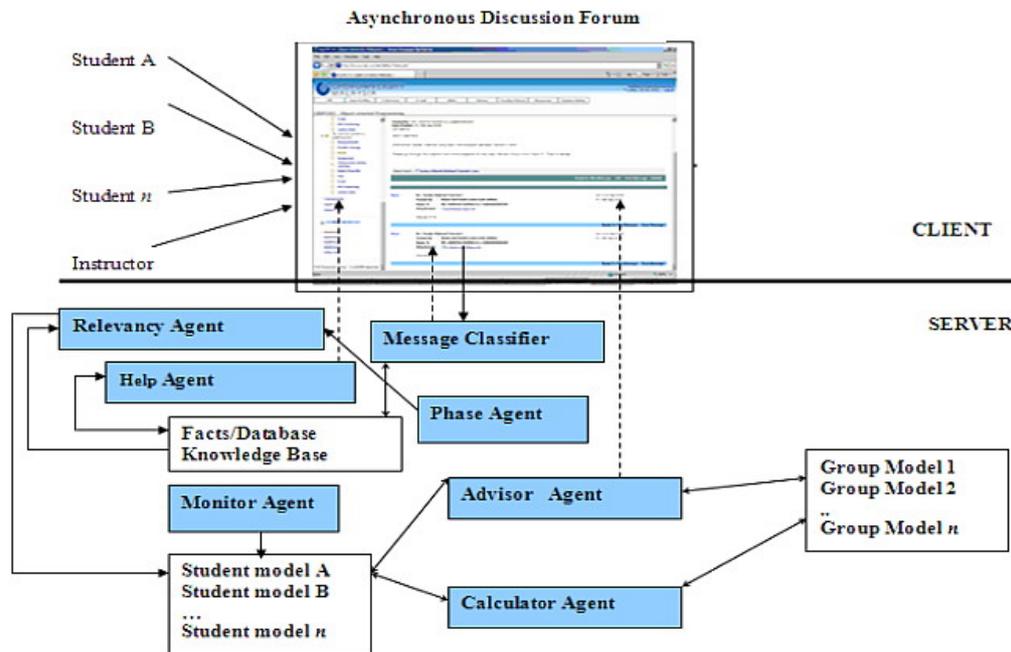
Figure 7: Architecture of the *Smart Forum*

ii. Identify the main keywords used by the students in completing the sentence (sentence closer) using the sentence opener. The analysis is done using the Knuth, Morris and Pratt (1997) string matching algorithm.
iii. Based on the sentence opener and sentence closer used by the students, the agent will classify the messages as *discussion messages*, *not relevant messages* (such as "how are you?") or *specific questions* from the students on the domain or problem that needs to be solved. The agent will ignore any other message that could not be classified.
iv. If the message is classified as *discussion message*, the agent will assign appropriate tag(s) available in Newman's content analysis model (Newman, Webb & Cochrane, 1995). Here a message can have more than one indicator depending on the keyword used in the sentence closer.

The *Calculator agent* calculates the critical thinking (CT) ratio of the individual learner and the groups for each of the categories in Newman's content analysis model (Newman et al., 1995). This model has instantiated indicators of critical thinking via approximately 40 codes in categories such as relevance, justification, novelty, and ambiguities, each with a plus or a minus appended to indicate whether the coded statement contributes to (+) or detracts from (-) critical thinking development. The coder only marks and counts obvious statements, which can be phrases, sentences, paragraphs, or messages containing one unit of meaning illustrating one or more of the indicators. In *Smart Forum*, the calculator agent will automate all these processes. In calculating the CT ratio, messages that are relevant to the groups' current phase in Garrison et al.'s "practical inquiry model" used to move the learner through a critical thinking process of (a) triggering event (b) exploration (c) integration and (d) resolution, will be taken into consideration (Garrison et al., 2001a, 2001b). This agent
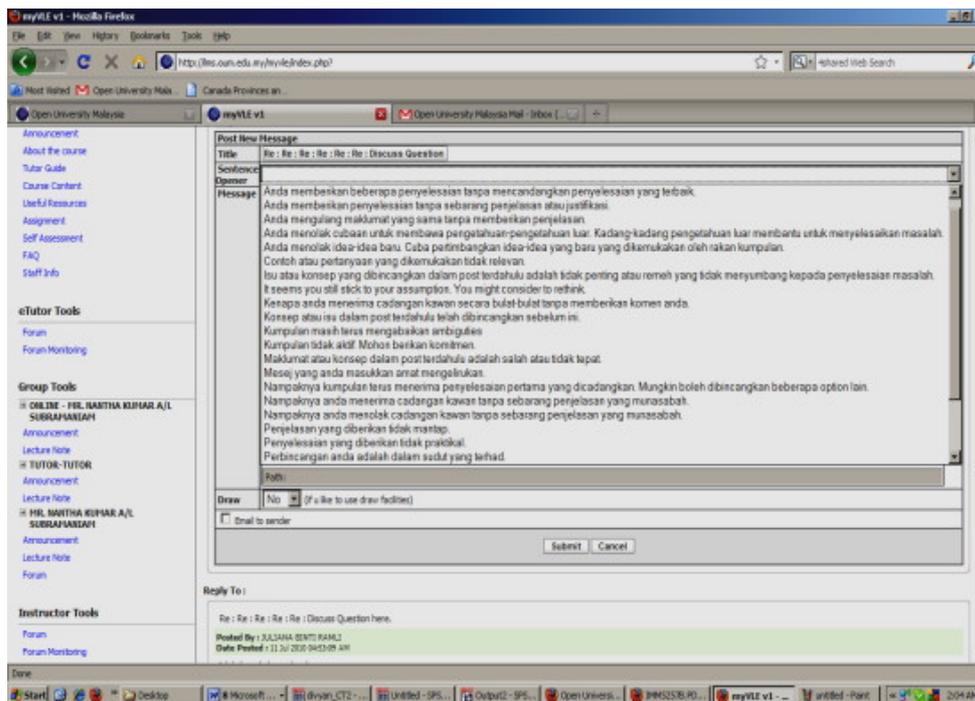
Figure 8: Sentence openers are provided as a pull down menu (student view)

will also calculate the cumulative CT ratio of the learners and groups independent of the phases. Once a passage is coded, one calculates a critical thinking ratio using the following formula:

CT = [(x+) − (x−)] ÷ [(x+) + (x−)]
x+: is the count of statements contributing to critical thinking for the coding category;
x-: is the count of statements detracting from critical thinking for the category.

Positive numbers approaching 1 indicate the highest levels of critical thinking. An overall critical thinking ratio is calculated by counting all the positive and negative postings in the forum and then applying the above formula.

The *Monitor agent* monitors students' participation level in the discussion forum. This agent sends postings / messages or reminders in the forum to the students who are not active by asking them to participate actively in the discussions in a week. This is to ensure that there are plenty of postings so that other agents can perform their tasks. The formula used to determine student activeness is based on the learners' *out-degree centrality* of their discussion (Suh & Lee, 2006):

$$d_o(M_o) = \frac{d_o}{(g-1)}.$$

$d_0(M_0)$: Out-degree centrality for student M_0
d_0: sum of messages that the participant sends toward others
g: number of participants in the group

Learners with high out-degree centrality are more active in providing information to others in discussion or providing comments on the opinions of others. Newman et al. (1995) also have mapped the relevant indicators of content analysis to each of the phases in the Garrison's "practical inquiry model" (Garrison et al., 2001a, 2001b). If a message is tagged by the message classifier agent, the *Relevancy agent* uses this mapping information to update the relevant parameters in the student model regarding the status of the current message posted by the learners (i.e. whether the message is appropriate for the current phase). This is to ensure that the students are in the same level of discussion and there are no students ahead or left out of the discussion.

The *Phase agent* tracks transitions through the phases in Garrison's "practical inquiry model" (i.e initiation, exploration, integration and resolution). Only the tutor is allowed to change the phase of the group and the phase agent notifies the relevant agents if there is any change of phase in the groups. The phase agent also identifies in which phase a message has been posted by the student. This information is vital for the relevancy agent. The phase agent influences the calculator and relevancy agents as information from the phase agent is used by these two agents in executing their tasks.

The *Help agent* provides possible answers for students' queries on the subject matter in the form of FAQs in a new pop-up window. If the agent cannot give possible answers or if the student is not happy with the answers given by the agent, the student has the option to alert the tutor by clicking an alert button provided by the agent on the same screen. When this is done, the agent sends the user's searched keyword together with their email to the tutor, who can then reply with the appropriate answer.

Information in the students' and groups' model is updated by the relevant agents as they perform their tasks. The student's model for each of the students stored in the database table consists of the following information: CT ratio of the phase, overall CT ratio, level of the learners' activeness (out-degree centrality ratio), indicator of relevant message tags posted in a message for a phase, the learners CT ratio of the prior phase, and information on the relevant tags for the latest posting. The group's model consists of the following information: overall CT ratio of the groups, CT ratio for each phase, and CT ratio of the group's prior phase. Finally, the *Advisor agent* swings into action to do the following tasks using all the messages classified as *discussion messages* and has been tagged by the message classifier agent earlier:

i. Monitor learners' and groups' CT ratio in moving from one phase to the another;
ii. Based on (i) and the status of the students and groups model (written in the form of rules), the advisor agent gives its feedback, advice or consultation to the students or/and their group (Figure 9). The feedback/advice/message that satisfies the condition of a rule will be fired by the agent. The rule is written in the form of IF-THEN statement and stored in a knowledge base. A total of 128 rules were written for the learners while a total of 64 rules were written for the groups.

iHelp

iHelp (Figure 10) provides possible answers for the learners' queries on the subject matter in the form of FAQs in a new pop-up window. This facilitates information searches by the learners. The previous semesters' discussions in the forum were mined to compile the questions and answers in *iHelp*.
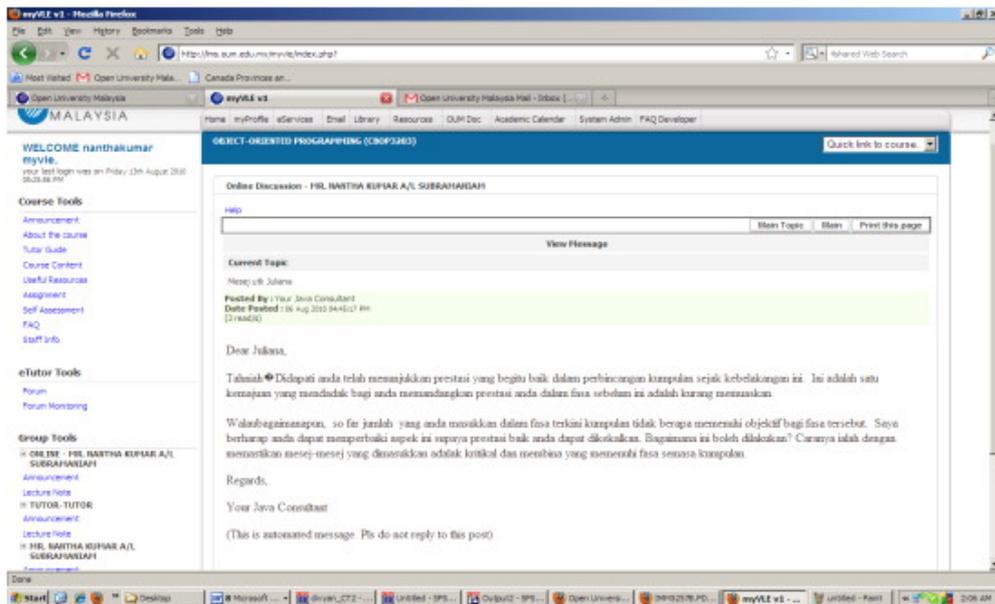
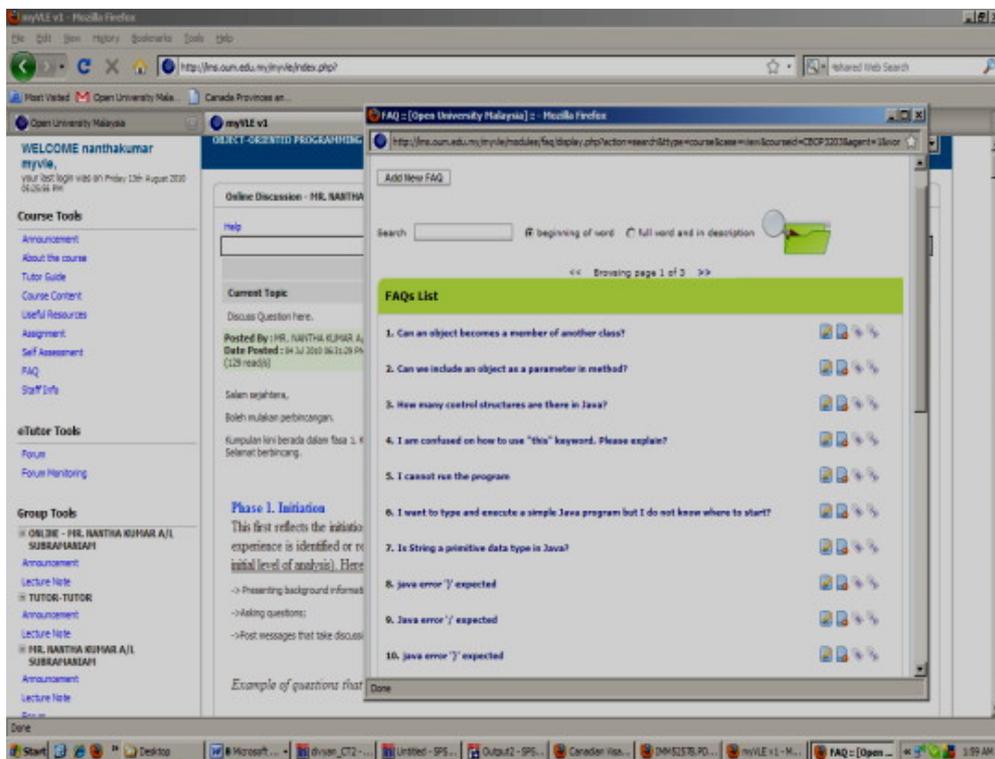Figure 9: Example of message sent by the agent to a learner

Figure 10: *iHelp* in the virtual classroom

Self assessment and activity

Self assessment is provided in the form of multiple choice questions (MCQs). The system gives feedback if a learner chooses an incorrect answer (Figure 11).
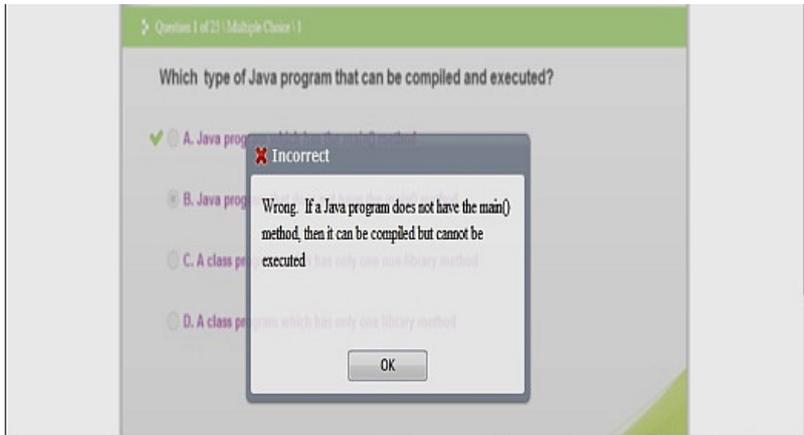

Figure 11: Assessment in the form of MCQs in the virtual classroom

On the other hand, *Activity* (Figure 12) is a *Flash*-based assessment which requires the learners to do some activities to test their understanding of a topic.
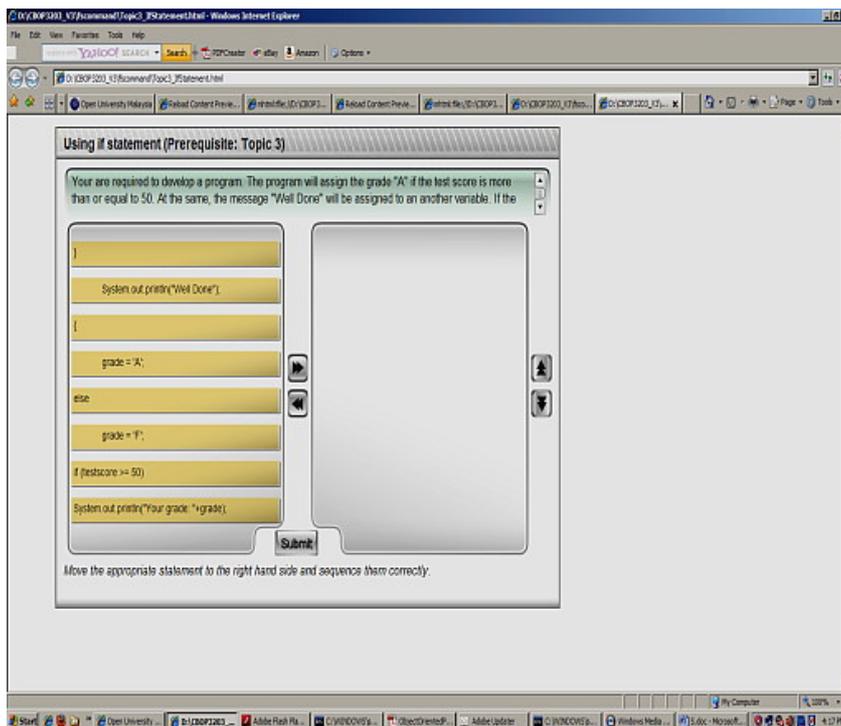

Figure 12: *Flash*-based *Activity* for self-assessment

All these sub-systems are tagged to *iBook* so that the learners can jump to the appropriate location in the *iBook* (or vice versa) whenever they face difficulties while going through other learning materials available in the virtual classroom (Figure 13). This makes the learning materials well integrated and not seen simply as individual components.
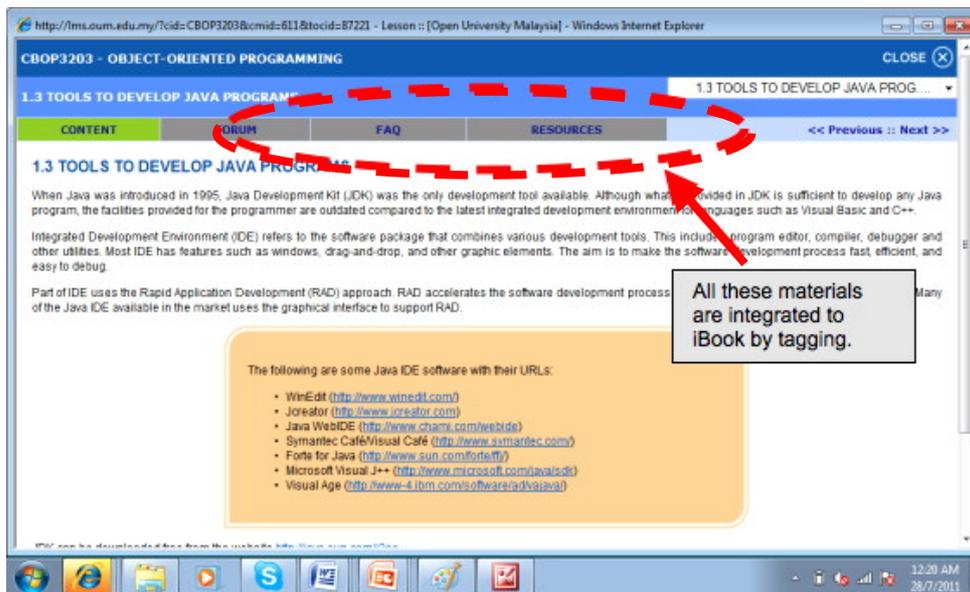

Figure 13: Some of the learning materials are "tagged" with *iBook*

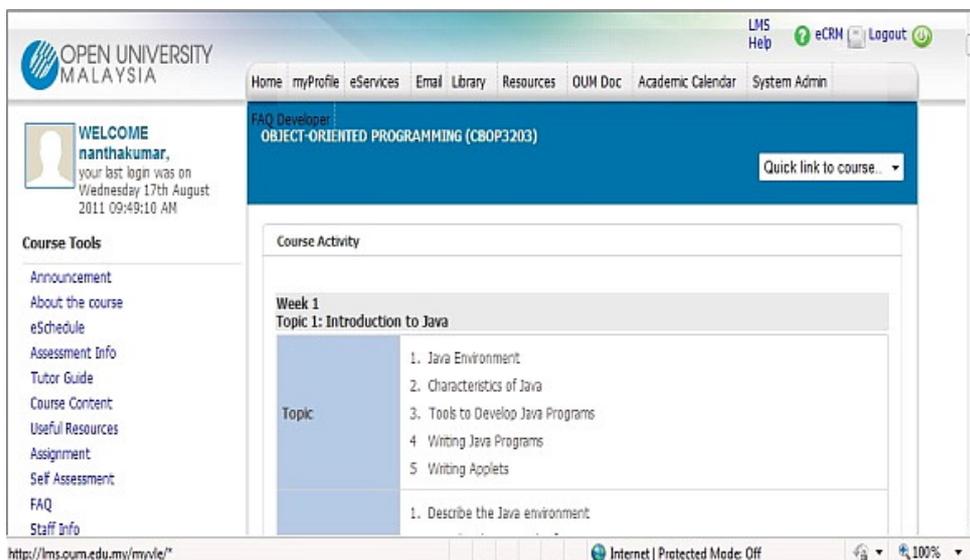## The implementation of the virtual classroom

Figure 14: Main page of the virtual classroom in *myVLE*

This section discusses the virtual classroom in *myVLE* based on the framework presented earlier (Figure 1). When learners access the virtual classroom for the CS1 subject, the main page of the virtual classroom that contains the *eSchedule* will appear. It guides the learners on the activities that they should complete in the ten weeks period (Figure 14). By doing so, the learners know when is the best time to access the content available in the virtual classroom.
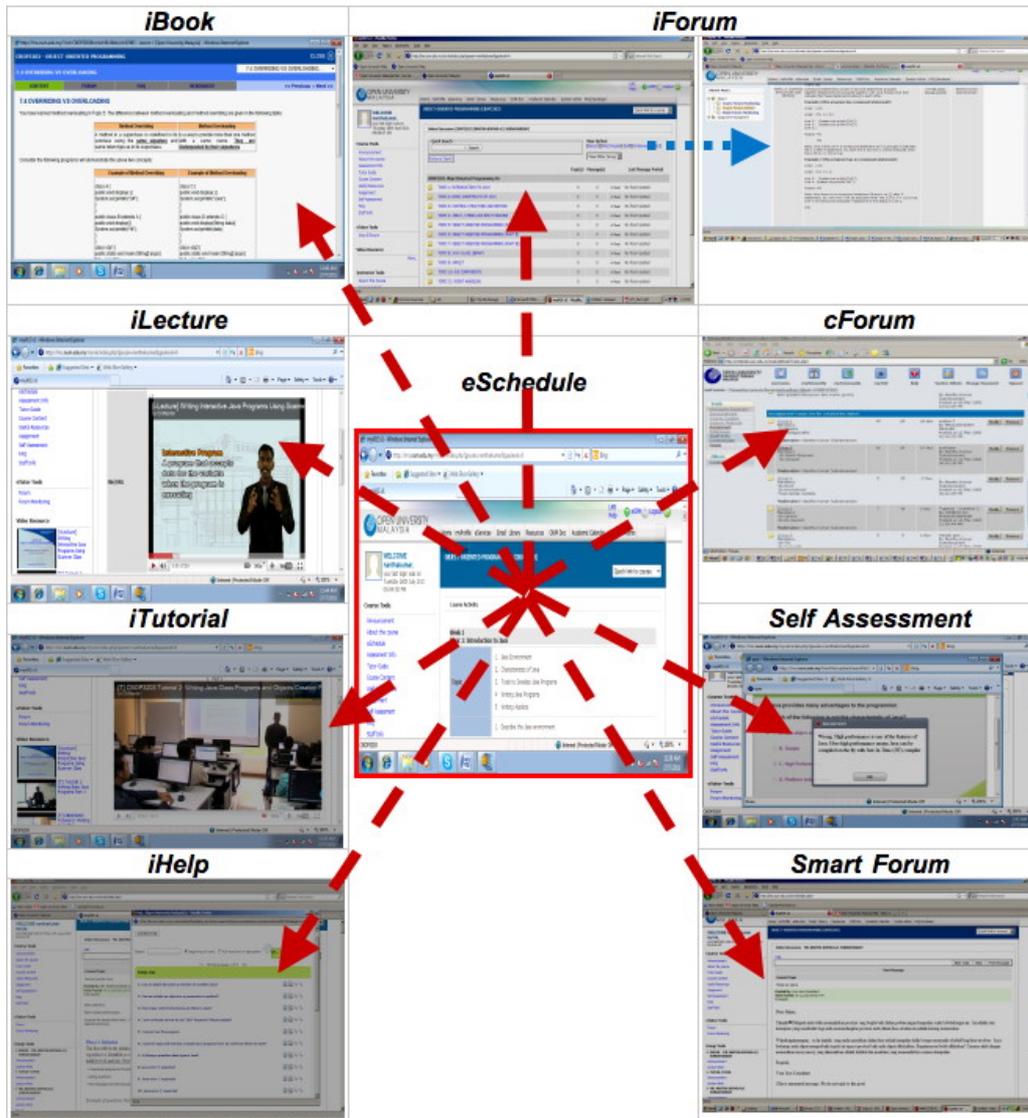

Figure 15: Virtual classroom implementation

At the same time, to provide flexibility, the learners also have the choice to access the content on their own by skipping the schedule provided in the *eSchedule*. Various learning materials are supported in *myVLE* to achieve the virtual classroom concept as shown in Figure 15. A total of 10 *iLectures* with total time of six hours each were

developed to cater for the difficult topics in that subject. A total of 5 *iTutorials* with total time of 10 hours were developed and 14 *Flash*-based activities were developed to support the self-assessment of the learners.

Findings and discussion

As stated earlier, data was collected for students' perceptions of their learning, self-managed learning and preference using a questionnaire. The mean scores for all the items in the questionnaire are shown in Table 1.

Table 1: Mean scores of the items for students' perceptions
1 = strongly disagree and 5 = strongly agree (N=23)

		Items	Mean score
Learning	1.	I experience a higher level of learning / understanding of the lesson through virtual classroom for this subject.	3.52
	2.	I am able to achieve the learning outcomes at the end of using the virtual classroom for this subject.	3.48
	3.	I experience learning the subject in a new way through the virtual classroom for this subject.	3.57
	4.	My knowledge on the subject matter increases after going through the virtual classroom	3.61
Self-managed learning	5.	The virtual classroom for CBOP3203 helps me a lot for my self-managed learning	3.52
Preference	6.	I find virtual classroom over face to face tutorials as the primary learning material.	3.0
	7.	Overall, I find that the virtual classroom is very useful in learning the subject – CBOP3203.	3.0
	8.	There is no need for face to face tutorials for this subject as a result of having this virtual classroom for CBOP3203	2.0

The results show that students gave responses between 2.0 to 3.6 on the Likert scale of 1 to 5, which indicates moderate responses for all the sections in the questionnaire. Item 8 was not encouraging as it was rated 2.0 on the Likert scale. This indicates that there are areas for improvement in the dynamics of the virtual classroom, and students still preferred face to face tutorials over the virtual classroom. This could be in line with Asian cultural expectations where attendance in a classroom is considered a 'must' in the teaching (Miliszewska, 2007).

The findings indicated that students viewed the virtual classroom as supplementary learning and classroom learning as the primary learning method. The learners' evaluation indicated that the virtual classroom has a moderate influence on their learning. Possible reasons for this include:

- *The nature of the subject*
  CS1 is a technical subject which requires problem solving and critical thinking skills with many pre-requisite knowledge chunks (McGill, Volet & Hobbs, 1997). The virtual classroom for such subjects may need to have support to address these concerns.

- *No synchronous support*
  The exclusion of synchronous support in the virtual classroom may have prohibited real time interaction among the learners and between the instructor and learner.

Learners may have had problems or enquiries that require urgent and immediate attention from peers or the instructor. Asynchronous tools currently available in the virtual classroom do not support such interactions. CS1 subjects may need to have synchronous tools in the virtual classroom (Nantha Kumar Subramaniam, 2011).

- *General perceptions of face to face interaction*
  Media richness theory (Daft & Lengel, 1986) suggests that face to face communication is considered to be the richest, while other forms of media are thought to be less learner-based, as they have fewer contextual cues and slower feedback compared to face to face (Daft & Lengel, 1986). Thus, students even in the online learning environment, naturally perceived face to face discussion to be faster, easier, and more convenient.

This study has focused mainly on learners' perceptions about using the virtual classroom for learning purposes. Another issue here is how much it prepares them for demonstrating tangible knowledge as quantified by examination marks. This implies another challenge faced by a virtual classroom model that seeks to make no use of face to face interactions, in order to create a fully online course. If this goal is to be achieved, the challenge for the virtual classroom is to enhance online learners' performance (with regards to summative assessment), so that it is better than experiences in traditional learning (Figure 16), or at least attaining parity with traditional learning (Figure 17).

In order to address this challenge, the virtual classroom needs to be further enhanced, perhaps by incorporating more learner-centred online supports for learning. Further research needs to be done to address this issue. Collaborative work among the subject matter experts, educational experts, cognitivists and instructional designers would certainly be beneficial, in order to attain a fully online course and to make obligatory face to face interaction a thing of the past. Work is in progress to ascertain how these online supports can be provided more effectively and efficiently, to ensure success in summative assessment outcomes.
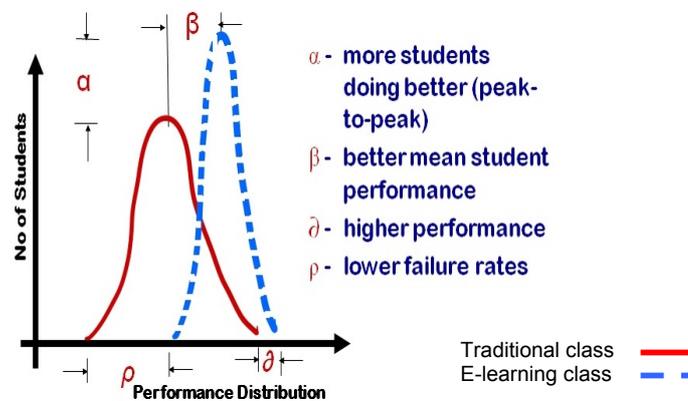

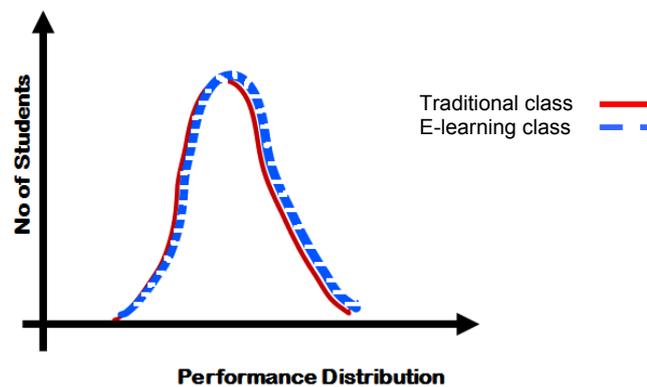Figure 16: Optimal situation for a virtual classroom (Tan, 2010)

Figure 17: Ideal situation for a virtual classroom (Tan, 2010)

Summary

In this paper, an online virtual classroom that supports three modes of interaction, namely peer-peer, student-instructor and student-content was introduced, capitalising on the asynchronous mode of communication. For effective implementation, the various technological features must function efficiently and furthermore should be used effectively by the students. Students need to know how and when to use these technological features and they need to see a perceived benefit when using them. Whilst in distance learning courses, design and assessment are important factors to be considered, the key factor is effective instruction soundly based on contemporary pedagogical theories.

In this article on the use of the virtual classroom environment for the teaching of the CS1 subject, this would be possible as indicated by the learners' evaluation. However, the model needs to be further refined so that online learning using a virtual classroom becomes the primary source for learning and subsequently classroom learning can be considered an alternative. In our future work, we plan to embed applications from the social networking tool *Google+* in the virtual classroom in order to give some synchronous support, as well as further developing an intelligent question answering system with diagnostic capabilities and immediate feedback.

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