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## Identifying the Challenges in Teaching Computer Science Topics Online

Yuwanuch Gulatee  
*Edith Cowan University*

Barbara Combes  
*Edith Cowan University*

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## PAPER 74

### Identifying the challenges to teaching computer science topics online

#### Abstract

In an attempt to provide educational opportunities to the students who are working or have other constraints on their time, many universities are developing distance education programs. In the past decade, web technology has been adopted to assist learners with studying at a distance. However, distance learning in the field of computer science, such as studying programming languages, remains challenging to teach via the web medium. There is little evidence that the effectiveness of web-based learning includes a process to solve complex problems. REFERENCES IN AN ABSTRACT!? In particular it can be problematic for technical subjects to be taught online because students find it very difficult to understand the subject content and ways of demonstrating cause and effect. As a result, the subject is potentially highly technical in nature, which may impede student ability to learn independently (that is, without staff assistance) in a fully online environment. Thus, there are some questions to be answered: How do we teach online? What works and what does not. Identifying the challenges to teaching computer science topics online is relevant and as yet has not been fully addressed in the research literature. As a result, this paper aims to identify the challenges to teaching computer science topics online and identify useful supports to enhance learning through the informed use of web-based e-learning. The abstract should give an overview of the paper – what it covers and its conclusions

#### Introduction

Over the last few years, web technology has been adopted to assist learners with real-time studying at a distance. Consequently, web delivery has grown rapidly and has been used as a vehicle for learning. The research of Kim, Bonk, & Zeng (2005, p.?) show that “Our current survey show that e-learning has become an increasingly important delivery format and may even dominate training in the near future”. A similar finding by Tanaka (2005) indicates that in the 1990s and the first half of this decade, people will be more focused on web-based e-learning to improve their skills. However, for distance learning in the field of computer science topics, such as programming, courses remain challenging and require further development. Sheard, Macdoald, and Hagan (1997) found that computer programming courses are more difficult and time consuming than other courses for the majority of students. The research of Sheard, Macdoald, and Hagan (1997) and Deek and Espinosa (2005) show similar findings in terms of programming courses: they believe that studying subjects such as programming languages are difficult because they have been designed without attention to human-computer interaction and the subject is potentially highly technical in nature, which may be hard for students to learn independently in a fully online environment. Thus, the question that needs to be addressed is: How do we teach programming courses online? This research aims to identify the challenges in teaching computer science topics online and identify useful support to enhance learning through the informed use of web-based e-learning.

Alexander (2001, p.?) stated that "ensuring that e-learning activities are assessed in appropriate ways, that students receive prompt and useful feedback on their work, and that the assessment reflects the learning objectives of the e-learning project". This concept is critical to understanding of how to ensure that teaching computer sciences topics in e-learning environment is done appropriate ways.

### Background to the study

The changing nature of teaching since the 1990s has driven teaching to evolve from 'chalk and talk' to computer based learning systems (Mcsporrán & King, 2005). The changes have developed in an attempt to provide educational opportunities to the students who are working or have other constraints such as time, and distance. Thus, many universities are developing distance education programs to provide more opportunity for these students. Distance learning has become popular since the 1970s and 80s but was generally conducted via postal mail until relatively recently. Since then the World Wide Web has been used as a distributed learning mechanism, enhancing the digital learning environment to support the online students by providing multimedia, video, audio and electronic blackboards to communicate with students (Lee, 2004) . Kazmer and Haythornthwaite (2005, p.1) found that "In the academic year 2001-2, five million people took at least one course online, and three million were enrolled in online degree programs." However, there is no sign that web-based effectively solves complex problems (Hentea, Shea, & Pennington, 2003).

### Significance of the study

Investigating the challenge of teaching computer science topics in an online environment is critical for teachers and university. This paper introduces a study that uses the opportunities presented by emerging technologies to create a new learning environment that could provide convenience for learners, who live a long way from the university and/or have to work at the same time.

### Purpose of the study

The purpose of the study is to identify the challenges of teaching computer science topics online and identify useful support and resources to enhance learning through the informed use of web-based e-learning.

### Research questions

The first question examines the difficulties in applying the theory and practice of classroom based programming courses to the online mode of delivery. This question examines whether programming students are at significant risk when attempting an online programming course (Hentea, Shea, & Pennington, 2003). RISK OF WHAT? For technical subjects, the instructors need to interact more to teach students to seek new sources of information to avoid the limitation of the subjects I DO NOT UNDERSTAND THIS SENTENCE (Hentea, Shea, & Pennington, 2003). As well as a change to the level of interaction between staff and students when teaching in the online mode, delivery and setup of the technical teaching environments is also a crucial factor relating to this research. THIS LATTER SENTENCE SHOULD BE ADDED TO THE RPEVIOUS ONE OR RE-WRITTEN. IN FACT, BOTH ARE NOT

VERY CLEAR. In addition, the second question aims to establish the challenges which relate to the technologies involved in the delivery of programming courses in an online environment.

Research question 1. Why are programming courses difficult to study online? AN INCREDIBLY BROAD QUESTION

Research question 2. What are the challenges relating to the technologies involved in the delivery of programming courses online with online students?

Review of the literature

Computer programming courses are more difficult than other courses (Linschner, 2002); it is very difficult for technical subjects to be taught online because students find it very difficult to understand the subject content and ways of demonstrating. WHO SAYS? MOST TECHNICAL KNOWLEDGE IS OBTAINED FORM MANUALS? The students in programming courses in an online environment also have difficulty visualizing abstract concepts and lack the social interaction with their teachers online (Mcsporrán&King,2005). VISUALIZING ABSTRACT CONCEPTS? IS SOCIAL INTERACTION NEEDED FOR ABSTRACT CONCEPTS?

To support this statement there is some literature, which supporting that opinions:

Computer programming is an area that contains complex knowledge, potentially highly technical in nature, and abstract concepts that provide more challenges and to learning than other courses (Jehng & Chan, 1998).

Students in computer science have to learn programming as a subject, which involves several cognitive abilities such as syntactic knowledge, conceptual knowledge and strategic knowledge (Bayman & Mayer, 1998).

The students have to work harder with their programming course than in others because they use several cognitive skills in computer science (Linschner, 2002)..

Mcsporrán and King (2005) mentioned that cognitive development does not occur in an isolated environment, thus studying computer science topic in an online environment is very difficult for the students.

Programming languages have highly technical syntax , which has complex rules and is difficult to learn and understand (Linschner, 2002).

Deek & Espinosa (2005) found that most novice programmers find introductory programming courses frustrating and difficult to learn.

From the available literature, it can be concluded that programming courses require more effort from the students to learn and understand the complexities of the subject. To develop such knowledge, students require the use of collaborative learning, which provides an interactive environment, learning tools, active learning, and conceptual discussions with their peers and teachers, as well as helping students with problem solving(Yang & Liu, 2004). Macporran & King (2005) and Hagan & Lowder (1996) showed that in online programming classes, students might find it more difficult to understand the complex knowledge and apply the theory of programming to problems than classroom students, in which students can have face-to-face feedback from their teachers and their peers. This is supported by work of Hentea, Shea &

Pennington (2003) who showed that for technical subjects, the instructors need to interact more to teach students to seek new sources of information to avoid the limitation of the subjects. Therefore, programming students are at significant risk when attempting an online programming course compared to traditional classroom students.

There are two primary methods with which to deliver online learning for students; asynchronous and synchronous techniques. Asynchronous methods use collaborative tools that enable students to communicate with their teacher and their peers. For example, e-mail and discussion forums are both asynchronous methods. E-mail is used widely and is the simplest form of asynchronous technologies, and can be used for teacher-student communication and student-student exchanges. Discussion forums can be used for distance education, providing a mechanism for discussion on specific course topics as well as informal exchanges (Neal & Miller, 2005). Midkiff and DaSilva (2006) identified the excellent benefits of asynchronous communications as being flexibility, engagement with different text documents and sharing file attachments. Another advantage of the asynchronous environment is that students can use it any time and any where they want. The second technologies, providing online communication and teaching with students, are the synchronous methods. Synchronous systems offer collaborative technologies which can be effectively used to fully or partially support distance education. These include all real-time technologies such as audio and video, text chat room, PowerPoint presentation slide shows, electronic whiteboards and screen sharing. Those technologies provide the students with two-way communication. (Ciocco, Toporski, & Dorris, 2005). The benefit of a synchronous learning environment is that it provides immediate interaction. However, there are also some disadvantages such as, learners needing to log in at the same time as their teachers or peers (Moore, 2001), which given international time zones and working schedules, may create 'attendance' problems for online students.

Teaching programming courses online also impacts on the students' learning style. Benty-Marom, Saporta & Caspi (2005, p. ?) suggested that "learning styles did not influence the ways students interact with media", but learning styles do impact on the students due to preference for different methods of learning interaction. Learning environments that suit some students might not satisfy others. For example, an analysis of Sanders & Morrison-Shetlar's (2001) work shows that their students preferred to talk to people in person rather than communicate with them through the chat room on the web. However, they were also comfortable with working with the content online, which supports their study. This result shows that while students may be happy with the online learning approach, they do appreciate the ability to communicate face-to-face, even if it is done so electronically !!!). The results from this preliminary investigation are very similar to those of Yang & Liu, (2004), to the extent that learners think that content online is a very useful tool for the learners but they do not feel able to use the virtual classroom as their main educational tool because they do not think the online learning environment can replace face-to-face communication and discussion completely. This aspect is very relevant to this study. Students prefer to use an online learning environment as a guide for their study as well as using the content online as a context which they can study in their own time. A synchronous mode of communication is very useful and helps the students to communicate with their instructor in a way that is almost face-to-face, but it can be inconvenient for the

students to log on at the specific time the instructor does (Sanders & Morrison-Shetlar, 2001). Similarly, the research by Benty-Marom, Saporta & Caspi (2005) provided the connection between Sanders & Morrison-Shetlar (2001) both research found relationship from learning styles influence to the satisfaction of activities involving class discussions and group activities. It seems, therefore, essential to understand the preferred learning styles of students because different students have preferences for different learning and teaching styles. Also, Meisalo, Sutinen & Torvinen (2002) indicate the differences in the subjects in a virtual class impact on the success of teaching online. These researchers indicated that programming courses in an online environment are more challenging to manage because the delivery method needs to offer strong support from teachers, like face-to-face interaction does. They found that the main problems of studying programming courses online are lack of time, difficult exercises and students did not benefit from the support given by the teachers via the web base system. Students also prefer to study face to face with their teacher during the difficult topics of programming rather than studying via the Internet. It shows that learning styles and course has an effect on the attitude toward of learning in an online environment. The role of the teachers in an online environment involved in virtual programming course is also very important (Meisalo, Sutinen, & Torvinen, 2002). While learning styles are important for the online environment, some students might be happy to communicate with their teachers in an online environment but the others are not. However, the large numbers of students in some online classes also increase the difficulty of communication. The teachers might not provide a rich support to all students in large online classes when students ask for their help immediacy even students who like to communicate with them in online environment also effect with this problems. As a result, even some students like to communicate with their teacher online for discuss about programming problem, they are still stuck in the traffic for online communication because most of online classroom have an enormous number of students,

The research by Yang and Liu (2004) make the connection between technologies and learning theories. In their research, they separate the study in an online environment in two parts. The first part is study in an online environment by using the teachers to control the learning and teaching process, which called instructional communicating environment (ICE). The second part is a collaborative learning environment (CLE) is the learner developed their own study by communicate with their peers. The analysis of Yang and Liu (2004) work show most of learners think that content online is very useful tool for the learners. Also, they declared that chat-room and contextual discussing forum can help them to learn well. However, students not happy to use the discuss questions by email because the student think in not the interactive tool WHAT DOES THIS MEAN?. They need to use just-in-time feedback, which is more flexible by using audio-visual communication tools such as chat-room with their lecturers. However, the students also not agree that using live broadcast center ,can promote level of interactivity like face to face study in the class room (Yang & Liu, 2004). *Live Broadcast Center* is a piece of piece of software, which provides teachers and students the ability to communicate to each other and provides the teachers opportunity to control the teaching and learning process in the virtual classroom. The result of this study shows that most of teachers agree this system makes learning process in the virtual classroom more effective similar to the traditional classroom. However, the researchers found that most of learners and teachers do not feel the can adapt to the virtual classroom as their main educational

tool because they do not think the online learning environment can completely replace face to face communication and discussion (Yang & Liu, 2004). Also, the cost for the system is expensive. In addition, Raymond *et al.* (2005) illustrated that using asynchronous learning environments is not interactive enough. Whereas, the use of synchronous learning environments provides more interaction between students and professors. This result is significant for the online learning technologies. It is true that synchronous communication technologies provide the opportunity for the online students to communicate with the professors like face to face. However, this method might not completely replace face to face communication and discussion for the technical topic such as programming language.

Gibson, Blackwell, & Hodgetts (1998) state that synchronous is an effectively component for online communication. It allows the students to ask questions and get feedback in real time like the students in the class room with the instructors. However, they also drawn some problems of synchronous. It stick for the time, which have to be log on the same time with instructors, student have more control for their study and hampered of the technologies. WHAT DOES THIS LATTER SENTENCE MEAN? Whereas, asynchronous communication provides more freedom for the students. Students can do their work in the own time. The researchers recommend "you keep you live simple and stick to asynchronous communication" (Gibson, Blackwell, & Hodgetts, 1998, p.280). This study is related to many research that said synchronous communication is very useful for online study but most of students who prefer to study online also prefer study any time by the own. REWRITE THIS LAST SENTENCE. It seems that the appropriate communication for online study is asynchronous communication. The research of Midkiff & DaSilvas (2006) shown that traditional classroom, synchronous and asynchronous are have there own strange. As well as synchronous and a synchronous both delivery grow very fast. However, asynchronous seem to be more develop because of its inherent flexibility. They also declared that difference subjects are appropriate which differences delivery technologies method. The subjects which not have many technical terms or complex knowledge such as human resource management is appropriate to study in an online environment. WHAT A BROAD UNSUBSTANTIATED STATEMENT In this kind of subject, the content is very important for the students so it is effective to use an online education to provide the content. It seem that interactive tools and good alternative tools to support the students to study the content by them self on their flexible time. REWRITE THIS LAST SENTENCE. It is adequate to use asynchronous communication for the students and the teachers to discuss and communicate to each other. Howell, Harris, Wikinson & Zuluaga (2003) demonstrated that good education should provide effective and alternative tools and option to support students. Thus, the delivery model should include student resources, facilitator resources and facilitator support. They claimed that student resources should include online course material, discussion groups, real time lectures, learning guideline, textbooks and facilitators. The research evaluates the project by using the percentage of the pass rate for each subject and students perspective from the focus groups. According to Goldsmith (2001) students tend to have different attitudes toward asynchronous communications. Most of the positive opinion is about the time, offer the feedback WHAT DOES THIS MEAN?, which enhances their ability to learn. As well as, it is convenient for the learner to learn either at home or work. However, there are some negative opinions in the area of lack of interaction. Some learners believe that they can express themselves clearly with face-to-face communication (Goldsmith, 2001). This shows that synchronous mode might be very useful for

courses that are provided fully online. Whereas , other courses, which just provide the online course to motivate and enhance students, provide the material and resources to support traditional class room study, THIS RPOEVUIOUS SENTENCE DOES NOT MAKE SENSE.

## Method

The literature review method was used to reach a conclusion for this preliminary research. THAT IS HARDLY A METHOD.

## Conclusion

From the foregoing discussion it appears that learning programming courses in an online environment have to provide more challenges because the subject involves complex knowledge, highly technical terms and problem solving. Firstly, the research evidence indicates that before providing an online environment course, teachers should understand the learning styles of their perspective students, because learning styles influence satisfaction with activities involving class communication. As the literature indicated communication or collaborative learning play an important role in the learning environment. Moreover, programming courses must include strongly collaborative learning between students, teachers and their peers to solve problems. As a result, to manage collaborative learning, the teacher must provide appropriate elements method for delivery of the course. This online environment also should provide rich support, effective and alternative tools and an option to support students. Learning resources are very effective tools for online learning: online course materials, learning guidelines, course activities and facilitator support. However, the size of the class for computer science subjects in an online environment should be limited so as to give the opportunity for the teacher to support all students. The technologies for delivery also should include synchronous and asynchronous technologies for the course because both technologies have strength of their own. However, the evidence shows that synchronous might be very useful for course provide a fully online environment. Whereas for course that provide online material to motivate and enhance learning but for which most of the material is delivered in the traditional class room, asynchronous technologies are appropriate and adequate. It also clear that the cost of an online has to be considered before establishing it. In addition, the teacher should give the opportunity to students to communicate face to face for difficult activities, programming assignment, and also for the students who prefer face to face communication with teachers.

As a result, the potentially significant factor for online courses on computer science subject is that they are high risk and costly to implement. The school or department of computer science should investigate costs and benefits before developing it. The most noticeable differences between online learning environment and traditional class rooms in the literature is that we can teach computer science subjects online but the potential obstacles are the subject content, the delivery method and cost impact on the success of the study. As a result, computer science subjects are appropriate for traditional class room more than an online environment. However, if the department has to establish the computer science subjects in an online



environment, they have to concern themselves with the issues outlined in this research.

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