Implementing Virtual Pair Programming in E-Learning Environment

Abdullah Mohd Zin
Sufian Idris
Department of Computer Science
Faculty of Information Science and Technology
National University of Malaysia
43600 Bangi, Malaysia
amz@ftsm.ukm.my sufian@ftsm.ukm.my

Nantha Kumar Subramaniam
Faculty of Information Technology and Multimedia Communication
Open University Malaysia (OUM)
50480 Kuala Lumpur, Malaysia
nanthakumar@oum.edu.my

ABSTRACT

Programming subjects are one of the core and important subjects that should be taken by students majoring in information system or computing. The problem of teaching and learning of programming has been widely reported in literatures. Many attempts have been made to solve this problems and this has led to many new approaches in teaching and learning of programming. One of the approach that has been proposed is the use of pair-programming, which is one of the practice of eXtreme Programming (XP). The advent of e-learning has given birth to the idea of Virtual Pair Programming (VPP). This paper describes how asynchronous mode of collaboration using VPP could be implemented for e-learning learners to learn programming.

Keywords: Pair-programming, Virtual Pair-programming, Programming, E-Learning, Distance Education

1. INTRODUCTION

Programming is known to be a difficult course, both for the instructors and learners and this subject is compulsory for all students majoring in information system or computing. Novice programmers suffer from a wide range of difficulties. According to Robins et al (2001), it will take about ten years of experience to turn a novice into an expert programmer. Since 1970's, many innovative approaches had been proposed by educators and researchers to overcome these problems. Some examples of these approaches in teaching of programming are "Tutorial-based teaching of introductory Programming" (Zachary 1994), "Methodology First and Language Second" (Zhu and Meng 2003) and "Process Model" approach (Gantenbein 1989). Some researchers also have proposed that the programming curriculum need to be reshuffled to reflect learners need, while other proposed the imposition of mathematics to the learners who plan to take programming subjects.

Another initiative that is slowly becoming more popular among many instructors is the concept of pair-programming. Pair programming is a practice in which two programmers work together at one computer collaborating on the same design, algorithm, code or test. While programming, the pair work side by side at a single workstation or computer with one person designated as the 'driver' who enters the code and the other person as 'observer' or 'navigator' who observe the codes for defects. These roles are switched as the programming session continues.

It seems that pair-programming is the most suitable approach for learning of programming in the e-learning or in distance education environment for two important reasons. Firstly, learners in this environment are not in constant contact with their instructor or physically close to each other. Secondly, learners in this environment normally have to work alone since they are not physically close to other learners. Pair programming provide an environment for them to work with peers, which in turn will help to reduce anxiety and uncertainty of learners. The implementation of pair programming in this environment has led to the introduction

of the concept of virtual pair programming (VPP) (Baheti et al. 2002; Hanks 2004; Ho et al. 2004 and Kiercher et al. 2001). VPP has been implemented by many academic institutions using various techniques. In the next section, we describe how we have implemented VPP at Open University Malaysia (OUM) which specializes in blended e-learning environment. In particular, we are looking at the effectiveness of using this VPP approach in learning of Java Programming for e-learners at Open University Malaysia (OUM) in asynchronous mode of collaboration.

2. VPP IMPLEMENTATION AT OUM

Two important components in our approach in implementing VPP are the task and the online forum.

2.1 Task

In our approach in implementing VPP, learners are required to use VPP in solving a programming project (later known as task) given to them. To introduce the concept of pair-programming, an overview about it has been attached on the programming assignment with clear instruction on what the tutor and the learner suppose to do. The learner submits their programming solution (both hard and soft copy) and print-out of their discussion from the forum towards the end of the semester. In implementing VPP, a task consists of carefully designed problems that demand from the learner the acquisition of critical knowledge, problem-solving proficiencies and self-directed learning strategies. The problem thus served as the organizing centre and the stimulus for learning and represented the vehicle that developed learners' creative and high-order thinking skills.

There are two questions in this task.

- Question 1 tests the learners to build a user interface using JApplet. They must use their creativity and innovation to develop a impressive layout for this user interface
- Question 2 tests the learners on the concept of class and objects by asking them to develop a Java-based games application that will stimulate a dice.

This assignment carries 20% of their final grade and their participation on the "pair forum" contributes 5% of their final grade.

2.2 Online Forum

Online forum is the important component in VPP. It serves as a platform to the learners to collaborate and discuss the task given to them and develop learners' creative and high-order thinking skills. The online forum that is used by OUM is shown in Figure 1.

Each tutor is given a separate forum in LMS which can be used to communicate with their learners. Tutors have been asked to create subfolders in their forums for each pair of learners. A handout on how to create this forum is prepared and distributed to the tutors. Each pair is given a different password to enter into their forum by their tutor, in order to block learners from participate in forums that do not belong to them.

At the end of the course, a questionnaire about learners' perceptions on VPP was given to the learners to obtain their feedback. The questionnaire was specially designed to elicit

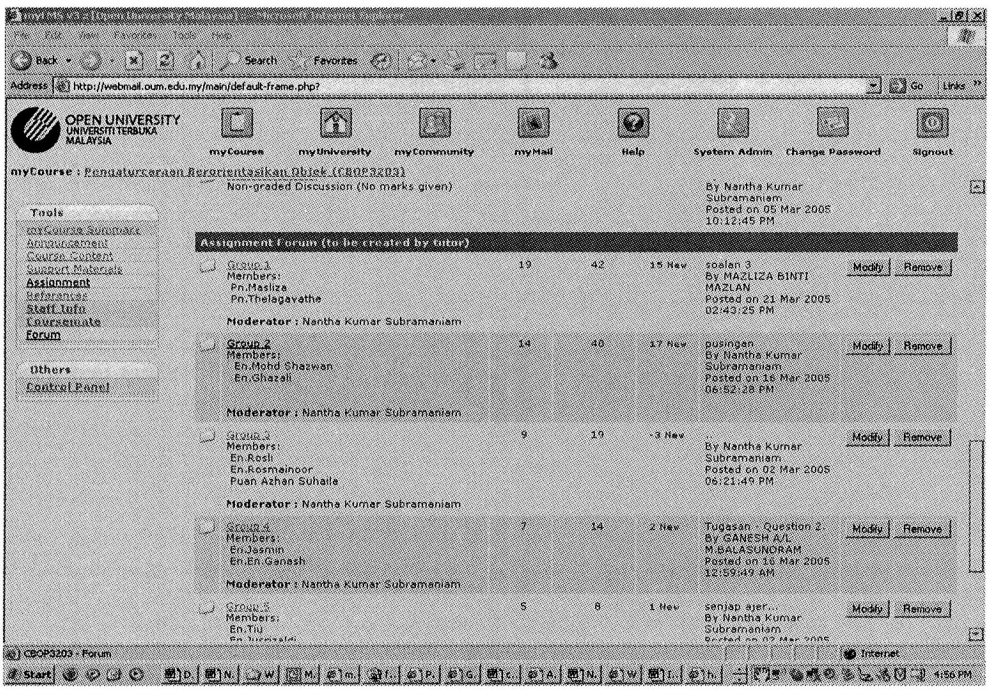

Figure 1. Snapshot of LMS showing pairs forum

No	Statements
1	Collaboration with my pair gives me more confidence in solving programming problems
2	Collaboration with my pair gives me more confidence in writing Java programs
3	It is easy to access forum in LMS
4	Tutor roles is very much important in guiding the learner to obtain the output
5	I gained more new knowledge by participating in this pair forum
6	The discussion in the forum is more focus towards the problem that need to be solved
7	Collaborating with my peer in solving the given task is a new rewarding experience
8	My group member gives concrete ideas
9	This collaborative learning should be expanded to other subjects
10	Less time is taken to obtain the solution using this approach
11	The collaboration in the forum will be more effective if it has more than TWO members
12	Pair collaboration with peer could replace the tutorial classes
13	The forum provided in LMS to collaborate with the peer is enough and no other facilities is required

Table 1. Questions/Items in the questionnaire

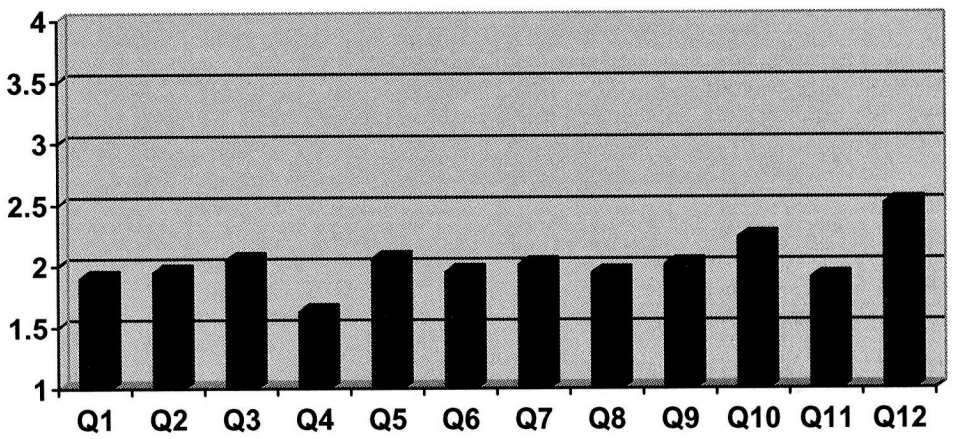

Figure 2. The effects of asynchronous virtual pair programming

the learners' perceptions towards the effect of the asynchronous collaborations that took place during the learning processes in VPP as shown in Table 1. All the questions (except question 13) in the questionnaire uses a 4 point Lickert scale to capture students feedback in the following scale:

1-Strongly Agree; 2-Agree; 3-Not agree; 4-Strongly Not Agree.

Question 13 is a TRUE/FALSE type of question.

3. STUDENTS' FEEDBACK

The result of the questionnaire is also very encouraging. We collected 147 answers from 165 learners registered for the course. The analysis of the data involved extracting the means of each of the items with means of 2.50 representing the equilibrium point. Means smaller than 2.50 reflected the degree of the respondents' agreement with the statement put forward; means with values more than 2.50 reflected the degree of the respondents' disagreement with the statements put forward to them.

The effects of the asynchronous collaborative programming process using VPP in an E-Learning environment is shown in Figure 2. In general, the means for all statements (except question 12) are less than 2.5. This result indicates that there is a high degree of agreement among the respondents towards statements put forward to them concerning the use of VPP.

It is evident that the learners perceived they had gained the confidence in programming by collaborating virtually with their peer ($\bar{x}$ =1.95) and this has contributed in more confidence on writing Java program ($\bar{x}$ =1.95). The good result on this confidence could be resulted from new knowledge gained in participating in virtual pair-programming ($\bar{x}$ =2.06) and rewarding experience they gained in VPP ($\bar{x}$ =2.01). The good result on confidence they gained on programming made them support the use of virtual pair-programming in the future programming subject ($\bar{x}$ =2.01). The result also shows that the role of tutor is very important in guiding the learner in virtual pair-programming ($\bar{x}$ =1.63). The concrete ideas given by the peer ($\bar{x}$ =1.94)

has made the discussion in the forum more focus on the problem that need to be solved ($\bar{x}$ =1.95).

One interesting discovery is the result of item Number 11. For this item, most of the learners agree that having more than two members in a group would be more effective ($\bar{x}$ = 1.90), although in general they are happy with their peer ($\bar{x}$ =1.94). In our opinion this is due to the fact that with only two learners in a group, there would be some delay in having the feedback from their partners. By having more than two, this delay could be minimised.

On question Number 12, there is almost equal number of learners who agree and disagree that VPP could replace the physical face-to-face tutorial ($\bar{x}$ =2.51). This indicates that although generally learners happy with VPP but there are still a large percentage who would like to have face-to-face meetings with their tutors. This confirm to the opinion of (Edwards et al 1997) who says that learning of programming subjects in e-learning institutions must have some face-to-face interaction. Furthermore, in the Asian culture, it is a norm for learners to have regular face-to-face meetings with the instructors or tutors.

For question Number 13, which is an open ended, 60% of the respondents do not agree that only asynchronous mode of forum collaboration is sufficient for them in learning programming. Those who do not agree mentioned that some extra tools or features need to be added, such as online compiler, online notes and instant messaging tool (such as Yahoo Messenger). This result indicates that learners' wanted some kind of synchronous features in the forum.

4. CONCLUSIONS

This research was started with the single objective to investigate the effectiveness of using VPP in learning of programming. In particular, this research focus on the use of asynchronous mode of collaboration through the use of the university's learning management system. More than one hundred learners have participated in this research. The result has revealed that the use of asynchronous VPP for learning of programming has produced many positive effects. Learners regarded VPP to be effective, motivating and enjoying. The research has also indicated that VPP has given them the confidence in programming. This may be attributed to the new knowledge gained through the collaborative learning process between the learners as well between learners and tutors. However, there are a few improvement that could be considered in order to make VPP more effective. Some learners have recommended that online compiler should be provided in the system. At this particular moment, if two learners are discussing about a piece of program code, they may have to copy the program from the discussion forum and paste it to the stand-alone editor provided in their own personal computers before it can be compiled and run. This arrangement can distract them from the focus of their discussion. By providing online compiler, the code can be compiled and run directly, and they can obtained the result immediately. Another recommendation from some of the learners is the inclusion of instant messaging. Although the discussion forum provided by the learning management system has given them the ability to communicate, instant messaging is preferred since it can be used to give immediate feedback. One interesting finding of this research is that most of the learners feel that the number of learners in a group should be more than two. Although, two programmers working together is considered to be the best practice in software industry which adopted XP, it may not be the ideal number for learners in learning of programming.

In the next study, we are going to investigate this issue by varying the numbers of learners in a group and observe their performance. We are currently trying to correlate the learners activeness in VPP with their final examination result and also to study how learners' demographic profile, learning style and the way learners been paired influence the learners' perception about VPP.

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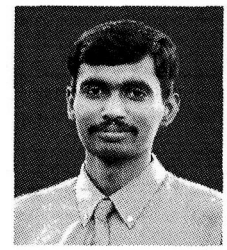
AUTHOR BIOGRAPHIES

Abdullah Mohd Zin is a full professor at the Department of Industrial Computing, Faculty of Information Science and Technology, National University of Malaysia. He obtained his PhD (Computer Science) from Nottingham University (UK). He has published numerous articles in international peer-reviewed journals. His research interest includes collaborative learning tools, software management, E-Learning and foundation of programming. Currently he is the deputy dean as well as the head of programming research group at the faculty.

Sufian Idris is a faculty member in the Computer Science Department of the Faculty of Information Science and Technology at National University of Malaysia (NUM). He holds a MSc in Computer Science from The University of Manchester, UK and a PhD in Computer Science from the University of Manchester Institute of Science and Technology, UK. He has been faculty member in NUM since 1988. His teaching interests are in the areas of Computer Programming, and Object-Oriented Analysis and Design. His research interests and work are in the areas of Teaching of Programming, Programming Tools, Object-Oriented Development and Mobile Computing. He has published papers in journals such as the WSEAS Transactions on Computers and conferences such as the International Conference on Enterprise Information Systems

Nantha Kumar Subramaniam is a faculty member in the Faculty of Information Technology & Multimedia Communication, Open University Malaysia (OUM). He holds a Master in Computer Science from National University of Malaysia and currently a PhD (Computer Science) candidate in the same university. His research interest includes intelligent learning tools and object technology. His teaching interests are in the areas of Object-Oriented Programming, Object-Oriented Analysis & Design and Data Mining.



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