Investigating the Impact of Pair-programming on Entry Level IT Students

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ABSTRACT

This paper outlines a study to investigate the effectiveness of Pair Programming (PP) on a small group of first-time programming students. Participants in this study were enrolled in a Level 4 Information Technology (IT) qualification at a New Zealand Institute of Technology. Numerous international studies have recommended PP as a pedagogical tool for first year tertiary level programming students. Anecdotal evidence confirm that students' performance in programming classes at the entry level requires improvement. Consequently, it was deemed crucial to investigate the effectiveness of PP on this group of students. Participants in this study confirmed that pair programming reduced their anxiety during the programming classes however little improvement was observed from their assessment marks. Factors that may have contributed to this include pairing of students with different ability levels, random pair selection, and negative pair pressure.

Categories and Subject Descriptors

K.3.1 [**Computers and Education**]:

General Terms

Measurement, Performance

Keywords

Pair programming

1. INTRODUCTION

First year programming students in New Zealand tertiary institutions face similar challenges as their counterparts elsewhere in the world. Teague [3] questioned "Is programming really that difficult – or are there other barriers to learning that have a serious and detrimental effect on student progression?" and concluded that paired students outperformed non-paired students in exams. . Studies of pair programming in university programming classes have shown that pair programming yields better design, more compact code, and fewer defects for roughly equivalent person-hours. Studies have also noted that pair programmers exhibit greater confidence in their code and more enjoyment of the programming process [2]. PP is a technique whereby two individuals use a single computer as they work together to complete an assigned programming task [1]. In this study, the researchers have been involved in teaching first year information technology (IT) students for over a decade. Anecdotal evidence suggested that first year programming students find the challenge unbearable which leads them to 'disappear' from the course. For those that attempt computer programming for the first time find it rather a stressful experience demanding long hours spent in the computer labs completing laboratory exercises and programming assignments. Consequently, the researchers were interested in how PP may motivate first-time programming students at a New Zealand Institute of Technology.

2. METHOD

This study investigated how pair programming may positively influence the attitudes of students in an introductory programming course. The class consists of two hour lecture and three hour lab. In the lecture, the basic theory and logic were explained. In the lab, a few of basic practical exercises were taught in a traditional way in the beginning, and then each pair of students practiced some advanced questions. In the first trimester of 2012, a total of 38 students were enrolled in the programming course. The first 20 students who enrolled for the CiC programme were allocated into the group A while the remaining students were placed in the group B. The researchers decided that the group A would be the pair programming group while the group B were the individual programming group. However, in 2013, the participants decided their own groups and partners. Therefore, we refer to the 2012 group as the Compulsory Group and the 2013 group as the Voluntary Group.

3. PROCEDURE

During the lab sessions, the pair programming group worked on the lab exercises in pairs while the individual programming group worked on the same exercises individually and assisted by the researchers. Course assessments were strictly an individual effort for each group and were not to be completed in pairs. Students

were advised that pair programming was only to be used for the lab work and not for the assessment. There were five major assessments for the course and three MSLQ questionnaires. Half an hour was allocated during the lecture session to undertake the questionnaire administration. Students were advised that pair programming was only to be used for the lab work and not for the assessment. There were five major assessments for the course and three questionnaires.

4. FINDINGS 2012

When we compared the participants between the pair programming group and the individual programming group, there was no noticeable difference in the two groups in terms of the scores for the internal and external motivations. Participants in the individual programming group recorded high scores for their confidence in completing assessment work and their understanding of the delivered learning materials. The individual programming group's assessment and learning confidence remained constant while the pair programming group's assessment and learning confidence declined slightly. In the learning strategies section, the critical thinking measures of participants in the individual programming group remained consistent at the middle score while the pair programming group declined during the trimester. The only measure that showed a slight decline was the satisfaction by the participants in the individual programming group.

The average academic performance of the Individual group was higher than Pair Programming group from the first week of the trimester, but the results of Pair Programming group were improved up to the same level of Individual group's in assessment 2 and 4.

Even though there were two big drops in assessment 3 and 5, we can see a big potential to improve students' academic results using Pair Programming if we investigate more variables influencing Pair Programming and improve the way of how to apply them in the classroom.

5. FINDINGS 2013

Compared to 2012, the internal and external motivations were very similar, but the assessment and learning confidences in 2013 were interestingly increased steadily during the trimester, which were exactly opposite in 2012. The same results occurred in the areas of interest and curiosity of the course, Learning Time management and Organizing ability.

For the Satisfaction section, it was steady all the way through the trimester, but the level of the satisfaction of Pair Programming group was higher than the individual programming group.

Participants in Individual Programming group recorded higher scores for their assessment and learning confidence than Pair Programming group and they remained constant while the pair programming group's assessment and learning confidence improved slightly which was different from 2012.

In the learning strategies sections that are Interest and curiosity, Learning Time management and organizing ability, they were constantly steady all the way through the trimester, but there was a noticeable improvement in Pair Programming Group.

Participants in Individual Programming group recorded higher scores for their assessment and learning confidence than Pair Programming group and they remained constant while the pair programming group's assessment and learning confidence improved slightly which was different from 2012.

In the learning strategies sections that are Interest and curiosity, Learning Time management and organizing ability, they were constantly steady all the way through the trimester, but there was a noticeable improvement in Pair Programming Group.

While the average academic results were decreasing throughout the trimester, the students from Pair Programming Group achieved almost same results in assessment 2 and 4.

6. RECOMMENDATIONS

The following issues must be considered for better understanding the effectiveness of Pair Programming to encourage entry level IT students into programming courses in the future:

1 Thorough explanation of how PP will work in the first class.

2. Monitor and control periodical role exchange and equal time spent on each role as driver or navigator by the participants..

3. Early identification of pairs mismatch in terms of motivation and academic abilities.

4. Due to Peer Pressure, we recommended having Individual work 50% and Pair work 50% in the lab.

5. It is recommended that the students do a skill level test in the first week and assign a pair with equal skill level because students want to work with a partner with similar or better skill level.

6. For Pair Programming in the classroom, the tutor's role is very important. They should remind and explain about the pair programming protocol in each class because students are not used to collaborate on work with their peers and they easily fall back to the traditional way of learning.

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