

Does Personality Influence Web-based Learning Performance of Novice Programmers? A Preliminary Study

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ABSTRACT

This paper presents a research investigating the effects of personality types and learning performance of students who learned introductory programming through content sequencing of web-based instruction (WBI). A controlled laboratory experiment was conducted with the aim to understand whether personality types affect learning performance when students use the content sequencing system. Thirty eight first semester's students who enrolled in information technology (IT) program in a higher learning institution in Malaysia voluntarily participated in this study. Statistical analysis on the data from the experiment revealed interesting findings about the effect of personality on learning performance. This finding is discussed in relation to personality model for adaptive WBI.

Keywords: personality types, web-based instruction, content sequencing, programming course

I INTRODUCTION

Computer programming is a fundamental course for students who enrol in Information Technology (IT) or Computer Science (CS) related-programs at higher learning institutions. Teaching and learning programming courses is always a challenge to both instructors and students (Miliszewska & Tan, 2007). Miliszewska & Tan (2007) highlighted that programming has been the most feared and hated course by many students who are novice to programming. They also found that programming has been the major factors contributing to student attrition from computing-related programs. The same scenario is believed to happen in other higher learning institutions.

Current research attempts to address this issue from various perspectives. The approaches taken include multiple supports to students such as the use of web-based instructions (Boada, Soler, Prados, & Poch, 2004; Weber & Brusilovsky, 2001), and pair-programming (Williams & Upchurch, 2001). In the context of learning new programming languages, a web-based instruction (WBI) could be an approach

to support classroom lecture and laboratory exercise.

It is important to note that students who started with computing-related programs have diverse background. This may include differences in learning style, knowledge, skills, preferences, as well as personality. Keller and Karau (2013) suggested that students' personality influences the way in which they learn and perform academically. This motivates us to investigate further whether personality affects novice programmers' performance within WBI. If that is the case, the results of this study can be used to design a personalized WBI for learning introductory programming courses.

This paper presents our study on how personality affects web-based learning performance among novice programmers. In Section II, literature on personality and learning performance is described. Next, the methodology of the study is explained in Section III. Then, the results are presented in Section IV. Finally, Section V discusses and concludes with several future works to be carried out.

II PERSONALITY AND LEARNING PERFORMANCE

Personality is defined as "... *characteristic patterns of thoughts, feelings, and behaviours that make a person unique...*" (Goldenson & Glanze, 1984; Nimmo & Holland, 1999). The theory on personality was first elaborated by Carl Jung (1971) and further refined by Katherine Briggs and her daughter Isabel Myers through Myers-Briggs Type Indicator (MBTI) (Myers & McCaulley, 1988). MBTI has been used widely to explain individual types' of personality characteristics in many areas including professionals in medical, legal, engineering, and computer science.

MBTI identifies one's personality according to how he or she

- i. focuses energy - introvert (I)/extrovert (E)
- ii. gathers information - sensing (S)/intuitive (I),
- iii. makes decision - thinking (T)/feeling (F), and
- iv. deals with the outer world- judging (J)/perceiving (P).

Table 1 summarizes the personality types based on MBTI as taken from Myers & McCaulley (1988).

Table 1. MBTI Types of personality

Dimensions	Characteristics
I-E	Extroverted person tend to work with people, socializing and aggressive, while introverted prefer to work alone, and not attracted to social communication.
S-I	The characters of a sensing person are practical, realistic and concrete. He/she always focuses on present. An intuitive person focuses on future, seek the possibilities and abstract.
T-F	A person with feeling type is based on principle, while thinking person makes decision based on fact. Other characteristics of a feeling person are gentle and dislike conflict. In contrast, a thinking person is rational and thick skinned.
J-P	A judging person likes to think in order or sequentially, and works in planning while a perceiving person is open, think in random and flexible.

Personality has been found to be related to academic achievement (Komarraju, Karau, Schmeck, & Avdic, 2011). Sadeghi et al. (2012) reviewed past studies and found a relationship between personality types of learners, the way they established their learning styles and their academic success in school and university both at an undergraduate and postgraduate level.

Huang (2009) suggested that learners with extraversion, intuition, thinking and judging (ENTJ) personalities are most probable to be prosperous alongside an online learning environment, as they had larger self-management skills for setting goals, working strategies, decision-making, and association. Through a series of experimental studies on students' personality and their learning performance, Al-Dujaily, Kim, & Ryu (2013) found that personality trait could influence the way in which they learn through WBI.

The findings of the above prior studies can be an important input towards designing a personalized and adaptive WBI for learning introductory programming. Considering that learner's personality is a factor that influences learning; further investigation on its effects within WBI can reveal evidence for designing a proper user model of such learning environment. Through this, it is anticipated

that WBI with personality model could support learners in programming courses. The next section describes our study which explored the effect of personality types and the students' learning performance with content sequencing WBI.

III LEARNJAVA: A WEB-BASED INSTRUCTION (WBI)

A content sequencing WBI; called LearnJava was developed to teach basic Java programming. A content sequencing system is a type of WBI that self-organises learning content depending on learning performance or skill level of the individual learners (Katuk, Kim, & Ryu, 2013). In this system, the learning content is presented to the learners through combination of quizzes and explanation. Figure 1 shows the process of learning with content sequencing.

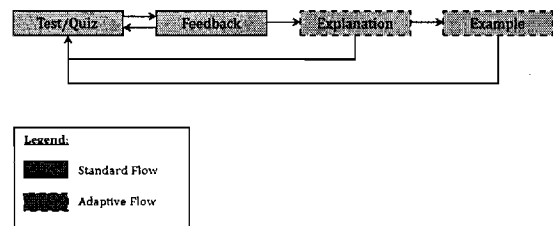


Figure 1. Content sequencing process

In content sequencing, students learn by answering a set of quiz related to the topic. Upon receiving the answer to the questions, the system gives feedback to the students and acknowledging them whether the answer is correct. If students provided a correct answer, they will be able to answer the next question. In the case that students have wrong answer, they will be presented by the explanation associated to that question. The dotted boxes in Figure 1 shows that explanation will only be presented to students when they had a wrong answer to that particular questions. Otherwise, students will be presented with feedback and back to the question. Figure 2 shows the main interface of LearnJava.

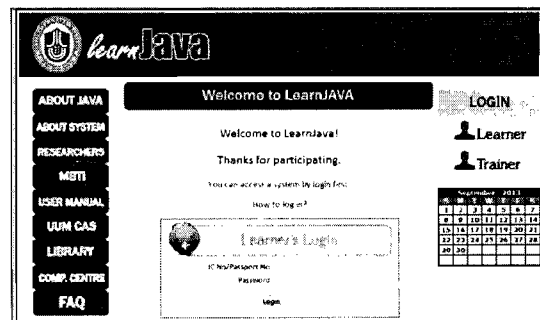


Figure 2. The main interface of LearnJava

LearnJava was developed to include eight chapters of a programming introductory course. The system was developed in PHP and run on Apache web server. The data was stored in MySQL database. The students are allowed to use the system for learning and viewing their performance.

IV METHODOLOGY

A. Experimental Design

A controlled laboratory experiment was implemented. Pre-test and post-test were conducted following a within-subject design while the personality and student performance was based on between-subject design. The experiment aims to test the following hypotheses:

H₁ – Students will improve their learning through LearnJava.

H₂ – Certain personality types will affect students' learning performance within WBI environment¹.

B. Participants

The participants of this study were recruited among first semester students who enrolled in Bachelor of Science in Information Technology program in a higher learning institution in Malaysia. The students were recruited during new students' orientation week at the beginning of the semester in September 2013. The total number of new students for the program was 110. However, only 88 students answered the personality tests and out of them, 38 were voluntarily participated in the lab experiment.

C. Experimental Apparatus

A personality questionnaire, a WBI for learning Java known as LearnJava and a set of pre- and post-test questions were the apparatus utilized in the study. Humanmetric Jung's Typology Test™ instrument was adapted as the tool to identify the participants' personality types. The questions were printed on the paper and the researchers' keyed-in the participants' response using the existing tool that is available online through <http://www.humanmetrics.com/cgi-win/jtypes2.asp>. The instrument consisted of 72 questions in relation to individual's daily behaviour.

In this experimental study, LearnJava that was described in the previous section had been the main

instrument for the experiment. However, only one chapter from the syllabus which equivalent to two-hours lecture was tested.

The pre- and post-test consisted of 15 multiple choices questions about basic Java programming. The results were used to measure the participants' performance in terms of their learning outcomes. The questions consist of the understanding and facts regarding to the course. The questions were divided equally into three levels of difficulties (i.e., easy, moderate, hard).

D. Experimental Procedure

The experimental procedure involved two phases; (i) personality test session, and (ii) controlled laboratory exercise.

i) Personality Test Session

The personality test was conducted in a lecture hall during a student-faculty meeting. This meeting was set out by the department as an activity during new student's orientation week. The printed personality test questions were distributed to the students. They were given thirty minutes to answer the test. 88 students gave their consent to participate in the study and answered the test. They were given an information sheet about the experiment and further invited for the lab experimental exercise. The students were identified according to their student ID. Participation in the study was on voluntary basis. The researchers further keyed-in the students' response into the online instrument to identify their types of personality. The types of personality were recorded in a worksheet.

ii) Controlled Laboratory Exercise

The experimental study was conducted in computer laboratory consisted of twenty computers with internet access. The students attended the session that they had chosen after completing the personality test. The experimental study was conducted in four sessions which were divided into two days. The students were given the information sheet about the experiment and consent form. Then, they were asked to answer the pre-test that has been pre-programmed and available online. Upon completion of the pre-test, the students accessed LearnJava and learned independently. One of the researchers supervised the session and provided assistance to the students whenever needed. After the students completed the independent learning, they were asked to answer the post-test questions. At the end of the experiment, the students were provided with light refreshments.

¹ The research was exploratory in nature; hence the hypothesis was generalized based on literature that personality might have effect on learning performance. However, specific personality types have yet to be discovered.

E. Analysis of the Results

We used statistical software SPSS19 to analyse the data. Non-parametric statistical tests were used in the analysis due to small sample size.

V RESULTS

A. Demographic Information

The participants' demographic data were analysed and presented in Table 2.

Table 2. Summary of demographic information

Demographic information	Categories	Number of Participants (%)
Age	17-20 years	2 (5.26%)
	21-24 years	36 (94.74%)
Gender	Male	19 (50%)
	Female	19 (50%)
Ethnicity	Malay	22 (57.89%)
	Chinese	14 (36.84%)
	Indian	2 (5.26%)
Language	Malay language	22 (57.89%)
	English	8 (21.05%)
	Mandarin	6 (15.79%)
	Tamil	2 (5.26%)
Experience of Java	Never	35 (92.11%)
	Below 6 months	1 (2.63%)
	6-12 months	1 (2.63%)
	13-24 months	1 (2.63%)
Experience of e-learning	Yes	10 (26.32%)
	No	28 (73.68%)

94.74% of the participants were aged between 21 to 24 years and the rest were between 17 to 20 years. Half of the participants were Malay, one third was Chinese (36.84%) and the rest were Indian. Both male and female participants were recruited equally. As expected, about half of them spoke in Malay language 21.05% spoke English, 15.79% spoke Mandarin and 5.26% spoke Tamil. In terms of their experience using Java, we found that 92.11% never learned Java programming language before. Meanwhile, 73.68% of respondents never had experienced with e-learning.

B. Personality Types

Due to small sample size, the participants' personality was divided into two dichotomous dimensions of personality as rendered in Table 3. We only focus our analysis on two dimensions of personality; (i) introvert/extrovert, and (ii) sensing/intuitive as they are directly related to learning through WBI. Based on the personality

test, we classified the students into the corresponding personality as shown in Table 3.

Table 3. The types of personality of the participants (n=38)

Personality Dimension	Personality Types	Number of Participant
Social interaction Dimension (n=38)	Introvert	16
	Extrovert	22
Information-gathering dimension (n=38)	Sensing	24
	Intuitive	14

C. Learning Performance

Learning performance is defined as the improvement of learning measured using the amount of knowledge gained through the learning process. In other words, learning performance is the difference between post-test and pre-test. We initially investigated whether learning actually happened when students use the WBI. The pre-test and post-test results were analysed and presented in Table 4.

Table 4. The means and standard deviations for the pre-test and post-test

Items	Pre-test	Post-test
Mean	5.66	9.95
Standard Deviation	2.281	2.460
Negative Ranks (Post-test < Pretest)	n=0, mean ranks =0	
Positive Ranks (Post-test > Pretest)	n=37, mean ranks =19	
Ties (Post-test = Pre-test)	n=1	
Test statistics	Z=-5.318, p<0.05 significant	

The mean pre-test score was 5.66 while the post-test was 9.95. The results suggested that there was an improvement in the participants' knowledge when they learn through the WBI (i.e., LearnJava). A Wilcoxon-Signed Rank test's result confirmed that the difference in the pre-test and post-test mean scores was statistically significant. Hence, the results support our first hypothesis. The hypothesis suggested that students improved their learning through LearnJava.

The pre-test data were first tested using Mann-Whitney U test to identify whether there is a difference in terms of the students' score in comparison to their personality types (i.e., introvert/extrovert and sensing/intuitive). The test results suggested that no significant difference was found in terms of the students' scores in their pre-

test. In other words, all students have homogenous prior knowledge before they use LearnJava.

D. Correlation between personality types and learning performance

We further analysed the students' score in their post-test against the personality types. The following sub-sections describe our analysis.

i) Introvert-extrovert

Table 5 shows the mean and mean ranks for both pre-test and post-test score of introvert and extrovert students. In general, the mean scores for extrovert students were higher than the introvert students in their pre-test and post-test. The Mann-Whitney U test on these data revealed that the difference was statistically significant ($p < 0.05$).

Table 5. Extravert-introvert personality type and learning performance

Personality	Introvert (n=16)		Extrovert (n=22)		Statistics Results
	Mean	Mean rank	Mean	Mean Rank	
Pre-test	5.32	20.72	6.13	18.61	Z = -0.584, p = 0.57
Post-test	9.23	23.75	10.94	16.41	Z = -2.028, p = 0.045, p < 0.05

ii) Sensing-Intuitive

Table 6 shows the means and mean ranks for both pre-test and post-test score of sensing and intuitive students. In general, the mean scores for intuitive students were higher than the sensing students in their pre-test and post-test. The Mann-Whitney U test on these data revealed no statistical significant difference.

Table 6. Sensing-intuitive personality type and learning performance

Personality	Intuitive (n=14)		Sensing (n=24)		Statistics Results
	Mean	Mean rank	Mean	Mean Rank	
Pre-test	6.43	23.43	5.21	17.21	Z = -1.687, p = 0.10
Post-test	10.36	21.50	9.71	18.33	Z = -0.855, p = 0.41

The results of this analysis suggested that personality affects students' performance within WBI. Specifically, extrovert students outperformed

introvert students in their post-test. Simply said, the students with extrovert personality gained more knowledge through the WBI compared to the students with introvert personality. In terms of their information gathering, there is no difference between sensing and intuitive students. These findings revealed that certain personality types affect students' learning performance and thus supported our second hypothesis.

VI DISCUSSIONS AND CONCLUSION

The previous section described the results of this study. In this section, we revisit the findings with regards to the hypotheses that we were interested to test. We also discuss them in conjunction to the programming problems faced by many computing students. The first hypothesis was:

H₁ – Students will improve their learning through LearnJava.

This study found that students improved their knowledge through the WBI. This could be evidence that supports the use of WBI for teaching introductory programming course at higher learning institutions. The content sequencing used in the WBI could be one of the ways that can promote effective learning and improve students' performance especially for the programming course.

Our second hypothesis was:

H₂ – Certain personality types will affect students' performance within WBI environment

The findings suggested that extrovert students outperformed introvert students when they used the WBI (i.e., LearnJava). This result could be a preliminary finding and evidence towards the effects of personality on learning performance within WBI. From the perspective of new students who enrol in computing programmes, the result could be important to take into consideration on their personality and the way they learn. Extrovert students could be more suitable to learn through content sequencing WBI compared to the introvert students. This supports the findings from Huang (2009) that learners with certain personality especially extraversion, intuition, thinking and judging (ENTJ) are more probable to be prosperous alongside an online learning environment, as they have larger self-management skills for setting goals, working strategies, decision-making, and association. The characteristics of students in this type of personality must be investigated further to obtain concrete justifications.

We suggest that researchers and application developers who involve in designing personalized and adaptive WBI consider types of personality in the student model as personality could also contribute to learning performance. This could enhance the personalization feature in WBI and consequently promotes effective learning.

As future work, we are currently replicating the experiment within a larger sample of computing students so that the results can be more generalized. We also plan to study the effects of personality on different types of content sequencing approach of WBI for teaching and learning introductory programming courses.

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