ASSESSING LEVEL OF MOTIVATION IN LEARNING PROGRAMMING AMONG ENGINEERING STUDENTS

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ABSTRACT

Students in programming courses have difficulties to master all required competencies and skills. Consequently, the failure rates in introductory programming courses are frequently high. Developing good programming skills typically requires students to do a lot of practice, which cannot sustain unless they are adequately motivated. This paper aims to identify the issues on programming motivation among engineering students in TATI University College (TATIUC). Research methodologies used in this study are qualitative and quantitative survey techniques. It is found that 'clear direction' and 'punishment' from extrinsic factor becomes an important role for motivating computer programming students. This study also assess about students' expectations and found that 60% of the students expect that this particular subject will be more fun, user friendly and entertaining.

Keywords: Programming, motivation, programming learning, programming expectation, engineering students

1 INTRODUCTION

Programming subject is known as a difficult to learn [1]. Many student claims to dislikes programming subject and not be able to do programming well. These difficulties result in high dropout and failure rates in introductory programming subjects. Language used for novice commonly c++ programming and Java programming [2], java script, C, C#[3].

Pseudo-code and flowchart have been widely use to explain programming solution [4][5]. Many different approaches have been suggested for programming teaching: Scratch System[6], collaborative work, simulation, games[7][8], teamwork skill [9], graphical programming [10], learning by doing [11]approach and many more.

Technology plays an important role to improve learning process. Scribbler robot and Alice used to allow students to interact with the fast world of programming through the use of instructions and programming structures represented by icons. In the context of this problem, it has been the need to implement more attractive methods in the teaching of programming [12]. These new strategies in the teaching of computer courses, is a fundamental pillar in the education of future engineers.

Many tools have been developed to assist teaching and learning process and each of those tools has its own benefits. However it is difficult to find one suitable for all students needs. Depending on the actual knowledge level and preferable study method of each student, we need to make the right tool available at the right time. Once again it is almost impossible for teachers to do this work due to class sizes [13]. Blog is also an alternative used in programming learning [14]. These tools used an internet as a media to make an online discussion and will be very helpful for educators.

Programming subject is the foundation of computer science education. Student's achievement and competitiveness are measured by

programming skills learned during their studies. However, teaching and learning programming subject is never an easy task as mentioned by many studies [15]. In addition, student's ability to get a job is also depending on their ability to create and execute computer program, which by virtue is the core activity in computer science [16]. The complexity of the programming subjects requires understanding of abstracts concepts, logical thinking as well as problem solving [17]. Previous research on why programming students failed revealed among others, incompetent students as well as incompetent lecturers. Some reasons that stated by students are did not understand lecturer's explanations, did not finish course tutorial, copying from friends and did not even try to answer questions from main text books, etc. (Roslina & Nazli, 2009) reported that students found programming a boring subject, lecturers explanations are difficult to understand, teaching method that is not interesting, and not enough exercises or practices during class lesson [18].

In this paper, the level of motivations of programming among a group of engineering students is discussed and evaluated. The students are currently pursuing an engineering degree in TATiUC, Terengganu [19].

2 BACKGROUND

It is well known that many students, worldwide, have difficulties in programming learning. These difficulties result in high dropout and failure rates in introductory programming courses [20]. Various reasons have already been mentioned in literature as causes to this problem. (Jenkins T, 2002) found that students often present a lack of abstraction capabilities and problem solving skills that are required for learning programming [21].

Students do face problems in connecting the knowledge they have learned into their practical work if no proper activities are given. Regarding to (Felder, R.M. and Silverman, L.K 1988), students learning can be by seeing and hearing; reflecting and acting; reasoning logically and intuitively; memorizing and visualizing and drawing analogies and building mathematical models; steadily and in fits and starts. Some instructors use a variety of teaching methods in their class. Some lecture, demonstrate or discuss; some focus on principles and others on application; some emphasize memory and others on understanding [22].

The introduction of interactive tools in the teaching of programming [23][24][25] as a first approach to languages, computer science, has shown an improvement in student performance and perception towards them. However it is difficult to find one suitable for all students' needs.

Confidence also plays a significant role in the successful outcome of students learning to program [26]. Confidence may be a key issue in successful learning outcomes, but is not in itself a reliable predictor of success. One of the major reasons for students to drop out of IT courses was found to be motivation. Much effort has gone into developing courses and tools which aim to motivate and captivate introductory programming students and make learning fun [27][28][11][29][30].

3 MOTIVATIONS FACTORS

Learning and motivation are highly complex facets of human behaviour. Relationships between motivating factors and learning have been a prominent research topic in the field of higher education. Regarding to (Kris M.Y. Law etl 2010), intrinsic factors include individual attitude and expectation and challenging goals. Meanwhile extrinsic factor may come from clear direction, reward and recognition, punishment and social pressure and competition. Factors such as rewards, working in teamwork and being involved in a new skill may motivate users to be better in programming.

Learning motivation and efficacy of students can be affected by environmental factors, such as the learning approach, infrastructure and social pressure from learning peers. Previous research found that learning motivation may come from intrinsic and extrinsic factors. Individual attitude and expectation and goals and emotions are included in intrinsic factors. Meanwhile extrinsic factor can be clear direction, reward and

recognition, punishment and social pressure and competition [31].

In this paper, issues in programming motivation are discussed. Student perceptions are surveyed and analyzed. Students also asked for their perception in this course which included together with six motivation factors. Students will not learn to new program if they are not interested or motivated. That is the reason why motivation is important in everyday life. Student must attach some sort of value to learn, and it is important that the teacher appreciates how the class is motivated and manages to tune in to their motivation.

Learning and motivation are highly complex facets of human behaviour. In the field of education, relationships between motivating factors and learning have been a prominent research topic. Motivation is believed to be an enabler for learning and academic success. In this research, a quantitative questionnaire was created to assess the components of motivational factors.

4 RESEARCH FRAMEWORK

Motivation is an abstract concept that is difficult to measure. It comprises of intrinsic and extrinsic motivational factors and they can be identified and measured. Research questions for this study can be separate into two parts, learning motivations and programming learning (RQ1, RQ2) and assessing students' expectations (RQ3, RQ4, RQ5, RQ6, RQ7). In second part, students also asked about their expectations towards programming course. This section is to know what is expected by student when they are taking programming course.

RQ1: Which factors play an important role in motivating student learning?

H_0: The identified factor is not a significant factor in motivating student learning

H_1: The identified factor is a significant factor in motivating student learning

RQ2: How strongly do the factors affect computer programming learning?

H_0: Students who value intrinsic factors more importantly show a higher level of efficacy.

H_1: Students who value extrinsic factors more importantly show a higher level of efficacy.

RQ 3: Gender and expectation that programming course can be more fun, user friendly and entertaining

H_0: The identified factor is not a significant expectation for computer programming learning

H_1: The identified factor is a significant expectation for computer programming learning

RQ 4: Gender and expectation that programming course can be easily programmed.

Ho: The identified factor is not a significant expectation for computer programming learning

H_1: The identified factor is a significant expectation for computer programming learning

RQ 5: Gender and expectation that programming course can bring them further on software programming development

Ho: The identified factor is not a significant expectation for computer programming learning

H_1: The identified factor is a significant expectation for computer programming learning

RQ 6: Gender and expectation that programming course can never involve them on writing using text or command.

Ho: The identified factor is not a significant expectation for computer programming learning

H_1: The identified factor is a significant expectation for computer programming learning

RQ 7: Gender and expectation that programming course can be implemented using interesting learning style.

Ho: The identified factor is not a significant expectation for computer programming learning

H_1: The identified factor is a significant expectation for computer programming learning

5 RESEARCH METHODOLOGY

5.1 Questionnaire Design

A questionnaire has been designed for this research. It contains questions on the background information such as gander, year of studies and faculty being studied, level of study and latest CGPA. It also contains questions regarding on programming acknowledgement, including types of programming language information. A section that includes five Likert-scale list has been added regarding programming perception.

To get the best results in this survey, the questionnaire was reviewed using a pilot study. It was distributed to Computer Programming students from engineering field. If any errors were found in the first version of questionnaire, amendments were done. The final questionnaire contains three sections including demographic information, programming background and programming perceptions.

The first section A contains 5 questions, section B contain four questions and section C contain sixth teen questions which was separate into subsection acceptance, motivation and expectation towards programming course. Students were asked with the questions regarding to programming acceptance. Five Likert scale questions (1=Strongly disagree, 5=Strongly agree) used to represent student's perception before and after programming class session start. Students also asked about their interested to learn programming course.

5.2 Data collection and validation

This study involves all students in TATiUC, who have taking Computer Programming subject. A set of questionnaire has been distributed to obtain the demographic profile and examine about programming background and respondents' perception toward this subject.

5.3 Interview session

Interview sessions have been implemented among two groups of students: high-performing and low-performing to find out the reasons for the motivations.

6 RESULTS AND DISCUSSION

The reliability and validity of the questionnaire was assessed and found to be a valid based on the examination done towards demographic data, programming background, programming perceptions and programming expectations. This paper discuss on the Issues on Programming Motivations among students. Students who involved in this research come from one of programming subject offered in this institution for this semester. 30 questionnaires were distributed to students who come from engineering faculty and have no skill in programming language. Tables 1 and 2 illustrate the percentage of demographic profile based on gender and year of studies.

Table 1: Summary of the demographic profile

Item	Category	Frequency	Percent	Percent
Gender	Male	18	60.0	60.0
	Female	12	40.0	100.0
Year	Year 1	2	6.7	6.7
	Year 2	25	83.3	90.0
	Year 3	2	6.7	96.7
	Year 4	1	3.3	100.0

Table 2: Result from the t-test

Factors	t-value	Sig (2-tailed)	Score	
			Mean	Std. Dev.
Individual attitude and expectation	3.540	0.001	2.67	1.093
Challenging goals	3.276	0.003	2.60	1.070
Clear direction	4.464	0.000	2.80	1.031
Reward and recognition	3.892	0.001	2.77	1.135
Punishment	4.464	0.000	2.80	1.031
Social pressure and competition	3.764	0.001	2.67	1.028

t-value= 1.96, df = 29

The result for demographic profile by the respondent comprises that 60.0% are male and 40.0% are female. The students are year-1 until year-4 groups. The result shows that, 6.7% are from year-1, 83.3% from year-2, 6.7% from year-3 and 3.3% from year-4. Computer Programming (BCT 1113) course for semester 2 was offered for engineering student which is come from one of engineering faculty, FTKEA.

Two research questions will focus on Learning Motivations and Programming learning as below:

RQ1: Which factors play an important role in motivating student learning?

To answer RQ1, a t-test is carried out to evaluate the strength of each factor's (positive) motivating effect on learning. From the t-table, the critical value at 95% confidence interval and the degree of freedom (df) of the data set is = 29 is 1.96. The t-value of each factor provides indication of its motivating effect on learning. If the t-value is greater than the critical value 1.96, we reject H_0. Otherwise, we do not reject H_0. The results of the t-test are summarized in Table 2.

It can be seen that both intrinsic and extrinsic factors, have strong positive motivating effect on learning. In particular, 'clear direction', 'punishment' and 'reward and recognition' have the greatest motivating effect. Meanwhile 'challenging goals' has the least. Among the three key motivating factors, 'clear direction' and 'punishment' from extrinsic factors have the same t-value = 4.464, and are the most recognized.

These two extrinsic factors become value added for student performance in learning programming. Assignments that are given to students with clear directions will help more understanding in fulfilling the requirements in the questions. Punishment factor also contributes to the motivation on learning programming. This factor may come from lecturer itself such as strictly mentioned about the date for submission and ask for marks deduction for every late submission. These two factors play an important role for motivating computer programming students.

RQ2: How strongly do the factors affect computer programming learning?

Table 3 Summary of the stepwise regression model.a,b

Model		R	R Square	Adjusted R Square	Std. Error of the Estimate
dimension0	1	.380[a]	.144	.114	.469

a. Predictors: (Constant), Individual attitude and expectation

b. Dependent Variable: Gender

Table 4 ANOVA table

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.038	1	1.038	4.719	.038[a]
	Residual	6.162	28	.220		
	Total	7.200	29			

a. Predictors: (Constant), Individual attitude and expectation

b. Dependent Variable: Gender

Table 5 Coefficients of the independent variables.

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
(Constant)	-.062	.229		-.269	.790
Individual attitude and expectation	.173	.080	.380	2.172	.038

a. Dependent Variable: Gender

Table 3 and 4 above summarizes of the stepwise regression. The output from Table 5 showed that only Individual attitude and expectation item from intrinsic factor has been entered into the regression equation, refer to 5, $F(1,28) = 4.719$, $p < 0.05$. The other five independent variables (Challenging goals, Clear direction, Reward and recognition, Punishment, Social pressure and competition) failed to meet the selection criteria, as indicated by the non-significant t-value ($p>0.05$). One of two factors in intrinsic factor significant and positive relationship, so H_0 can only be partially verified. Meanwhile all four factors in extrinsic factor are not significant.

It can be seen that both intrinsic and extrinsic factors, have strong positive motivating effect on learning. In particular, 'clear direction', 'punishment' and 'reward and recognition' have the greatest motivating effect. Meanwhile 'challenging goals' has the least. Among the three key motivating factors, 'clear direction' and 'punishment' from extrinsic factors have the same t-value = 4.464, and are the most recognized.

Five research questions focus on assessing student's expectations. Students were asked about

their expectations towards programming course. This section is to know about programming expectations among students. Most of the students (60%) expect that programming subject will be more fun, entertaining and user friendly. 50% of them expect that this subject will be implemented using interesting learning style. Expectation that these subject will easily programmed and will bring them further on software programming development got 36% for both factors.

RQ3: Gender and expectation that programming course can be more fun, user friendly and entertaining

From the Levene's test, the significant value is > 0.05, the two variances are not significantly different; that is, the two variances are approximately equal. T-value is 0.894, degree of freedom (df) is 28. There is not a significant difference between the two groups (the significance is greater than 0.05). Accept H_0. Therefore, we can say that there is not a significant difference between the Male and Female groups. Male and female had not significantly expected that programming course can be more fun, user friendly and entertaining.

RQ4: Gender and expectation that programming course can be easily programmed.

From the Levene's test, the significant value is > 0.05, the two variances are not significantly different; that is, the two variances are approximately equal. T-value is 0.450, degree of freedom (df) is 28. There is not a significant difference between the two groups (the significance is greater than 0.05). Accept H_0. Therefore, we can say that there is not a significant difference between the Male and Female groups. Male and female had not significantly expected that programming course can be easily programmed.

RQ5: Gender and expectation that programming course can bring them further on software programming development

From the Levene's test, the significant value is < 0.05, the two variances are significantly different; that is, the two variances are approximately not equal. T-value is -2.016, degree of freedom (df) is 27.450. There is not a significant difference between the two groups (the significance is greater than 0.05). Accept H_0. Therefore, we can say that there is not a significant difference between the Male and Female groups. Male and female had not significantly expected that programming course can bring them further on software programming development.

RQ6: Gender and expectation that programming course will never involve them on writing using text or command.

From the Levene's test, the significant value is < 0.05, the two variances are significantly different; that is, the two variances are approximately not equal. T-value is -1.062, degree of freedom (df) is 27.980. There is not a significant difference between the two groups (the significance is greater than 0.05). Accept H_0. Therefore, we can say that there is not a significant difference between the Male and Female groups. Male and female had not significantly expected that programming will never involved them on writing using text or command.

RQ7: Gender and expectation that programming course will be implemented using interesting learning style.

From the Levene's test, the significant value is > 0.05, the two variances are not significantly different; that is, the two variances are approximately equal. T-value is 1.497, degree of freedom (df) is 28. There is not a significant difference between the two groups (the significance is greater than 0.05). Accept H_0. Therefore, we can say that there is not a significant difference between the Male and Female groups. Male and female had not significantly expected that programming course can be implemented using interesting learning style.

An interview has been conducted with two groups of students: high-performing and low-performing to find out the reasons for the motivations. Results found that low-performing students do not interest to command based course. They do familiar with the graphical user interface which is can be clearly understand and generate the output. This group can clearly understand the flowcharting and

pseudo code chapter but cannot perform well in function. Do a program without directly using computer can be more difficult for them.

7 CONCLUSION

The results of this study show that the motivation factors may come from two intrinsic factors and four extrinsic factors. Individual attitude and expectation and challenging goals are the intrinsic factors. The extrinsic factors are clear direction, reward and recognition, punishment and social pressure and competition. All of these factors contributed on the motivations on programming course learning. Students should be motivated and encouraged to make sure that programming learning process can smoothly running and student can easily follow the instructions given by instructor. Instructors itself also need to have an initiatives to make programming course learning exciting and enjoyable.

What are the best methods to improve teaching programming for those low-motivated students? Most books on programming use pseudo-code and flowchart to emphasize their explanations. However, different other approaches have been proposed and evaluated. They include individual work, collaborative work, simulation tools, use of games, pair programming, role games, test-first approach, test-driven approach, read before write approach, CRC cards, visual programming, learning by doing, cloud programming, interactive learning model and special graphical environments. In the future work we will look at the effectiveness of the flowcharts and pseudo-code in learning programming.

REFERENCES

1. D. Teague, "A People-First Approach to Programming," *Education*, no. Ace, pp. 171-180, 2009.
2. J. Zhang, "An Adaptive Model Customized for Programming Learning in E-learning," *Power*, pp. 443-447, 2010.
3. R. Mason, G. Cooper, and M. D. Raadt, "Trends in Introductory Programming Courses in Australian Universities – Languages , Environments and Pedagogy," *Reproduction*, pp. 33-42.
4. J. H. Greyling, C. B. Cilliers, and A. P. Calitz, "B #: The Development and Assessment of an Iconic Programming Tool for Novice Programmers," *Current*, 2006.
5. D. Lučanin and I. Fabek, "A Visual Programming Language for Drawing and Executing Flowcharts," *Architecture*, pp. 1679-1684, 2011.
6. S. Garner, "Learning to Program from Scratch," *2009 Ninth IEEE International Conference on Advanced Learning Technologies*, pp. 451-452, Jul. 2009.
7. L.-C. Wang and M.-P. Chen, "Learning Programming Concepts through Game Design: A PCT Perspective," *2010 Third IEEE International Conference on Digital Game and Intelligent Toy Enhanced Learning*, pp. 219-221, Apr. 2010.
8. R. Ibrahim, "Students Perceptions of Using Educational Games to Learn Introductory Programming," *Science*, vol. 4, no. 1, pp. 205-216, 2011.
9. P. Sancho-Thomas, R. Fuentes-Fernández, and B. Fernández-Manjón, "Learning teamwork skills in university programming courses," *Computers & Education*, vol. 53, no. 2, pp. 517-531, Sep. 2009.
10. G. Bucks and W. Oakes, "Work in Progress - Using Graphical Programming Languages in the Introductory Programming Course," *Education*, pp. 1-2.
11. Y. Lijie, X. Liwen, and G. Wenrong, "Teaching Web Technology by Learning-by-Doing," *2009 Second International Conference on Education Technology and Training*, pp. 19-21, Dec. 2009.
12. S. L. Salcedo and A. M. O. Idrobo, "New tools and methodologies for programming languages learning using the scribbler robot and Alice," *2011 Frontiers in Education Conference (FIE)*, p. F4G-1-F4G-6, Oct. 2011.
13. Á. Santos, A. Gomes, and A. J. Mendes, "Integrating New Technologies and Existing Tools to Promote Programming Learning," *Algorithms*, vol. 3, no. 2, pp. 183-196, Apr. 2010.
14. J. Ramasamy, S. Valloo, J. Malathy, and P. Nadan, "Effectiveness of Blog for Programming Course in Supporting Engineering Students," *Evolution*, pp. 1347-1350, 2010.
15. M. Muratet, P. Torguet, J.-pierre Jessel, and F. Viallet, "Towards a Serious Game to Help Students Learn Computer Programming," *Teacher*, vol. 2009, 2009.
16. R. Ibrahim, "Using Educational Games in Learning Introductory Programming : A Pilot Study on Students ' Perceptions," *Online*, no. form 4, 2010.
17. A. I. Wang and B. Wu, "An Application of a Game Development Framework in Higher Education," *International Journal of Computer Games Technology*, vol. 2009, pp. 1-12, 2009.
18. Y. Roslina, I., & Nazli, "Development and effectiveness of educational games for learning introductory programming.," 2009.
19. "http://www.tatiuc.edu.my." .
20. J. Bennedsen and M. E. Caspersen, "Failure Rates in Introductory Programming," *Computer Science Education*, no. ACM 2007, 2007.
21. T. Jenkins, ""On the difficulty of learning to program"," *Proceedings of the 3rd Annual LTSN for*

Information and Computer Science Conference. Loughborough, UK. pp. 53-58., 2002.
22. C. Bonilla, S. M. Lord, and L. A. Perry, "Promoting Understanding in the Classroom : Comparison of the Strength Deployment Inventory , Learning Styles Inventory , and Myers-Briggs," *Education*, pp. 5-10, 2008.
23. I. Paliokas, C. Arapidis, and M. Mpimpitsos, "PlayLOGO 3D: A 3D Interactive Video Game for Early Programming Education: Let LOGO Be a Game," *2011 Third International Conference on Games and Virtual Worlds for Serious Applications*, pp. 24-31, May 2011.
24. A. Garmpis, "Design and Development of a Web-based Interactive Software Tool for Teaching Operating Systems," *Journal of Information Technology Education*, vol. 10, 2011.
25. P. Benachour and R. Edwards, "Animation and Interactive Programming: A Practical Approach," *Electronic Notes in Theoretical Computer Science*, vol. 224, pp. 133-140, Jan. 2009.
26. G. Gonzalez, "A Systematic Approach to Active and Cooperative Learning in CS1 and its effects on CS2," *SIGCSE 2006 Technical Symposium on Computer Science Education. Houston, Texas,USA*, 2006.
27. M. Eagle and T. Barnes, "Evaluation of a game-based lab assignment," *Proceedings of the 4th International Conference on Foundations of Digital Games - FDG '09*, p. 64, 2009.
28. C. Hillyard, U. Washington, R. Angotti, M. Panitz, J. Nordlinger, and D. Goldstein, "Game-Themed Programming Assignments For Faculty : A Case Study," *Assessment*, pp. 270-274, 2010.
29. M. Carbonaro, D. Szafron, M. Cutumisu, and J. Schaeffer, "Computer-game construction: A gender-neutral attractor to Computing Science," *Computers & Education*, vol. 55, no. 3, pp. 1098-1111, Nov. 2010.
30. C. Education, "Blog Interface Producing mechanism in e-Leaming Platform," *Evaluation*, pp. 1544-1548, 2010.
31. K. M. Y. Law, V. C. S. Lee, and Y. T. Yu, "Learning motivation in e-learning facilitated computer programming courses," *Computers & Education*, vol. 55, no. 1, pp. 218-228, Aug. 2010.

Appendix A: Summary of questionnaires

SECTION	QUESTIONS	SCALE
A	RESPONDENT'S PROFILE	Nominal Scale
	~ 5 questions	
B	PROGRAMMING BACKGROUND	Nominal Scale
	~ 4 questions	
C	PROGRAMMING PERCEPTIONS	Interval / Rating Scale
	a) Programming Acceptance	
	~ 4 questions	
	b) Programming Motivation	
	~ 7 questions	
	c) Programming Expectations	
	~ 5 questions	