Analysis of Students’ Feedback on C++ Programming Assessment Using an Online Survey

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Abstract:
Educational data mining can be used in mining student’s opinion for the enhancement of learning outcomes, instruction and learning effectiveness. Based on these reasons, this study investigated the opinions of 146 first-year student of School of Computing, Universiti Teknologi Malaysia on learning C++ programming based on skilled-based test using an online survey. The study will also investigate some issues on the zero-score awarded to students for unsuccessfully compiled program for the skilled-based. An online survey was used to collect student opinions as data because it is simple, subject-based and easy access to the students with the help of WhatsApp groups commonly used by the students for social interaction among them and their course lecturers. The result of mining students’ opinions on learning C++ programming shows that both skill-based test 1 and 2 is found to be difficult or complicated. Students’ emotions on both skill-based test 1 and 2 is found to be scary. In terms of performance, the result is slightly different with respect to program compilation. The number of students with successfully compiled programs regarding skill-based test 1 is higher than those with otherwise. So also, the number of students with successfully compiled program regarding skill-based test 2 is higher than those with uncompiled program. In both cases, the percentage pass is greater than 50% and failure is lower than 37%. The overall result shows that Skill-based test is difficult and it, therefore, gives scary emotions to the first-year undergraduate students of School of Computing, Universiti Teknologi Malaysia.

Keywords: Analysis, student feedback, C++ programming, skilled-based test, assessment, online survey

1. Introduction
Nowadays, higher institutions collect student opinions at the end of every class or examination in order to assess course content, method of teaching, special skill for the effectiveness of the learning process. The data collection is mostly done through the institution’s survey. These surveys are characterized as tedious, wide in scope and time-consuming. Hence there is a need for simple, subject-based and comprehensive (Hanan (2019). The author also expressed the significance of educational data mining in the enhancement of learning outcomes, instruction and learning effectiveness. Based on these reasons, this study intended to investigate the opinions of the first-year student of School of Computing, Universiti Teknologi Malaysia on learning C++ programming. Enderson et al., (2014) used first-year engineering courses based on student feedback with the aim of producing a framework that will ease the analysis of the workload of first-year engineering student due to the difficulty and time consumption in the manual analysis of the data from online surveys. However, the scope of the research is wide in scope and not specific in the subject area. For example, programming assessment of a course. In my own opinion, specific issues on a course may not be captured in the survey late alone to be addressed. Therefore, an online survey is needed for computational analysis.

1.1. Problem Background
Universiti Teknologi Malaysia, School of Computing offered programming courses such as programming technique I (SCSJ1013) and programming technique II (SCSJ1023) for the first-year students. The courses provide students with both practical and theoretical knowledge of C++ programming in topics like C++ concepts, association, aggregation and composition. Students from various discipline in the School of Computing register for these courses as part of the
requirement for the award of Bachelor of Computer Science, Software engineering and information Security. The students’ performance is measured practically using a skill-based test I and II as programming technique I and II respectively; it lasts for 1 hour 45 minutes. The criteria of awarding zero score for students with unsuccessful program are an issue in focus. The School of Computing uses student evaluation of teachers (SET) as an online survey to assess teacher, course content and assessment and teaching methodology of a course. However, the survey is tedious, time-consuming and uniform for all courses and, students’ responses not justifiable due teacher-student relationship. The research output will assist the School of Computing in decision making on programming assessment and also a knowledge contribution to the literature.

1.2. Problem Definition

The main problem to be addressed by this study is to analyse students’ opinion on learning C++ programming. This includes the course content, assessment and teaching methods adopted by the School of Computing, UTM. The study will investigate impact of zero-score policy- awarding zero mark for students with unsuccessfully compiled C++ program during skill-based test 1 and 2.

2. Review on Learning C++ Programming

According to Renzella et al, (2018) Since the introduction of computer programming in institutions, learning programming was very difficult to beginners. Since then the challenges in learning programming language as well as the teaching methodologies have been studied. These methodologies range from complexity related to tool support, educational module, teaching method, and language structure (Pears et al, 2018). In connection to methodology support, there are difficulties with many programming tools as they were initially created for expert or software engineers (Renzella et al., 2019). In this specific situation, the variety of choices given to experts overpower students for whom even the fundamentals of the language become an issue. This shows that there is a need for sufficient literature on student attitudes towards learning programming.

Notwithstanding the difficulties of learning, programming depends on the Language structure and comprehending how programs are executed. A lot of students at first-year finds it difficult to write and execute the program, this is due to the fact that every programming language has its own syntax, semantics and development tool (compiler and editor). Some languages like Java, C and C++ have some syntaxes in common and are an advancement over another. Lack of Background knowledge about one program can affect learning another (Rozali and Zaid, 2017). The student needs to become familiar with an unbending syntax structure and flexible commands that may have apparently subjective or maybe contradictory names.

Programming languages usually can be executed in many compilers (Jones, 2009). Some of these compilers are designed for the professional programmers which may be difficult to use by a beginner. Programming compilers are not an error-free during coding and some languages like Java, C++ is very case sensitive, and the best way a beginner can understand programming easily is to be instructed practically using tools that can detect and alert the user whenever an error occurs. For example, anacoda for python programming (Pears et al, 2018).

Yang, Tsai, and Ho (2013) conducted research on course assessment on C++ programming. The study aimed at improving learning, student performance and interest to study programming. The issue with the study is that the assessment of the course defends two measurements; the results obtained through competence inventory tests and programming qualify examination but the author concludes on the result from the programming qualify examination with a pass accuracy of 85%. And the data collection is multiple from four sources not centralized on the student. Hence, there is a need for a study that focused on the student as the target respondent in the assessment of C++ programming.

In a study by Medhat et al., (2014) Learning programming challenges range from a student not having interest in programming, fear of conducting Skill-based test over the written one, difficulty of the test with respect to the time given, environment motivation on learning programming, complexity of the of programming language syntax (e.g. C++), development tools (for example Dev C++) and method of teaching.

2.1. Skill-Based Test

Smee (2003) conducted research on skill-based assessment of ABC learning and teaching medicine. And he defined skill based test as a method developed in order to evaluate the level of competency of a person based on knowledge and skills in a given domain. The author had also mentioned that oral examination (VIVA) is a traditional method of assessing a student’s skill and is always focused on one specific area of study. Smee (2003) conclude that skill-based specifically the oral examination does not substitute knowledge-based tests, but evaluate competency elements that the knowledge-based tests can’t be assessed. This implies that there is a need for a computer-based test to assess student skills.

In another study on computer-based versus paper-based examination; perception from the teachers concludes that teachers have positive attitudes towards skill-based tests but they prefer paper-based test. The study had further discovered that teachers with computer-based examination training experiences or certified in computer science are more positive towards skill-based tests Jamil et al., (2012). The conclusion made by the author after conducting all the relevant research papers shows that there is no enough research on computer-based test examination from a student perspective. Electronic testing systems have reduced teachers ’ stress and encouraged the purposeful conduct of exams. Computer-based assessments can be used by assessing a variety of skills, knowledge and understanding to facilitate more successful training. It is possible to access and handle data and to maintain and improve communication skills online, which cannot be assessed in the regulations (Jamil et al., 2012).
According to the report compiled by Thurlow et al., (2010) on computer-based testing and practices, computer-based test (CBT) is praised as a solution to cheaper and faster test delivery for states in the United States and its district-wide assessments. The author also concluded that there is a danger that the use of software (CBT) may lead to tests that are not available to some disabled students and that do not assess student performance in a reasonable manner.

According to Lassen & Brown (2010) as reported by Jamil et al., (2012), Computer-based examinations can be used by testing a range of skills, knowledge and understanding to promote more effective learning. Online evaluation is possible to access and manage information and to manage and develop communication skills that cannot be evaluated in regular essay-based examinations. The Skill-based tests were conducted by the School of Computing on programming technique I and II. The details criteria for the conducts and assessment are shown in Table 1.

2.2. Programming Assessment in School of Computing UTM

Learning programming is a core course for the first-year student of Computer Science Department at School of Computing UTM. The students are from five (5) programme of study namely; Bioinformatics, Software Engineering, Computer Network and Security, Graphics and Multi-Media Software and Data Engineering. Students are expected to register the courses programming technique I and programming technique II during their first year, object-oriented programming and data structure in the second year, programming technique III and web programming in the third year. The programming skill is very crucial and compulsory for the student to develop their final year project and most important of all to provide exposure in programming for them to prepare for their industrial training and working career with confident and good skill. Therefore, this research intends to do analysis of their opinions while they are still in the first year. This analysis may help the lecturer to improve their teaching style, their teaching approach and assessment in order to motivate them to like programming. The courses assessments are conducted using a Skill-based test as described in Section 1.2 of this study. The assessment criteria for the programming technique is shown in Table 1.

| Continuous Assessment | PLO | Percentage |
|-----------------------|-----|------------|
| Assignments (2)       | AP  | 10         |
| Lab Exercises (4)     | KW  | 10         |
| Skill-Based Tests (2) | AP  | 10         |
| Mid Term Test         | KW  | 15         |
| Group Project (Outcome)| AP  | 10         |
| Group Project (Progress)| TW  | 5          |
| Peer and Self Assessments (3) | TW  | 3          |
| Project Demo (Individual) | TW  | 2          |
| Final Assessment      |     |            |
| Final Exam (Theory)   | KW  | 15         |
| Final Exam (Practical)| AP  | 20         |
| Grand Total SLT       |     |            |

*Table 1: Programming Technique Assessment Criteria School of Computing, UTM*

3. Methodology

This refers to the data collection procedure for the analysis of student opinion on learning C++ programming. The data was collected via an online survey. The survey was formed based on C++ programming contents and Skill-based test conducted by the School of Computing, UTM. It consists of the following questions:

- Program compiles or not compile. If not compile why? student score = 0
- Difficulty or Simplicity of skill-based test.
- Time accuracy
- Skill-based test scary or Motivational
- Internet Speed (good or bad),
- Questions relevant or irrelevant to the content of the skill-based test.

Figure 1 shows the process followed in order to obtain the data. It can be seen that the survey was initially created and distributed to the students in nine Sections. The Sections are the Nine (9) WhatsApp groups created for the students to respond to the survey. The Sections represent the first-year students of the School of Computing lecture/practical grouping. Finally, the responses were analyzed by the online survey. The online survey sample is shown in Appendix A.
4. Result Analysis: Online Survey

The online survey result analysis is the graphical representation of the data collected from 146 first-year students of the School of Computing, Universiti Teknologi Malaysia 2018/2019 session. The results include the student's demography and the survey as shown in bar and pie charts.

| S/N | Attributes       | Description                                                                 |
|-----|------------------|-----------------------------------------------------------------------------|
| 1   | Gender           | The student is either Male or Female                                         |
| 2   | Age              | Student age                                                                 |
| 3   | Course           | Student programme of study-SCSB/SCSJ/SCSP/SCSR/SCSV                        |
| 4   | Section          | Grouping of students for lecture and practical (i.e., 0-9)                  |
| 5   | Compile          | The student C++ program is executed successfully by the Dev compiler. Otherwise not compile and score=0 |
| 6   | Time accuracy    | Is the student satisfied with the time given to complete the Skill-base test 1 and 2? (Appropriate/Not appropriate) |
| 7   | Internet Speed   | The strength of the network to submit the skill-based test. Bad or Good     |

Table 2: Description of Attributes for the Survey

Figure 1: The Students’ Course of Study

Figure 1 is a pie chart showing that the survey was responded by 146 students from five courses namely: SCSB with 13.7% -20 students, SCSJ with 43.2% -63 students, SCSP with 21.2%-31 students, SCSR with 20.5%-31 students and SCSV with 1.4%-2 students.

Figure 2: The Students’ Course of Study

Figure 2 indicates that there are 10 Sections namely. Section 1 with 15.1%-22 students. Section 2 has 19 students represented by 13%. Section 3 is represented by 14.4% with 21 students. Section 4 has 17 students according to 11.6% of the respondents. Section 5 has 10 students according to 6.8%.
Figure 2: Students’ Gender

Figure 3 shows that both genders (female and male) responded to the survey. The number of female students is 63 according to 47.3% of the total respondent. The male students are 77 with 52.7%.

Figure 4: Students’ Age

Figure 4 shows that 143 responded out of 146 revealed their ages on the survey. There is only 1 student within below 18 represented by 0.7%. Student at the age of 18 is 10 according to 7% 143 respondents. There are 13 students at the age of 19 represented by 9.1 %. Student at the age of 20 is 49 in number having the highest population of the total respondent. There are 34 students under the age of 21 according to the percentage of 23.8. Student at the age of 23, 24, 41 and above have their corresponding numbers of 1, 3, 1 and 1 as represented by 0.7%, 2.1%, 0.7% and 0.7% respectively.

Figure 5 shows that most of the student (110 of them) find skill-based test 1 to be difficult according to the 75.3% while only 36 of the respondents find skill-based test 1 to be simple as indicated in the chart with 24.7%.

Figure 5: Students’ Opinion on Skill-based Test 1

Figure 6: Students’ Opinion on Skill-based Test 1
Figure 6 indicated that 132 students out of 146 consider skill-based test 2 to be complicated according to the chart with 90.4%. Only 14 students consider the skill-based test 2 to be easy as represented by 9.6%.

Figure 7: Student’s Emotion on Skill-Based Test 1

Figure 7 shows that 65.19% of the students (i.e., 95 students) find skill-based test 1 to be scary while 34.9% (i.e., 51 students) consider it to be motivational. This implies a negative sentiment on skill-based 1.

Figure 3: Students’ Emotion on Skilled-based Test 2

Figure 8 shows that 95 students represented by 65.1% consider Skill-based test 2 to be scary while 51 students represented by 34.9% found it to be encouraging.

Figure 4: Students Program Status on Skilled-based Test 1

Figure 9 shows that 93 students’ programs compiled successfully while 53 students’ program did not compile successfully as represented by 63.7% and 36.3 % respectively.

Figure 5: Student’s Program Status on

Figure 10 shows that 101 students represented by 69.2% had their program successfully compiled. The students with the unsuccessfully compiled program are 45 and represented by 30.8 %.

5. Discussions and Conclusion

The results obtained from the online survey analysis (See Figure 1-9) indicated that the general opinion of the students on learning C++ programming seems to be difficult based on analysis of their responses on both skill-based test 1
and 2. This is justifiable by the responses of 110 students (75.53%) for skill-based test 1 and 132 students represented by 90.4% for skill-based test 2 (Refer to Figure 5 and 6). The students’ emotions on skill-based test 1 and 2 is scary according to 95 students (both) represented by 65.19% and 65.1% respectively (see in Figure 7 and 8). It can be observed that the result (See in Figure 9 and 10) is slightly different with respect to program compilation. 93 students (63.7%) from skill-based test 1 had their program successfully compiled and 101 students (69.2%) from Skill-based test 2 had their program successfully compiled. The overall result shows that Skill-based test is difficult and it, therefore, gives scary emotions to the first-year undergraduate students of School of Computing, Universiti Teknologi Malaysia. This is attributed to the high concentration of the students towards getting their programs successfully compiled. Awarding zero score for unsuccessfully compiled program affects students’ emotions and it therefore discourage them to learn C++ programming. Hence, the rule should not be considered. On the other hand, the result of the student on successfully compiled program shows that Skill based according to 95 students 90.4% for skilled and 2. This is justifiable by the responses of 110 students (75.53%) for skill-based test 1 and 132 students represented by 90.4% for skill-based test 2 (Refer to Figure 5 and 6). The students’ emotions on skill-based test 1 and 2 is scary according to 95 students (both) represented by 65.19% and 65.1% respectively (see in Figure 7 and 8). It can be observed that the result (See in Figure 9 and 10) is slightly different with respect to program compilation. 93 students (63.7%) from skill-based test 1 had their program successfully compiled and 101 students (69.2%) from Skill-based test 2 had their program successfully compiled. The overall result shows that Skill-based test is difficult and it, therefore, gives scary emotions to the first-year undergraduate students of School of Computing, Universiti Teknologi Malaysia. This is attributed to the high concentration of the students towards getting their programs successfully compiled. Awarding zero score for unsuccessfully compiled program affects students’ emotions and it therefore discourage them to learn C++ programming. Hence, the rule should not be considered. On the other hand, the result of the student on successfully compiled programs indicates that the efficiency of the skill-based test in programming assessment of the student is good.

6. References

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Appendix

**Online Survey Sample**

| Skill-based test1 Survey (Programming Technique I-SCSJ1013) |
|-------------------------------------------------------------|
| This study is intended to find out student’s opinion on Skill-based test1 ( C++ class concept) for Sentiment analysis. Your response is very important. It would be used only for academic purpose. I am hereby seeking your assistance for the successful completion of my master thesis. The questions cover two Sections; demography and survey. |
| * Required |

- **Course:** *SCSB [ ] SCSJ [ ] SCSP [ ] SCSR [ ] SCSV [ ]*
- **Section:** *---------*
- **Gender:** *Female [ ] Male [ ]*
- **Age:** *---------*
- **Q1:** How did you find the skilled-based test 1? * Difficult [ ] Simple [ ]
- **Q2:** Rate the time accuracy for the Skill-based test1 *
  - Appropriate [ ] Inappropriate [ ]
- **Q3:** The internet speed used for submitting program is? * Good [ ] Bad [ ]
- **Q4:** What is the status of the program you have submitted? *
  - Successfully compiled [ ] Unsuccessfully compiled [ ]
- **Q5:** If your program did not compile, what is the reason? *
  - Insufficient Knowledge of C++/programming skill [ ] Lack of practice [ ]
- **Q6:** What is your emotion on Skill-based test1? * Scary [ ] Motivational [ ]
- **Q7:** Is the Skill-based test1 questions’ relevant to C++ class concept? *
  - Relevant [ ] Irrelevant [ ]

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## Appendix E  First-year Undergraduate Student’s Syllabus SC, UTM

| School/Faculty: | Computing/Engineering |
|-----------------|-----------------------|
| Program name:   | Bachelor of Computer Science (Bioinformatics) |
|                 | Bachelor of Computer Science (Software Engineering) |
|                 | Bachelor of Computer Science (Computer Network and Security) |
|                 | Bachelor of Computer Science (Graphics and Multimedia Software) |
|                 | Bachelor of Computer Science (Data Engineering) |

| Course code:    | SCSJ1023 |
|-----------------|----------|
| Academic Session/Semester: | 2018/19/2 |

| Course name: | Programming Technique II |
|-------------|--------------------------|
| Credit hours: | 3 |

| Pre/co requisite (course name and code, if applicable): | SCSJ1013 Programming Technique I |

### Course Synopsis

This course presents the concept of object orientation and object-oriented programming (OOP) techniques using the C++ programming language. It equips the students with the theory and practice on problem solving techniques using the object-oriented approach. It emphasizes on the implementation of the OOP concepts including encapsulations, associations and inheritance. At the end of this course, students should be able to apply the OOP techniques to solve problems.

### Course coordinator (if applicable)

Lizawati bt Mi Yusuf

### Course lecturer(s)

| Name                           | Section | Office   | Contact no. | E-mail (@utm.my) |
|--------------------------------|---------|----------|-------------|------------------|
| Pn Lizawati bt Mi Yusuf        | 1 and 8 | N28-438(03) | 32095       | lizawati         |
| Dr Ajune Wanis bte Ismail      | 2 and 10|          |             | ajune            |
| Dr Shafaatunnur bte Hasan      | 3       |          |             | shafaatunnur     |
| Dr Norbahiah bte Hj Ahmad      | 4 and 6 |          |             | bahiah           |
| Dr Mohamad Ashari bin Hj. Alias| 5 and 7 | N28A-05-13-01 | 38811   | ashari           |
| Dr Syed Zainudeen bin Mohd. Shaid| 9 | N28A-5-11 | 38809       | szainudeen       |