Investigation on designing a fun and interactive learning approach for Database Programming subject according to students’ preferences

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Abstract. Industrial Revolution 4.0 and Internet of Things are two important area which requires development of computational system. To allow this to become reality, students in most higher education institution were taught with programming and database as their fundamental subjects that can be related to develop computational systems and automation concept. For better efficiency, PL/SQL was also being taught but only in a certain higher education institution. In previous years, to attract students being active in learning PL/SQL, we have developed an offline game covering the topic of stored procedure and trigger. To enhance the enjoyable of learning this subject among the students, a survey has been conducted among undergraduate students of the Faculty of Communication and Technology (FICT) in Universiti Teknikal Malaysia Melaka. This survey involved 33 junior students and 12 senior students of Computer Science majoring in Database Management. The results show that students have preferences on a game that include socializing elements such as interaction among themselves, testing their thinking ability with some challenging task and expected elements but should not put pressure on time management.

1. Introduction
Industrial Revolution 4.0 and Internet of Things has become a current yet important area which requires development of computational system. To allow this to become reality, students in most higher education institution were taught with programming and database as their fundamental subjects that can be related to develop computational systems and automation concept.

In reality, only few students who set the programming as a vital skill in demand by industry [1]. Meanwhile, most of the students as according to the study by [2], programming courses are generally regarded as difficult, and often have the highest dropout rates. For the purposes of this study, [1, 2, 3, 4, 5, 6, 7, 8] were researchers who investigate on teaching and learning programming to help students to become better in learning programming.

[4] performed a survey to rank programming concepts in order of difficulty, from students and lectures’ point of view. Meanwhile, [2] identified several significant trends, focusing on novice programmers, exploring their capabilities and typical problems, their characteristic behaviours, and also factors relating to course design and teaching. [2] also propose a framework which
makes explicit some of the relationships between important topics explored in the literature, and highlight the significance of the distinction between effective and ineffective novices, in particular focusing on the strategies that they employ.

Meanwhile, research by[5] focused on programing coursework consisting programming assignments that need to be assessed from different points of view. [5] figured that the submitted assignments are executable programs with a formal structure, thus, some features can be assessed automatically. By recognizing automatically assessable features can help teachers to create educational models, where automatic tools let teachers concentrate their work on the learning issues that need student-teacher interaction the most.

Furthermore, [7] performed a comprehensive survey of environments developed to support the learning of problem solving and programming follows, covering programming environments, debugging aids, intelligent tutoring systems, and intelligent programming environments.

Despite that programming is a tough subject, universities must keep on developing their education in order to be able to provide the skills and fundamental knowledge base that society expects[3]. Here, in our faculty, for better efficiency, PL/SQL was being taught but students who wish to enrol this subject, the prerequisite subjects database and programming were required to pass.

Inspired with Aristotle’s statement, as lecturers, we believed that as a student, ”one must learn by doing the thing, for though you think you know it, you have no certainty until you try”[9]. Thus, the more that students became active partners in the learning process, the more they took ownership of the course and of their learning[13]. This approach is named as Active Learning[9, 12, 13] and was defined as any instructional method that engages students in the learning process[12] which requires students to do meaningful learning activities and think about what they are doing.

In previous years, to attract students being active in learning PL/SQL, an offline game for the subject Database Programming have developed covering the topic of stored procedure and trigger. For improvement, this study investigate on designing a fun and interactive learning approach for Database Programming subject according to students’ preferences.

This paper is organized as folows. Section 2 provides the background of the Procedural Language SQL. Section 3 describe the methodology in conducting the survey while Section 4 discuss the survey results. We draw our conclusion in Sectoin 5.

2. Procedural Language SQL

Structured Query Language (SQL) is a special-purpose programming language designed for managing data in relational database management systems (RDBMS) [14], and has been used in relation to support managerial decisions making[15]. Meanwhile, the purpose of Procedural Language for SQL (PL/SQL) is to combine database language and procedural programming language[14] thus students who wish to learn this PL/SQL should have knowledge in database and programming.

PL/SQL is a standard data access language for Oracle relational databases that offers features like data encapsulation, exception handling, information hiding, and object orientation[18]. PL/SQL[17, 18, 19] has several benefits such as 1) gives high productivity to programmers as it can query, transform, and update data in a database; 2) saves time on design and debugging by strong features, such as exception handling, encapsulation, data hiding, and object-oriented data types and 3) applications written in PL/SQL are fully portable. Interestingly, PL/SQL is consistently in the top 20 of this common programming language ranking[18].

In our finding, research focus more on programming [5, 3, 4, 2, 6, 7, 8]. Meanwhile, for learning database programming there were only few research has done study in [14, 15, 16] while the rest were normally text books[17, 18, 19] which student can refer any time.

[14] developed a code generator named as SQL-PL4OCL which enables the mapping from
begin
open Feds_cur;

--get info about year
select extract(year from sysdate)
into v_year from dual;

Loop
fetch Feds_cur into v_jumgaji, v_jumpend, v_state;
exit when Feds_cur%notfound;

--get info state from table Federal
select count(state)
into v_checkstate
from federal
where state = v_state;

-- check if state in table Federal is same as
-- state from table Negeri
if v_checkstate > 0 then
update Federal
set total_S = v_jumgaji, total_R = v_jumpend
where state = v_state;
end if;
end loop;
close Feds_cur;
end;
/

Figure 1. A Sample Code of PL/SQL

OCL iterator expressions to iterative stored procedures remains the same. [15] introduced the concept of JDBC-ODBC bridge for MS-access database, which is believed to be an useful concept for understanding and teaching the database programming. Meanwhile [16] describes Sakila, a well-designed and highly available semi-realistic database provided by MySQL, to support instructions and multiple assignments in a graduate database course. Despite that [14, 15, 16] has its own contribution for database, but their purposed was not used for active learning in the classroom. Thus, this give us idea to improve our offline database programming game to be suitable for active learning in classroom.

2.1. Sample coding using PL/SQL
Despite that PL/SQL is not growing language, but it has it’s advantages in giving high-performance batch processing for those who use Oracle as their database system. The benefits of PL/SQL [17, 18, 19] allows sending an entire block of statements to the database at one time, as shown in Figure1. This reduces network traffic and provides high performance for the applications, thus PL/SQL gives high productivity to programmers as it can query, transform, and update data in a database.
Table 1. List of Survey Questions

| Question Code | Question Description |
|---------------|----------------------|
| Q1            | I prefer the game to test my memory capability. |
| Q2            | I prefer the game to test my maths capability. |
| Q3            | I prefer the game to test my logic capability. |
| Q4            | I prefer the game to test my literacy capability. |
| Q5            | I prefer the game to test my previous knowledge. |
| Q6            | I prefer the game to be related with industrial revolution 4.0. |
| Q7            | I prefer the game to be with a group. |
| Q8            | I prefer the game to have an expected elements. |
| Q9            | I prefer the coding game allows me to compile the code in my head. |
| Q10           | I prefer the coding game allows me to foresee any mistake or error while compiling in my head. |
| Q11           | I prefer the coding game to challenge my ability of thinking. |
| Q12           | I prefer the coding game has social elements. |
| Q13           | I prefer the coding game that everyone has their own role in playing the game. |
| Q14           | I prefer the coding game allow me to contribute on how to improve the game become better. |
| Q15           | I prefer the coding game allow me to contribute in helping friends to be able to answer the game together. |
| Q16           | I prefer the coding game has a period of time so that i will manage to answer faster. |
| Q17           | I prefer the coding game is related with other subjects. |

3. Method
In previous years, in order to make the students being active while learning database programming, an offline game had been developed, covering the topic of stored procedure and trigger. With the intention to improve the teaching and learning process, a survey has been conducted in order to seek students’ preferences in improving the designation database programming game in future. This survey was conducted among undergraduate students of the Faculty of Communication and Technology (FICT) in Universiti Teknikal Malaysia Melaka.

In designing a good survey instruments, some guideline survey in [10, 11] were referred. Table 1 is a list of survey questions being used in our survey and the survey was written using the google form. Since Database Programming is a subject only taught to students who were in majoring Database Management, therefore, our survey were distributed among the undergraduate students who enrolled this subject for this semester. This survey involved 33 junior students and 12 senior students of Computer Science majoring in Database Management. From total of 45 students, there were 20 male students and 25 female students.

4. Results and Discussions
With the intention to improve our previous learning game for our future students, a survey among the computer science majoring in database management has been conducted. Likert-type rating scale has been used to measure student’s preferences in designing a better learning approach yet enjoyable for the subject of Database Programming. Likert scales according to [20] stated that it has been commonly used to measure attitude, providing a range of responses to a
Typically, there are 5 categories of response, from (for example) 1 representing strongly disagree to 5 representing strongly agree.

The results of the survey has been shown in Table 2. The exact questions can be refer in Table 1 and results of survey were displayed in order of the combination Likert scale 4 and 5 representing students’ agreement on the question being asked. Through the results of this survey shown in Table 2, 40 respondent positively agree when being asked if they prefer the game to be within group. This can be intrepreted that students prefer social game rather than individual game.

The following questions were related on students preferences in testing their logic thinking and letting them to contribute on improving better game with expected elements. This 3 questions manage to get a total of 39 respondent with positive agreement and can be intrepreted that students wanted game than can test their logic thinking, allow them to be useful in contributing something better and have expected elements for them to achieve the target. The following questions that student prefer is a game that allow them to help their friends while playing, followed by games that test their memory and thinking ability. Students also prefer each of member have a role to play and wish the game can be related to Industrial Revolution 4.0. Meanwhile, the last element that student prefer is games that had to make the think and play within a period of time. Despite that time management is a normal level to setup challenges while playing game, but for this study, we intrepret that student does not like to be put under pressure.

Table 2. Results Survey on Investigation Designation Database Programming Subject According to Students’ Preferences

| Question Code | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---------------|-------------------|----------|---------|-------|----------------|
| Q7            | 2                 | 1        | 2       | 9     | 31             |
| Q3            | 0                 | 0        | 6       | 16    | 23             |
| Q8            | 0                 | 1        | 5       | 24    | 15             |
| Q14           | 1                 | 2        | 3       | 26    | 13             |
| Q15           | 1                 | 0        | 6       | 20    | 18             |
| Q1            | 2                 | 1        | 6       | 19    | 17             |
| Q11           | 1                 | 2        | 7       | 18    | 17             |
| Q13           | 2                 | 0        | 9       | 16    | 18             |
| Q6            | 1                 | 1        | 9       | 13    | 21             |
| Q2            | 3                 | 0        | 9       | 16    | 17             |
| Q12           | 3                 | 3        | 7       | 17    | 15             |
| Q10           | 2                 | 1        | 11      | 19    | 12             |
| Q5            | 1                 | 6        | 9       | 14    | 15             |
| Q4            | 1                 | 1        | 15      | 13    | 15             |
| Q17           | 1                 | 3        | 14      | 13    | 14             |
| Q9            | 2                 | 1        | 15      | 19    | 8              |
| Q16           | 3                 | 6        | 13      | 13    | 10             |
5. Conclusion
Active learning is one of the popular approach in ensuring students learn in class. There several studies that perform survey in supporting teaching and learning on programming subjects but we are more interested in [5, 6]. [6] has given some useful guideline in developing and designing a programming learning tool that may be useful and shall be considered by us in redesigning our Database Programming offline game. [5] highlighted that many of the present assessment tools are developed for a local use and only for a certain type of assignments and should be available for a wider use and should not be difficult to adopt to another university, considering interoperable tool approaches and promoting reuse and material sharing between developers.

The survey has been conducted among undergraduate students of the Faculty of Communication and Technology (FICT) in Universiti Teknikal Malaysia Melaka, involving 33 junior students and 12 senior bachelor students of Computer Science majoring in Database Management. The results show that students have preferences on a game that include socializing elements such as interaction among themselves with expected elements yet provide challenging task but less pressure on time management. Interestingly, even this study was investigating designation to improve an offline game, we found that students preferences shall consider positive vibe in being helpful to friends and having challenging and relevant task, but do not stress them regarding on time management.

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