

Correlation of Mathematical Ability and Programming Ability of the Computer Science Students

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Abstract – *Students find programming courses difficult in the BSCS program because it includes structures, syntax, critical thinking, and the ability to solve programming problems. On the other hand, Mathematics is found to be significant in dealing with programming courses because it improves the logical ability of the students needed to solve programming problems. Hence, this study attempts to investigate the correlation of mathematical ability and programming ability of a student taking BSCS program. This study used the correlation research design to determine the extent to which two factors are related, not the extent to which one factor causes changes in another factor. This study also used several variables such as the College Entrance Examination results (Non-verbal Stanine) in Mathematics only and their performance in all programming courses from the first-year level up to fourth-year level.*

Keywords – *Computer Science, Mathematics, Programming, correlation*

INTRODUCTION

Computer Science program is said to be one of the most difficult programs which provide a comprehensive training in computer science [1] courses such as object-oriented analysis, problem analysis, and program design principles, computer organizational principles, database principles, operating system principles, computer network principles and programming principles. Among these courses, programming is considered as the key factor in pursuing computer science program, but also the most difficult [2]. Studies show that programming course becomes difficult because of mathematics [3], [4]. Mathematics improves the ability of the students to solve problems. Additionally, mathematics found to have a positive effect or one of the factors that contribute to the success of the students taking computer science program [5]. Hence, students must have a strong background in mathematics in which

some studies predict success in programming courses [2], [6], [7]. Works of literature also suggest that math scores on the College Entrance Test correlate with programming grades [7], [8] [9]. As such, there is a tendency that students who get high scores in mathematics (through College Entrance Exam) can perform well in programming courses. Hence, scores in college entrance exams in math specifically, can be a factor to consider whether a student can be accepted into the BSCS program.

The entrance examination is an examination that many educational institutions use to select students for admission. This exam may be administered at any level of education, from primary to higher education, although they are more common at a higher level which is often referred to as the college entrance exams. This examination is tended to measure the various skill of a student such as verbal, mathematics, analytical and writing skills.

On the other hand, mathematics is found to be significant in dealing with programming courses because math is said to be a good indicator of having the essential cognitive growth to learn to program. However, math grades from high school might not be comparable due to several reasons like different books, different tests and different grading standards [10].

Many studies have been conducted to show the relevance of the present study. The researcher examined more than a few kinds of literature related to correlation of mathematical ability and programming ability.

One study was conducted about the correlation of mathematical ability and programming subjects of the BSCS students [2]. The author used the Mathematics scores of BSCS students during the College Admission Test (CAT) and their programming grades. He applied the Cochran's formula to identify the sample size and Pearson correlation to further test the level of significance. His study found that the students'

performed in Math and computer programming courses are similar. Hence, the two variables correlated with 99 percent level of confidence. Therefore, the Mathematics performance of the students could be the basis of admission for BSCS students.

Another study was conducted concerning computer science students' attitudes toward mathematics [6]. The study tested the reliability of students' math attitudes scale which found to be correlated with the performance in computer programming subjects.

Consequently, the previous study also revealed that a strong mathematical background was said to be effective in learning and understanding theoretical courses of computer science, particularly the Theory of Computation [11]. This study concluded that "19.6% of students had a decrease of two letter grades" and "41.3% of students had a decrease of one letter grades" than their average grade in other CS courses because of insufficient training in mathematics. Thus, it is strongly believed that the importance of mathematics even to software engineering and its practitioners can contribute to the development and maintenance of software systems [12], [13].

Recently, a similar study was also conducted on math attitudes of computer education and instructional technology students in Turkey [14]. The study investigated a number of variables, such as type of graduated high school, GPA in high school diploma, YGS score, gender, parents' educational level, and grades in IT and in math courses that could affect students' attitudes towards math and the Cronbach's alpha coefficient of the scale was found to be 0.96.

This study was concerned if mathematical ability correlates with programming ability of the students taking BSCS program at LPU-B. Additionally, this study was also to determine whether math can be a factor to consider in accepting students in the BSCS program.

In Lyceum of the Philippines University – Batangas (LPU-B), the BSCS program is under the College of Computer Studies (CCS). The courses include in the BSCS program are computer programming, data structure, computer organizations, algorithm, object-oriented programming, software engineering, free elective 2, 3, and 4. The free-elective courses depend on the field of specialization. There were two specializations in the BSCS program – the Game Development and the Mobile Application Development. The program is taught in a lecture and laboratory format where students require a 2 hours duration for the lecture and 3 hours duration for the laboratory. The program also requires the students' many laboratory activities.

These laboratory activities will serve as an assessment whether the students improved their ability to solve programming problems.

The outcome of this study could be of value to the LPU-B since the findings could provide reliable data sets on the direction and degree of relations of some selected variables.

OBJECTIVES OF THE STUDY

This study aimed to determine whether mathematical ability correlates with programming ability of the students taking BS Computer Science in a Private Higher Education Institution in the Philippines; to identify the level of performance of the BSCS students-respondents in the following variables: CS4 – Computer Programming, CS5 – Data Structure, CS6 – Computer Organizations, CS11 – Algorithm, CS13 – Object Oriented Programming, CS20 – Software Engineering, CS21 – Free Elective 2, CS23 – Free Elective 3, and CS24 – Free Elective 4; to test the significant relationship between the mathematical ability and the performance in programming courses.

METHODS

This section discussed and interpreted the methods of research, selection of respondents, subjects and grades, data gathering information and the statistical treatment used by the researcher in interpreting the results.

Research Design

This study used the correlation research design to determine the extent to which two factors are related, not the extent to which one factor causes changes in another factor. This study also used several variables such as the College Entrance Examination results (Non-verbal Stanine) in Mathematics only and their performance in all programming subjects.

This study considers the different subjects in programming from 1st year to 4th year including the math scores in LPU-B entrance exam, to establish the correlation between the mathematical ability and programming ability.

Correlation study or research is a collection of data to determine whether or to what degree a relationship exists between two or more variables. It also means that the value of the variables varies in a nonrandom way, correlation does NOT imply causality and cause-effect not determined. The measure of correlation is, correlation coefficient, Values possible-1.00 to +1.00, a value of 0 means no relationship between the variables.

Respondents

The respondents were students under the BSCS IV-A batch 2016. These students were said to be the batch entered the school year 2012-2013 and was graduated last year, 2016. BSCS IV-A is the only section for the BSCS program. A total of 19 students who took the entrance exams and enroll for the BSCS program. On the other hand, there were 9 programming subjects that include in the BSCS curriculum.

Data gathering procedure

The data were collected manually. For mathematics, it includes scores from the entrance exam result which is the Non-verbal Stanine. For the programming, it includes all the programming courses from 1st year up to 4th year. It will compute first the average of these variables for each year level per student. To measure the variables, this study used the correlation coefficient to identify the values of the two variables. It also used the Pearson correlation to further test the level of significance.

Data Analysis

To gather the data, a request to the Guidance office was made for the release of the Stanine result of the BCSC students who took entrance exam last 2010. The result is specific with Non-verbal Stanine (mathematical scores) and only for the students who enrolled in BSCS. This set of data is to determine the mathematical ability. For the programming ability, the sample size was 19 records. The given scale was used for the verbal interpretation of performance in programming: 1.0 as outstanding, 1.01 – 1.25 as excellent, 1.26 – 1.50 as superior, 1.51 – 1.75 as very good, 1.76 – 2.00 as good, 2.01 – 2.25 as satisfactory, 2.26 – 2.50 as fairly satisfactory, 2.51 – 2.75 as fair, and 2.76 – 3.00 as passing rate.

RESULTS AND DISCUSSION

Table 1. Stanine Frequencies (Non-Verbal)

Stanine	f	%
2.0	1	5.3
3.0	2	10.5
4.0	4	21.1
5.0	4	21.1
6.0	2	10.5
7.0	2	10.5
9.0	4	21.1
Total	19	100.0

Data gathered were tallied and treated utilizing SPSS. After encoding the data, descriptive statistics

was used. Table 1 shows the stanine frequencies where the scores from non-verbal stanine were extracted from the entrance exam results. The non-verbal stanine pertains to the mathematical ability of the students. The result revealed that 21.05% or 4 out of 19 students got a score of 9.0, whereas 10.52% or 2 out of 19 students got a score of 7.0, 6.0 and 3.0. There were also 21.05% or 4 out of 19 students got a score of 5.0 and 4.0, and only 5.3% or 1 out of 19 students got a score of 2.0.

Table 2. Performance of Students' on Programming Courses

Subjects	Mean	Interpretation
CS 4	2.09	Satisfactory
CS 5	2.18	Satisfactory
CS 6	1.61	Very Good
CS 11	1.76	Good
CS 13	1.88	Good
CS 20	2.26	Fairly Satisfactory
CS 21	2.14	Satisfactory
CS 23	2.00	Good
CS 24	1.97	Good
Over-all Performance	1.99	Good

Table 2 shows the level of performance of the BSCS student-respondent in Point Average in all programming subjects from the first-year level up to fourth-year level. From this table, students performed well in CS6 interpreted as Very Good with an average of 1.61 while they got Fairly Satisfactory in CS20 with an average of 2.26. The overall performance of the students is 1.99 interpreted as Good.

Table 3. Relationship Between Non-Verbal Stanine Score on Programming Courses

Subjects	r-value	p-value
CS 4	0.505*	0.028
CS 5	0.586**	0.008
CS 6	0.384	0.105
CS 11	0.412	0.080
CS 13	0.561*	0.012
CS 20	0.229	0.347
CS 21	0.507*	0.027
CS 23	0.412	0.080
CS 24	0.339	0.156
Over-all Performance	0.505*	0.027

*Significant at *p-value < 0.05; **p-value < 0.01*

As seen from the result of Table 3, there was significant relationship found on CS 4, CS 5, CS 13, CS 21 and the over-all performance on programming

courses when correlated to the respondents' non-verbal stanine score. These were observed since the obtained p-values of 0.028, 0.008, 0.012, 0.027, and 0.027 were less than 0.01 and 0.05 alpha level. This means that the higher the student's non-verbal stanine score, the better the performance. Also, students with high non-verbal scores can often be expected to do well with logic, models, creative thinking, constructions or building, technology, or other non-language based activities.

Additionally, the overall grade point average might be expected to forecast that mathematics can be a factor to consider in accepting students for BSCS program.

CONCLUSION AND RECOMMENDATION

An explanation as to why mathematics is important in dealing with all the programming courses in the BSCS program. It is because programming courses have a logical component and mathematical ability is likewise needed.

This study examined whether mathematical ability correlated with the programming ability of the students taking BSCS program. Using correlation research technique, this study revealed that math scores can predict whether a student can be able to pass in the programming courses of the BSCS program. The relationship between Non-verbal Stanine and the performance of students in programming courses is statistically significant, hence, it supports the notion that math score can be a factor to consider in accepting students under the BSCS program.

Likewise, the level of performance of the BSCS student-respondent in Point Average revealed the significance between the math score in the college entrance exams and programming courses.

Therefore, the data tabulated is sufficient to allow this study to draw several conclusions and inferences. First, it is reasonable to conclude that Mathematical ability of the students could be the basis of admissions for BSCS program. Second, students who performed well in math can, therefore, performed well in programming courses. Third, the Mathematical ability could be a predictor of student performance in programming courses.

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