

A Correlation of Entrance Exam Scores (Stanine) and Programming Ability of Computer Science Students

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Abstract – *The Bachelor of Science in Computer Science (BSCS) is a four-year degree program that includes the study of algorithmic foundations, computing concepts and theories, and new developments in processing. The program prepares its students to develop new and effective algorithms, and design and create algorithmically complex software for solving computing problems.*

The study determined the correlation between entrance exam scores (STANINE) and the programming ability of students. It intended to identify whether the stanine score achieved by a student can be a predictor of computer programming success. The study used the correlation research design to determine the extent to which two factors are related. Respondents are the Bachelor of Science in Computer Science graduates of batch 2017. Stanine records of the 20 students who took the entrance exam and graduated were used as basis for the study.

The study aimed to determine whether entrance exam scores (Stanine) correlate with programming ability of BS Computer Science graduates of a Private Higher Educational Institution in the country; identify level of performance of BS Computer Science graduates in the following programming courses: CS1-CS Fundamentals, CS4-Computer Programming, CS5-Data Structures, CS6-Computer Organization, CS11-Algorithms, CS13-Object Oriented Programming, CS14-Database Management System, CS20-Software Engineering, CS 21-Elective 2, CS23-Elective 3, CS24-Elective 4, and CS27-Special Project 2; and test if there is a significant relationship between stanine level and programming ability in selected programming courses.

Using correlation research technique, the study revealed that there is a significant relationship between the stanine and programming ability of BS Computer Science students. stanine score could be used as predictor for the programming ability of BS Computer Science students.

Keywords – Admission test, Computer science, Entrance exam, Programming ability, Stanine

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INTRODUCTION

The early classification of university students according to their potential academic performance can be a useful strategy to mitigate failure, to promote the attainment of better results and to better manage resources in higher education institutions [1]. The ability to predict student performance in a course or program creates prospects to improve educational outcomes. With effective performance prediction approaches, professors can allocate resources accurately and deliver instructions more effectively. Research in this area seeks to identify features that can be used to make predictions, to identify algorithms that can improve predictions, and to quantify aspects of student performance. Moreover, research in predicting student performance seeks to determine interrelated features and to identify the underlying reasons why certain features work better than others [2].

Freshmen applicants are given an entrance examination to determine readiness for tertiary education in all fields. The result of the test is a determining factor whether the applicant is accepted or not in the school or program from which the applicant seeks admission. Schools may opt to use a standardized test which may be purchased from an outside vendor or from a teacher-made test which can be validated within by the officer in-charge. Academic achievement represents performance outcomes that indicate the extent to which a person has accomplished specific goals that were the focus of activities in instructional environments, specifically in school, college, and university [3]. Admission tests apply a common standard. These help Higher Educational Institutions (HEIs) evaluate and compare the preparation of students who graduated from different high schools. Schools do not offer the same academic programs, learning environments or even prospects. HEIs look at the test scores, alongside high school grades and

courses, to see how well-prepared student applicants are for college-level work.

Stanine (STANDARD NINE) is a method of scaling test scores on a nine-point standard measure with a mean of five and a standard deviation of two. It can be used to convert any test score to a single-digit score. A person with a score of 9 is in the top 4% of the scorers, while a person with a score of 1 is in the bottom 4%. This technique identifies whether a test score is below the mean (a score of 5) or above the mean.

The Bachelor of Science in Computer Science (BSCS) is a four-year degree program that includes the study of computing concepts and theories, algorithmic foundations, and new developments in computing. The program prepares its students to design and create algorithmically complex software and develop new and effective algorithms for solving computing problems. It includes the study of the standards and practices in Software Engineering. It prepares students to acquire skills and disciplines required for designing, writing, and modifying software components, modules, and applications that comprise software solutions.

The Bachelor of Science in Computer Science program of the College of Computer Studies has been in existence since 1988. The college prides itself as being the 1st to offer the program in the region. Also, it is the 1st to achieve level 4 PACU-COA accreditation status, wherein only a few higher learning institutions have reached this stage. The BSCS curricula is continuously updated based on the recommendations from CHED, PACU-COA, TESDA, various linkages and its other stakeholders. The college has partnerships with prominent computing companies like Microsoft, IBM, CISCO, and Sun Micro Systems to name a few. Its highly qualified faculty members and students are active members of computing organizations like Philippine Computer Society (PCS), Computer Science Teachers Association (CSTA), Philippine Society of Information Technology Educators (PSITE), Philippine Society of Information Technology Students (PSITS), Junior Philippine Computer Society (JPCS), Integrated Southern Tagalog of Information Technology Education (iSITE), etc.

Correlation is known to make projections. When a score on one measure is known, a more accurate projection of another measure that is highly related to it can be done. The stronger the relationship between/among variables the more precise the prediction; that is when practical evidence from correlation studies can lead to testing evidence under controlled experimental conditions. While it is true that

correlation does not necessarily imply causation, causation does imply correlation. Correlational studies are a stepping-stone to the more effective experimental method, and with the use of complex correlational designs (path analysis and cross-lagged panel designs), allow for very limited causal inferences.

The study determined the correlation between entrance exam scores and the programming ability of students. It intended to identify whether the stanine score achieved by a student can be a predictor of computer programming success. The study used the correlation research design to determine the extent to which two factors are related. Respondents are the Bachelor of Science in Computer Science graduates of batch 2017. Stanine records of the 20 students who took the entrance exam and graduated were used as basis for the study. The BS Computer Science 2012 curriculum was used also in which programming courses were identified. The stanine & final grades of students in programming courses were statistically treated to determine correlation.

OBJECTIVES OF THE STUDY

The study aimed to determine whether entrance exam scores (Stanine) correlate with programming ability of BS Computer Science graduates of a Private Higher Educational Institution in the country; describe the stanine level of BS Computer Science graduates; identify level of performance of BS Computer Science graduates in the following programming courses: CS1-CS Fundamentals, CS4-Computer Programming, CS5-Data Structures, CS6-Computer Organization, CS11-Algorithms, CS13-Object Oriented Programming, CS14-Database Management System, CS20-Software Engineering, CS 21-Elective 2, CS23-Elective 3, CS24-Elective 4, and CS27-Special Project 2; and test if there is a significant relationship between stanine level and programming ability in selected programming courses.

MATERIALS AND METHODS

Research Design

The 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. The study also employed several variables such as the entrance examination results (stanine) and programming ability based on the final grades in selected computer programming courses.

Respondents of the Study

Twenty (20) of the twenty-eight (28) or 71.42

Percent BS Computer Science students who took the entrance examination and graduated on the year 2017 served as the respondents of the study. Stanine results of only 20 students were available at the time of data collection.

Data Collection

Stanine results are considered as confidential. Thus, a request letter was sent to the Counselling and Testing Center of the Private Higher Educational Institution, for the release of the stanine results of the respondents. Thru the university's online student information system, the final grades of the respondents in CS1-CS Fundamentals, CS4-Computer Programming, CS5-Data Structures, CS6-Computer Organization, CS11-Algorithms, CS13-Object Oriented Programming, CS14-Database Management System, CS20-Software Engineering, CS 21-Elective 2, CS23-Elective 3, CS24-Elective 4, and CS27-Special Project 2 were collected and tabulated.

Data Analysis

The chart presentation of the stanine level was generated using tabulated data in MS Excel. Performances (final grades) were subjected to computation of the mean value. Pearson correlation coefficient was used to test the significant relationship. Data gathered were treated using a statistical software, SPSS version 26 to further analyze the results.

Ethical Considerations

Stanine results are considered as confidential. Thus, a request letter was sent to the Counselling and Testing Center of the Private Higher Educational Institution, for the release of the stanine results of the respondents. Student names were intentionally omitted in the generation of charts/figures to maintain data privacy.

RESULTS AND DISCUSSION

Figure 1 displays stanine level of BS Computer Science students of batch 2017. As can be seen from the figure, one student (5 Percent) achieved a stanine score of 1, two students (10 Percent) each with a stanine score of 7, and 2 more students (10 Percent) with a stanine score of 8. The rest ranges from 3 to 6 stanine scores. Stanine scores are derived from a national norm reference sample. A stanine is a score from 1 to 9 with a stanine of 9 indicating a very high level of general ability relative to the whole norm reference group, and a

stanine of 1 indicating a very low relative achievement. At present, enrollment in the Computer Science program does not require a certain stanine level, as can be seen from the results there is a heterogenous group of students enrolled in the program. Stanine of students ranges from 1 – 9.

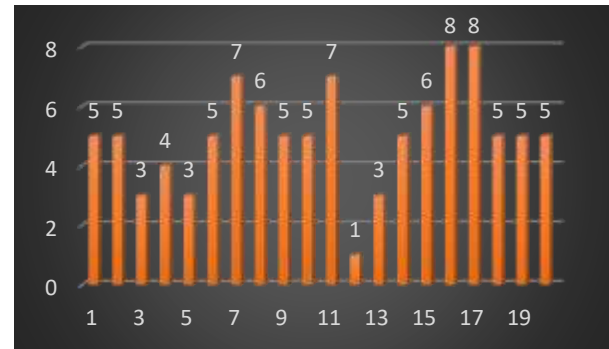


Figure 1
Stanine Level of BS Computer Science Students of Batch 2017

Examinations at all stages of education have been considered an important and powerful tool for decision making, with people of all ages being evaluated with respect to their achievement, skills, and abilities. Zoller and Ben-Chain [4] have the opinion that “the era in which we live is a test-conscious age in which the lives of many people are not only greatly influenced but are also determined by their test performance”. Freshmen applicants are given an entrance examination to determine readiness for tertiary education in all fields. The result of the test is a determining factor whether the applicant is accepted or not in the school or program from which the applicant seeks admission. Schools may opt to use a standardized test which may be purchased from an outside supplier or from a teacher-made test which can be validated within by the officer in-charge [3].

It should be noted that during the conduct of the research there is no policy of non-acceptance in the Computer Science program for low stanine scorers. Enrollment in Computer Science programs has been facing a steady decline for several years. Although more recent trend has shown a slight upward trend in enrollment, but the number of admitted students into Computer Science programs falls far short of what they have been before and in meeting employment demands [5].

Table 1
BS Computer Science Students' Performance on Selected Programming Courses

Course Code	Course Title	Mean	Interpretation
CS 1	CS Fundamentals	1.76	Good
CS 4	Computer Programming	2.00	Good
CS 5	Data Structures	2.02	Satisfactory
CS 6	Computer Organization	1.86	Good
CS 11	Algorithms	1.79	Good
CS 13	Object Oriented Programming	2.08	Satisfactory
CS 14	Database Management System	1.92	Good
CS 20	Software Engineering	2.11	Satisfactory
CS 21	Elective 2	2.06	Satisfactory
CS 23	Elective 3	1.54	Very Good
CS 24	Elective 4	1.61	Very Good
CS 27	Special Project 2	1.68	Very Good
Over-all Programming Performance		1.87	Good

Legend: 1.00 = Outstanding; 1.01 – 1.25 = Excellent; 1.26 – 1.50 = Superior; 1.51 – 1.75 = Very Good; 1.76 – 2.00 = Good; 2.01 – 2.25 = Satisfactory; 2.26 – 2.50 = Fairly-Satisfactory; 2.51 – 2.75 = Fair; 2.76 – 3.00 = Passing

Table 1 presents the BS Computer Science students' performance on selected programming courses. From the BSCS 2012 curriculum, programming courses were selected to correlate with the stanine scores of the students. Mean data from the final grades reveal that programming ability of the respondents range from "Very Good" to "Good" and "Satisfactory", with an over-all programming performance of 1.87 (Good). Mean data indicates CS 23 (1.54) as "Very Good" and CS 20 (2.11) as "Satisfactory". CS 23 ranks first as an elective programming course which deals with development of android mobile applications and gaming platform frameworks. Students may have enjoyed coding in the integrated development environment of the latest software for developing mobile apps and mobile games.

For the CS 20 – Software Engineering course which ranks last, students may have experienced difficulty since the course required the application of the principles of the course "Systems Analysis and Design" and software development/intensive programming using the VB.Net language.

Programming is part of the basic curriculum for Computer Science and Information Technology. The ability to understand and implement the programming language is an important skill for the students to acquire. Programming has been a difficult subject to learn and master even at the early stage of education. Although, there are many education tools available to complement the teaching and learning of computer programming. The problem persists until present day. Even at the initial stage of computer introduction courses, there were high failure rates and high dropout. One of the rationalisms behind this scenario is from the students' lack of problem solving abilities [6]. The main ability that computers lack is the ability of analogy, association and adaption. While humans possess these characteristics, computers do not, and they must be instructed mechanically with flawless precision and rules that cover all cases that computer is expected to deal with. Basically, it can be simply said that humans are intelligent, and computers are not, and this is the main difference that causes collision between intuitive way of reasoning that programming novices are using, and the way of thinking required to write proper computer programs [7].

Table 2
Relationship Between Stanine Score and Students' Ability on Programming Courses

Variables	r-value	p-value	Interpretation
Stanine and Programming Ability	0.524	0.018	Significant

Legend: Significant at p-value < 0.05

Table 2 presents the relationship between stanine score and students' ability in selected programming courses. Results show that the computed r-value of 0.524 between stanine and programming ability reveals a moderate positive correlation, which was statistically significant. Thus, there is a significant correlation between stanine and programming ability. This implies that having higher stanine is a predictor of good programming ability. It is deemed from the research that stanine level is a pre-determining factor in the programming ability of BS Computer Science students.

Results reveal that the higher the stanine score/level is, the better is the performance in the identified programming courses.

The study conducted by Balmes [8] examined whether mathematical ability correlated with programming ability of students enrolled under the BSCS program. Using correlation research technique, the study revealed that math scores can predict whether a student will be able to pass the computer programming courses. 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 for the BSCS program. Similarly, the study conducted by Ramos [3] determined whether stanine results correlated with the academic performance of students taking the BS Computer Science program. Using correlation research technique, the study revealed that there is a significant relationship between the stanine level and academic performance of BS Computer Science students specifically in the following courses: CS1-CS Fundamentals, CS2-Computer Applications, CS3-Digital Design, CS4-Computer Programming, CS13-Object Oriented Programming, CS15-Networking2, CS19-Networking3, CS21-Game Development/Mobile Application Development and CS25-Modeling and Simulation. The research concluded that stanine level is a pre-determining factor in the academic performance of BS Computer Science students. Results revealed that the higher the stanine score/level, the better is the performance in the mentioned professional courses.

Mathematics is one of the components of entrance examinations. Since it has been determined that math score can be a predictor of students' computer programming performance, this supports the findings of this study that stanine scores determine programming capability of Computer Science students. The research by Ramos [3] established the fact that stanine score is a pre-determining factor in the academic performance of Computer Science students. Hence, results of this study revealed a significant correlation of stanine with academic performance in computer programming courses.

CONCLUSION AND RECOMMENDATION

Using correlation research technique, the study revealed that majority of the respondents have a stanine level of 5. BS Computer Science graduates have good programming ability. The study revealed that the higher the stanine score, the better the performance in

the programming courses. Since a positive correlation exists as indicated by the results of the study; the stanine score could be used as predictor for the programming ability of BS Computer Science students.

To the professors of BS Computer Science programming courses, prior information may be given as to the stanine level of students, and special attention or assistance in the form of tutorials may be given to low-ranking ones. Professors may also be advised to conduct varied teaching methods and strategies as to improve programming ability of students. To the Dean and Department Chair of the college, monitoring of programming performances may be conducted intensively and since stanine results can be used as predictor; low ranking students may be given prior assistance and attention that will result to improved academic performance.

For future researchers, other data of the entrance examinees that can still be retrieved from the registrar's repository (e.g., high school grades, gender, economic background) may be subjected to data mining. Data mining may be used to predict examinees who are likely to discontinue or finish the program on time. Data mining may be used also to help identify which students need immediate intervention to help them succeed in the program.

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