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Predictors of Programming Abilities of Information Technology Students in UNP

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ABSTRACT

Programming is one of the essential skills to be learned in the Information Technology curriculum. However, the subject is considered complicated and categorized as one of the biggest challenges in computing education. This paper is conducted to analyze and discuss the variables and limitations faced by students in learning programming. A survey of 100 University of Northern Philippines Information Technology students was achieved through questionnaires. The responses and views from the students were analyzed and investigated regarding their attitude toward learning programming. In the survey, the needs and concerns about the variables are highlighted and answered, leading to the inferences made and recommendations to enhance learning programming understanding, thus minimizing failure rates.

Keywords: *Computer programming, computing education, programming attitude*

INTRODUCTION

In this open era where development is drastic on computer technology, its demand is also increasing for globalization. This indicates that experts are advantageous, especially in Information and Communications Technology (ICT). Such needs include software engineering, database, creative multimedia, computer networking, and software programming. Studies show a high demand for software engineers in the industry, indicating that people who are good at programming are critical for sectors. Therefore, to meet the industry's needs, a programming subject should be an introductory course in college for the curriculum and those program areas, including Mathematics, Science, and Engineering.

One of the oldest universities in the North is the University of Northern Philippines, located in the Heritage City of Vigan, offering a Bachelor of Science in Information Technology program since 2009. Part of the curricular program includes studying programming subjects that consider complex technological factors and providing computing solutions to address emerging needs in the industry. The programming courses, which are required for the students to complete, cover the use of general purpose to solve problems. The emphasis is to train the students in designing, implementing, testing, and debugging programs to solve problems using different constructs. Programming measures students' cognitive abilities; these abilities

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may be assessed using a paper-based method, such as a multiple-choice exam or a hands-on approach (Bringula, Aviles, Batalla, et al., 2017).

Also, the challenges within the academic program itself bring along concerns such as limited access to computer facilities, poor learning styles of the students, high students intake, university traditions, and within the natural environment, there are issues to work out with electricity, making it a threat to hardware and data, internet connectivity, computer viruses, and the socio-economic climate registers concerns such as the tradition behind the procurement of equipment, inability to buy personal computers for learning purposes, poor living conditions, and low level of income. Nevertheless, notable among these concerns are the practical difficulties and failure of the students in programming.

Programming is known for its complexity and difficulty; thus, many students have problems acquiring the necessary programming competencies (Gunbar, 2018). To such a degree, students competent in other subject areas may be deficient for programming success, and students with low, moderate, and high success commit similar mistakes. Further, according to Amoako et al. (2013), there are many reasons why students pass or fail particular subjects in their study. It may be that the concept of a Programmer's Quotient is misdirected since (just as with IQ) innate cognitive ability is but one factor of many that affect student grades.

However, the question then arises of how prepared the students can respond to the industry's needs in programming. In essential respects, programming has been categorized as one of the significant challenges in computing education today because of its difficulty and complexity. Erdogan, Aydin, and Kabaca (2008) clearly stated that it is not surprising that the development of programming languages and methods and their teaching have, up to now, hardly been linked to several studies due to the variety of applications and training that programmers undergo. It is also believed that many factors can influence success in programming, including prior knowledge (Qian & Lehman, 2016). Some investigated standardized methods of aptitude, while some focused on effort and motivation.

Moreover, Gunbatar (2018) posits that students will create a computer program with real programming editors, especially in their professional lives. It is relevant that students should be examined in terms of other variables besides computational thinking. Programming self-efficacy, attitude, and thinking styles are essential for programming performance.

Although there have been studies that concern programming, it is also essential to investigate the possible factors that influence the success of learning how to program. As Qian and Lehman (2016) argued, it is vital to identify the factors that influence learning how to program. Further, Mohan and Vimina (2021) mentioned that there is a dire need to identify the factors affecting the students' programming skills. According to their study, factors include educational background and programming debugging skills. Moreover, in the study of Gurer, Cetin, and Top (2019), they found that the attitude toward computer programming significantly correlated with their

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achievement in computer programming courses, computer programming self-efficacy, and perceived learning.

Therefore, the University, like other schools, according to Pardo and Pichay (2019), must provide the students with the necessary knowledge, abilities, and experiences to prepare them for the workforce and aid in nation-building. The school should prepare students in today's information society, guarantee that they can use new information and communication tools productively, and have the critical and analytic tools necessary to live and flourish in an information-saturated environment (Pardo, 2012). The former also cited that several studies have shown a relationship between respondents' classroom use of computers and computer attitudes and demographics such as sex. However, age had little effect on classroom computer use. Furthermore, Cadorna et al. (2015) found that the use of Information and Communication Technology (ICT) has caused changes in the way teachers and students live in educational institutions. They needed to be more confident in using ICT tools and equipment. Still, they had an extremely positive attitude toward using ICT.

If educators knew the critical factors that affect the success of students' programming skills, they could better support and prepare instructions that enhance students' learning of programming. Further, the difficulties need to be identified to aid the students' learning effectively.

This study looked into the predictors of programming abilities of the Bachelor of Science in Information Technology students of the University of Northern Philippines to provide inputs in improving the teaching-learning process. Specifically, it sought to determine the socio-economic and academic profile of the respondents. It also examined the respondents' attitudes towards programming, IT resources' status, and programming abilities level. The predictors of programming abilities of IT students were also determined through regression analysis.

METHODOLOGY

This study employed a descriptive research design that utilizes a quantitative approach. With no control over the variables, descriptive research can be defined as a statement of the current state of affairs, as mentioned by Fox and Bayat (2007). In this study, descriptive design was used to describe the mean, percentage, and regression analysis of the results. The study was conducted during the Academic Year 2019-2020. Total enumeration was used to determine the sample of this study. The sample consisted of 100 First Year Information Technology students of the College of Communication and Information Technology, the University of Northern Philippines, enrolled in Fundamentals and Intermediate Programming using Java. Data were obtained through a questionnaire. The computer programming attitude scale was from Baser (2013). It consists of a series of positive and negative statements, which are reverse-coded before summing the subscale scores. Part 3 determined the status of the computer and other resources that may affect students' programming abilities. A multiple-choice test consisting of 25 questions constructed by the researchers was used

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to measure the competitiveness of IT students in Programming. The test had undergone item analysis, and the reliability coefficient was found to be 0.82, which means the test is perfect for a standardized test. Written consent is addressed to the respondents for the researchers to administer the questionnaire and test. The test was administered using Google Forms (as a link) and sent to the different classes. The students took the test for 1 hour and 30 minutes. Only the target students with verified email can access the test administered. Responses were also validated after the conduct of the said test. Upon critical audit of the answered questionnaire to ensure that responses were free from errors, further analyses were made using the Statistical Packages for Social Sciences (SPSS) software, version 22. The data gathered and results were analyzed through frequency, percentage, mean, and multiple regression.

RESULTS AND DISCUSSIONS

Profile of the Respondents

Majority of the respondents (55 or 55%) obtained a high school grade in computer of 87–90. Also, a marked percentage of the respondents (29 or 29%) have a high school grade of 83–86, while the remaining percentages are distributed in the other ranges. This implies that the students had high regard for their computer subject during high school and that their performance on the computer subject was averagely high.

Regarding sex, the majority (71%) is Male, and the remaining 29% are Females. This can imply that males are more into Information Technology-related programs than females. Also, in the respondents' outcomes concerning their father's educational attainment, a significant percentage were high school graduates (45 or 45%), and a substantial portion (41 or 41%) had fathers who finished their Bachelor's Degrees. On the other hand, a great percentage finished their Bachelor's Degree (47 or 47%) in terms of the educational attainment of the mother of the respondents, and a marked percentage graduated high school (34 or 34%).

Further, majority of the household of the respondents have an income of Php 5,000 – Php 10,000. It is also evident that a substantial percentage (22%) of the respondents' family income ranges between Php 10,000 – Php 20,000. Some households belong to low-income earners and average-income earners. Only a few respondents belong to upper-class households.

Attitude towards Programming

The following table presents the attitude of the respondents towards programming.

There is a neutral attitude of the students toward computer programming. This implies that the students do not give enough importance to computer programming or are uncertain whether they feel happy when doing computer programming activities. There is a need to increase students' perspective toward programming as it improves their performance and success towards it, as Baser (2013) emphasizes in his study.

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Table 1
Level of attitude towards programming

Indicators	Mean	DR
Confidence in Learning Programming	3.37	Neutral
Attitude toward success in IT	3.50	Positive
Information Technology as a male domain	3.37	Neutral
Usefulness of Programming	3.32	Neutral
Effective Motivation in Programming	3.08	Neutral
Grand Mean	**3.33**	**Neutral**

Taking the indicators singly, the respondents are neutral regarding their confidence in learning programming. Although the respondents Disagree with the item "Programming has been my worst subject," the majority of the items were marked as Agree and Fair. This indicates that the respondents can improve their attitude towards programming with their confidence in learning it, which can be made possible through advanced online readings and tutorials.

On the level of attitude towards programming in terms of success in IT, the respondents are Positive about the level of attitude towards programming in terms of attitude towards success in Information Technology. This means that the respondents are optimistic about becoming excellent students in programming. Further, excellent and responsive mechanisms to recognize and appreciate milestones can boost the students' attitude toward success. According to Mathews (2017), desiring to learn how to program is a significant step toward success and can be a reflection of the culture of Information Technology subjects, specifically programming, more than a trait that helps students to learn how to program.

Regarding IT as a male domain, the respondents have a Neutral view of their attitude toward programming. This is supported by the mean of 3.37. This indicates that though men dominate IT, respondents still perceive that females also can be good at programming as men do. As cited by Oroma, Wanga, and Ngembuke (2012), male students are noted to have at least been exposed to computers before than female students. This is due to the fact that some of the students have had access to at least one video game, either at school or at a friend's house.

Moreover, respondents rated the Usefulness of programming as Neutral, which suggests that studying and learning to program is worthwhile and necessary. It is also important to note that while most students are aware of how useful programming is, there are still those unaware. Also, programming is not only a subject in college to complete, but rather, it is also a skill for earning a living.

Moreover, lastly, in terms of compelling motivation, the students have a Neutral view on their perspective regarding effective motivation. This indicates that there must be a strong driving motivation to be provided with an optimal learning environment that the students need in learning programming. A visualization tool can also be used as a learning model to help link new Information with old knowledge. In the real sense, it can be noted that a large number of students taking IT are not

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intrinsically motivated to study programming since most of them must admit that taking the IT program was not their decision; this, according to Oroma, Wanga, and Ngembuke (2012). On the contrary, in comparison to extrinsic motivation, which is described as doing an activity solely to achieve a separable result, students must demonstrate intrinsic motivation, which is defined as doing an activity for its inherent gratification than for any separable consequences.

Status of Information Technology Resources

The table below analyzes the responses on the status of IT resources.

Table 2

Status of information technology resources

IT Resources	f	%
Appropriateness of Software	46	46.00
User-Friendliness	66	66.00
Updated Software	51	51.00
Response Rate		
Fast	27	27.00
Medium	39	39.00
Slow	7	7.00
Quality	54	54.00
Durability	54	54.00
Capacity	43	43.00

The results obtained from the student's experience in using the resources in the different laboratory rooms of the college claimed that it is user-friendly, durable, and has a good capacity, and also, the software being installed and used is updated.

Programming Abilities of Information Technology Students at UNP

Table 3 presents the level of Programming abilities of Information Technology students at the University of Northern Philippines.

Table 3

Level of programming abilities of the respondents

Level of Ability	f	%
21 - 25 (Very Highly Proficient)	-	0.00
16 - 20 (Highly Proficient)	8	8.00
11 - 15 (Proficient)	48	48.00
6 - 10 (Almost Proficient)	41	41.00
1 - 5 (Not Proficient)	3	3.00

Mean: 11.12
Descriptive Rating: Average

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As to the level of programming abilities of the respondents, it is evident in the table above that based on their test results, 48% are proficient, and a remarkable 41% are almost proficient. Although 8% of them are highly proficient, there are still 3% who are not proficient in programming.

The programming ability of the students was measured using a programming examination. The said exam comprises different components, including basic programming concepts, programming syntaxes, determining the correct codes, and determining the output of a particular program. The exam's result determines a student's programming ability level. The exam result implies that though students are knowledgeable, as supported by the mean rating of 11.12, described as Average, to become excellent or expert in programming, there is a need for the students to focus on studying the foundation of programming, particularly syntaxes.

Table 5
Regression analysis in the performance of the respondents in programming

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	204.537	15	13.636	1.357	.188[b]
Residual	864.051	86	10.047		
Total	1068.588	101			

a. Dependent Variable: Test Score
b. Predictors: (Constant), G, B, Att, CompGrade, MHEA, db, FamIncome, dc, E, Sex, A, FHEA, C, F, da

There is no significant difference between the different predictors and the test scores of the respondents. This implies that regardless of the sex of the respondents, the highest educational attainment of their parents, high school computer grade, net family income, and their attitude towards programming, the respondents have the same level of programming abilities.

Moreover, despite having adequate resources in terms of appropriateness of resources, user-friendliness, updated software, response time of the resources, quality of the resources, durability, and capacity, programming abilities of the respondents are at the same level. In the study of Imlach, Ward, Stuart, et al. (2017), it was found that age, gender, working memory, psychosocial factors, and IQ did not influence any academic performance. Their study shows that academic performance is not hindered and that lifetime involvement in cognitively stimulating activities and certain cognitive abilities can help older persons succeed in school.

CONCLUSIONS

Based on the analysis of the findings, a more significant percentage of students in Information Technology are men, as found in this research. Also, the respondents have built a positive approach to programming. In addition, the IT resources the respondents utilize are user-friendly, durable, and have a good capacity for learning

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programming. Furthermore, the respondents are proficient in programming and that they have the same level of programming abilities.

RECOMMENDATIONS

Based on the results, it is recommended that the school periodically review its course outline on programming subjects and enhance students' learning experiences with programming courses. Also, there is a need to provide a one-to-one ratio on the number of units to be used by the IT students and ensure that these resources are maintained and monitored. Further, it is recommended that students from Information and Communication Technology strand should be a priority to be accepted in the Information Technology program.

ETHICAL STATEMENT

This study was reviewed and approved by the University of Northern Philippines. Ethics Review Committee. Ethical principles observed in the study include the conflict of interest, principle of informed consent, principle of privacy and confidentiality, principle of vulnerability, recruitment, benefits, compensation, and community considerations.

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