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The information technology Students' cognitive determinants and its relationship to academic performance

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***Abstract*—** *This study aimed at assessing the cognitive determinants of the BSIT students during the second semester of the academic year 2019-2020. A total of three hundred ninety-four (394) respondents participated in this study to understand the relationship of the cognitive determinants to their academic performance in a major programming course. Results revealed that the number of male students was more significant than the number of female students, there was a small gap between the number of students who graduated from public and private secondary academic institutions, and technical-vocational strand and academic strand were the two senior high school strand that the IT students had taken. In terms of the cognitive determinants, academic competence were very evident to the students with mean ratings of 3.826. However, test competence, time management and strategic study habits need to be improved based on the mean ratings of 3.208, 3.115 and 3.414, respectively. In assessing the relationship between the variables, the academic performance has a significant relationship with cognitive determinants ($r = 0.443$, $p < 0.05$). This study suggests that teachers must incessantly create more meaningful learning experiences to continuously improve academic performance and explore new ways to improve the teaching and learning process.*

I. INTRODUCTION

The teaching and learning process has evolved due to constant changes brought by different advancements in society's different sectors. Teaching pedagogies were reviewed and revisited to identify suitable means and methods to facilitate the teaching and learning process effectively. 21st-century teaching and learning pose new challenges and opportunities for teachers and learners. 21st-century teaching and learning require 21st-century that includes learning and innovation skills, information, media, and technology skills, and life and career skills (Stauffer, 2000; Trilling and Fabel, 2009).

Learning and innovation skills include critical thinking and problem solving, communication and collaboration, and creativity and innovation. These skills are essential for learners to develop the relevant and necessary skills needed for 21st-century work. Since the global economy requires a higher level of imagination, creativity, and innovation, teachers are encouraged to develop these essential skills. Apart from the learning and innovation skills, learners must be able to develop their information, media, and technology skills. This set of skills requires information literacy, media literacy, and information and communication technology literacy. Learners must be able to access, analyze, evaluate, and construct valid and appropriate judgments critically and

competently concerning the contents published over the internet to draw valuable insights that may significantly impact the community and their surroundings. The last set of skills required in the 21st century focuses on the life and career skills. This skill set enables the learners to survive, thrive, and succeed in the global arena (Stauffer, 2000; Trilling and Fabel, 2009).

Globalization plays an essential role in today's modern world; thus, learners must successfully develop this skill set. Life and career skills are also crucial in the workplace because of the diverse group of people working together.

The mentioned sets of 21st-century skills needed by learners are developed, enhanced, and further improved through the teaching and learning process. The learning process must be conducted and performed using the appropriate tools, techniques, methodologies, strategies, and procedures to achieve the ultimate education goal. In the process of learning, teachers must be able to recognize the importance of learning domains. Learning domains include cognitive, affective, and psychomotor domains (Hoque, M.E., 2016). The cognitive domain contains learning skills principally focused on cognitive thinking. Learning processes in the cognitive domain include a hierarchy of skills starting from processing information, constructing understanding based on the information at hand, applying essential knowledge, solving problems, and the ability to conduct research.

On the other hand, learning is not only focused on the cognitive aspect but also includes the affective side. The affective domain includes the process of learning attitudes and behaviors essential for learners to develop holistically. The affective domain focuses on the development of emotions and character. Lastly, the psychomotor domain focuses on learning through physical functions, reflex actions, and interpretive movements. The psychomotor domain of learning involves the physical components such as actions and the body itself to express and learn new insights. In general, the learning process includes these domains to establish a concrete and effective teaching and learning process.

Learners need to exert efforts in order to develop, enhance, and improve these domains holistically. Apart from teachers' efforts as facilitators of learning, learners must take into account the importance of regarding these domains for their overall improvement. The cognitive learning domain is typically the domain in which students struggle. According to Plessis S. (2015), cognitive skills determine learning ability; however, learners experience difficulty and struggle cognitively because of the following cognitive factors. Factors include the lack of concentration, lack of experience, or low perception about things and events, memory, and logical thinking.

This study focuses on learners' cognitive aspects concerning academic performance, including assessing their academic competence, test competence, time management, and strategic study habits. Bangirana et al. (2013) explain that cognitive ability is strongly associated with academic performance. Nesaya et al. (2019) also assert that academic performance has a significant relationship to cognitive profile. Self-Efficacy can be directly affected by cognitive factors such as academic competence, test competence, time management, and strategic study habits. Different studies were conducted in the past about the relationship between the learners' cognitive determinants to their academic performance. However, the present researchers seek to contribute further to the body of knowledge relating to understanding these aspects and look at the variables' relationship in a more contextualized manner. That is, in the case of BSIT students in a higher education institution in Nueva Ecija, Philippines. Integrating the 21st century skills developed during the Senior High School years of the learners, the researchers wanted to assess the cognitive determinants composed of the following factors: academic competence, test competence, time management, and strategic study habits of the students and its relationship to their academic performance.

1.1. Statement of the Problem

1.1.1. How may the demographic profile of the BSIT students be described in terms of
  1.1.1.1. Sex;
  1.1.1.2. Age;
  1.1.1.3. Type of School Graduated From; and
  1.1.1.4. Senior High School Strand?

1.1.2. How may the cognitive determinants be described in terms of
  1.1.2.1. Academic Competence;
  1.1.2.2. Test Competence;
  1.1.2.3. Time Management;
  1.1.2.4. Strategic Study Habits

1.1.3. Is there a significant relationship between the cognitive determinants and academic performance of the BSIT students?

1.2. Scope and Limitations

The study was conducted in a higher education institution in Nueva Ecija, Philippines, during the Academic Year 2019-2020, involving the second year Bachelor of Science in Information Technology students enrolled in a major programming course. The academic performance was based on the final grade. Incomplete,

unofficial, and officially dropped students were not included in this study as respondents.

II. METHODOLOGY

2.1. Research Method and Design

This study utilized a quantitative research methodology. The quantitative method was used to assess the cognitive determinants of the BSIT students. When data are gathered numerically, it is easier to quantify and measure them using appropriate statistical treatment. In this study, the researchers employed a descriptive-correlational approach to identify and describe the relationship between the respondents' cognitive determinants and academic performance without establishing a causal connection between the variables. The descriptive-correlational design is applicable to measure the degree of relationship among variables. Correlations may be positive, negative, or zero correlation.

2.2. Research Local, Respondents, and Sampling Technique

The locale of this study was a higher education institution offering a BSIT program in Nueva Ecija. The researchers chose the academic institution to provide new insights and recommendations for the college to enhance instruction further. The total number of students enrolled in the major programming course was 411 students. The researchers computed the sample size using the Slovene's formula assigning a confidence level of 95% and a margin of error of 0.5. The suggested number of samples from the population was 199. However, the researchers collected 394 responses resulting in a 1.01 confidence interval. This implies that the results presented in this study were almost representative of the entire population.

In getting the samples for this study, the researchers initially planned to include the entire population of second-year students. However, due to the pandemic, some students were not reached and included in the data gathering. Total population sampling provides more accurate, precise, and objective results. However, some instances have to be considered when employing the total population sampling technique like unforeseen events such as the pandemic, availability of the respondents, and the accessibility of data gathering tools for them.

2.3. Data Gathering Procedure and Data Analysis

In the first semester of the academic year 2019-2020, the researchers started to conduct the study. The researchers carried off activities such as reviewing related literature and studies to gather essential information that served as a foundation for this study. The views and insights gained through the review of related studies and literature clarified preconceived thoughts and knowledge about the topic and provided new relevant details that aid the researchers in pursuing this study. After that, the researchers adopted an instrument and revised it accordingly to suit the study's needs. The 20-item Study Management and Academic Results Test (SMART) was adopted from Ubaka et al. (2015) to measure the cognitive determinants of the BSIT students. SMART Questionnaire contains four constructs for cognitive determinants: academic competence, test competence, time management, and strategic study habits. When the instrument was adequately revised, the data gathering took place during the second semester of 2019-2020. The researchers explained the goal of the research and the contents of the instrument to the respondents. Clarifications were given to them, and relevant information was expressed. The researchers ensured the respondents that the data that were collected were treated with utmost confidentiality and security.

Tables 1 show the scoring rubric used for this study to properly treat the gathered data.

Table 1: Scoring Rubric for Cognitive Determinants

Range	Verbal Interpretation	Verbal Description
4.60 – 5.00	Strongly Agree	The BSIT students show very good competencies to different cognitive determinants.
3.60 – 4.59	Agree	The BSIT students show good competencies to different cognitive determinants.
2.60 – 3.59	Neutral	The BSIT students show either good or bad competencies to different cognitive determinants.
1.60 – 2.59	Disagree	The BSIT students show bad competencies to different cognitive determinants.
1.00 – 1.59	Strongly Disagree	The BSIT students show worse competencies to different cognitive determinants.

To ensure that the instrument used were valid and reliable, the researchers performed content and face validity checks and reliability analyses to ensure that the

data gathered were valid and reliable. Table 2 shows the result of the reliability analysis using SPSS.

Table 2: Reliability Analysis

Instrument	Cronbach's Alpha	No. of Items
Cognitive Determinants Questionnaire	0.839	20

III. RESULTS AND DISCUSSION

3.1. The Demographic Profile of the Respondents

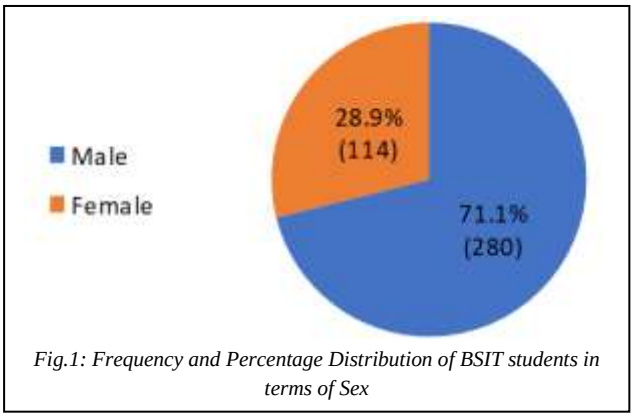

Fig.1: Frequency and Percentage Distribution of BSIT students in terms of Sex

Fig. 1 presents the frequency and percentage distribution of BSIT students in terms of sex. As presented, 280 of 394 respondents, or 71.1 percent, were male while 114 respondents, or 28.9 percent, were female. A 42.2 percent difference between males and females exists, indicating that male-dominated students in the program. A study conducted by Chan et al. (2000) composed of 7,411 respondents revealed that more males have a higher interest in Information Technology careers, making them pursue IT-related programs. Results of this study about the gender gap between male and female also affirm the studies of Fried (2013) and Margolis (2013) that females are still underrepresented in the field of computing, posing an opportunity for academic institutions to provide more avenues for women to be empowered in the field of computing.

In a study conducted by Luciano and Bantug (2019) and Olipas and Luciano (2020), results suggest that more male students were enrolled in the college compared to female, posing an opportunity for the college to devise other programs that would encourage more females to engage in computing and enroll in IT program. As the global landscape continuously evolves, diversity is essential, and the gender gap in computing must be narrow down.

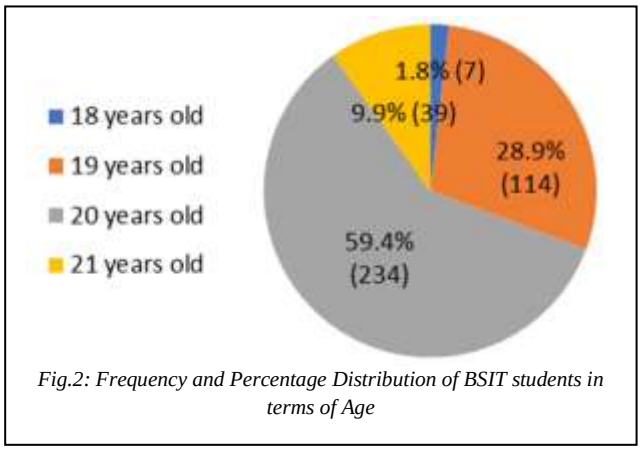

Fig.2: Frequency and Percentage Distribution of BSIT students in terms of Age

Fig. 2 presents the frequency and percentage distribution of BSIT students in terms of Age. Of the 394 respondents, seven were 18 years old, constituting 1.8 percent, 114 were 19 years old or equivalent to 28.9 percent, 234 or 59.4 percent belonged to the 20 years old bracket, and 39 respondents 9.9 percent belongs to the 21 years old category. This study's respondents were sophomore students during the Academic Year 2019-2020, and most of them fall under the 19 and 20 years old age category. Before the implementation of the RA 10533 or the Enhanced Basic Education Act of 2012, students in the tertiary levels mostly fall from the age bracket of 16 to 20 years old, but because of its implementation, an additional two years were added in the secondary level, making the Age of college entry adjust (Official Gazette, 2013).

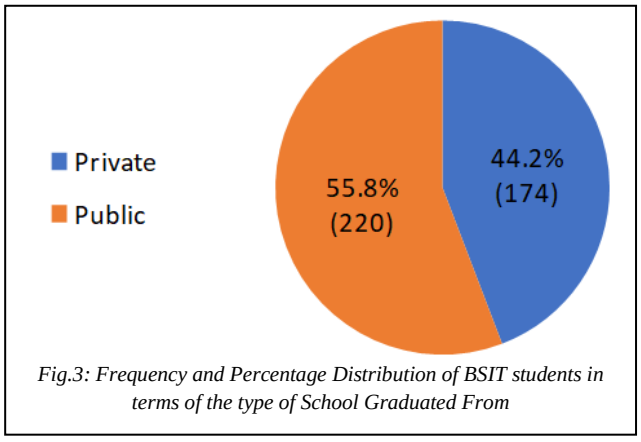

Fig.3: Frequency and Percentage Distribution of BSIT students in terms of the type of School Graduated From

As shown in Fig. 3, 220 or 55.8 percent of the respondents came from public secondary schools, while 174 or 44.2 percent graduated from private secondary schools. There is a close gap between the numbers of students from private and public schools because of the equal access to quality tertiary education. In 2017, the Philippine Congress passed into law "An Act Promoting Universal Access to Quality Tertiary Education" or the RA 10931 giving every student an equal opportunity to study in college. Results revealed that the university provides

equal opportunities for all to access quality tertiary education (Official Gazette, 2017).

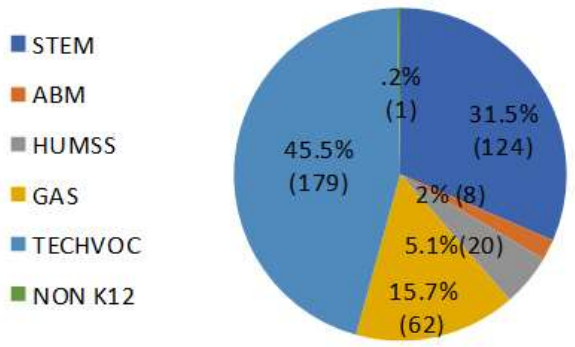

Figure 4: Frequency and Percentage Distribution of BSIT students in terms of Senior High School Strand

Fig. 4 shows the frequency and percentage distribution of BSIT students in terms of the Senior High School strands they have taken in their secondary education. One hundred seventy-nine or 45.5 percent of the total number of respondents took Technical-Vocational Strand, 124 or 31.5 percent took Science, Technology, and Engineering Track, 62 or 15.7 came from the General Academic Track, 20 or 5.1 percent from Humanities and Social Sciences, 8 or 2 percent from the Accountancy, Business, and Management, while there was one who was not a K12 graduate. In general, most students took SHS strands aligned in the Information Technology program, making them more prepared and oriented.

3.2. The Cognitive Determinants of BSIT Students

Cognitive determinants are composed of BSIT students' competencies to describe their over-all academic self-efficacy, including academic competency, test competency, time management, and strategic study habits.

DiPerna and Elliott (2000; 2002) define academic competence as “a multidimensional construct consisting of the skills, attitudes, and behaviors of learners that contribute to success in the classrooms” (p. 294). Students must develop significantly in higher education to prepare them for the world of work. Presented in Table 3 is the weighted mean and verbal interpretation for assessing the level of BSIT students’ academic competence - one of the cognitive determinants.

Table 3: Academic Competence of IT Students

Items	Weighted Mean (WM)	Verbal Interpretation
I have been able to manage the academic course load	3.533	Neutral
I easily understand course material taught.	3.396	Neutral
I find the courses interesting.	3.944	Agree
I enjoy courses offered in the IT curriculum	3.893	Agree
I always do my best to understand course material.	4.363	Strongly Agree
Academic Competence Overall Grand Mean	**3.826**	
Verbal Interpretation	**Agree**	

Results show a grand mean of 3.826, indicating that students demonstrate "very good" academic competence in the college. Specifically, students were able to manage the academic course load in the college (WM=3.533, SD=0.791), they quickly understood the course material being taught (WM=3.396, SD=0.879), they find the courses being taught in the college exciting (WM=3.944, SD=0.808), they enjoy the courses being offered as part of the curriculum (WM=3.893, SD=0.784), and they strive to do their best to understand all the course material being provided in the college (WM=4.363, SD=0.740).

However, Mah and Ifenthaler (2018), in the case of first-year students in Germany, assert that students often enter higher education unprepared and with unrealistic perceptions about academic competencies. One reason can be attributed to the lack of generic skills, often called 21st-century skills. Since the Philippines have changed the basic education curriculum in 2012 and included additional two-years in the secondary level, the students' generic skills have been further developed. Results indicate that the "very good" academic competence of the IT students can be attributed to their preparation at their high school level. Furthermore, the activities being conducted in the college have contributed to the holistic development of the students as reported in the study of Olipas and Leona in 2020.

Table 4: Test Competence of IT Students

Items	Weighted Mean (WM)	Verbal Interpretation
I can easily manage the amount of course material used for an examination.	3.297	Neutral
I do not find it difficult to prepare for an examination	3.051	Neutral
I can easily cope with examination tension	3.132	Neutral
I usually don't expect complex questions on an examination	2.977	Neutral
I have great difficulty managing the amount of study material for an examination	3.581	Neutral
Test Competence Overall Grand Mean		**3.208**
Verbal Interpretation		**Neutral**

In Table 4, results show the weighted mean and verbal interpretation for assessing the level of BSIT students' test competence. In terms of test competence, students got a "neutral" result indicating that students may or may not have enough test competence as reflected in the overall mean score of 3.208. This may be due to students having difficulty managing the number of study materials in preparation for the examination (WM=3.581, SD=0.838), the contents of the course materials for the exam (WM=3.297, SD=0.654), the tension they feel caused by the examination (WM=3.132, SD=0.586), the actual preparation they conduct for the examination (WM=3.051, SD=0.780), and the ability to foresee complex questions resulting to complacency for the actual examination (WM=2.977, SD=0.540).

Pressley et al. (1997) explain why students are having a hard time taking tests, resulting in declining test competency. The reasons include inconsiderate text in the tests, the inadequate teaching of teachers, and the students' not-so-good information processing. However, the students in the college attributed the primary factor of low test competency to difficulty in managing their time considering their active life as students engaged in different learning experiences and activities. In the study of Olipas and Leona (2020), IT students were identified as participative and engaged in different learning activities in the college; thus, it may have affected their time management relating to testing preparation

Table 5: Time Management of IT Students

Items	Weighted Mean (WM)	Verbal Interpretation
I find it very difficult to balance study and leisure time	2.876	Neutral
I find it difficult to study regularly	3.348	Neutral
I usually end up cramming for examinations	2.774	Neutral
I can organize my study material and leisure time easily	3.414	Neutral
I always start preparing for an examination well in advance	3.162	Neutral
Time Management Overall Grand Mean		**3.115**
Verbal Interpretation		**Neutral**

Table 5 presents the weighted mean and verbal interpretation for assessing the level of BSIT students' ability to manage their time. In general, results show that students are "neutral" in time management. This means that some students can adequately manage their time, while other students cannot due to different factors, as reflected in the overall mean rating of 3.155. Due to lack of time management in taking examinations or tests, some students tend to end up cramming (WM=2.774, SD=0.898) and experience difficulties in balancing their study and leisure time (WM=2.876, SD=1.109). On the other hand, more students tend to start to prepare for an examination in advance (WM=3.162, SD=1.152), do not always find it difficult to study (WM=3.348, SD=1.001), and can organize study materials and leisure time easily (WM=3.414, SD=0.978) as reflected in the more loose distribution of data shown in the value of standard deviation.

Based on the assessment results relating to time management, it can be viewed that time management is a challenge for IT students. Results revealed that some could manage their time effectively, while others are having a

hard time. Students usually find it hard to regulate and manage their time for school and other activities, resulting in time mismanagement, poor sleep patterns, and increased stress levels (Van der Meer and Torenbeek, 2010; Hardly, 2003). Adams and Blair (2019) explain that effective time management is correlated to more excellent academic performance and lower levels of anxiety in students; yet, it was found out that many students find it hard to find a balance between their studies and day-to-day lives. This is in parallel with this study's results; thus, IT students have to manage their time effectively.

Table 6: Strategic Study Habits of IT Students

Items	Weighted Mean (WM)	Verbal Interpretation
While I am studying, I regularly try to find out what questions' lecturers may ask and they ask examination questions.	3.680	Agree
Planning well in advance is the best way to handle study material.	3.850	Agree
I discuss course materials with my classmates while studying for an examination	3.157	Neutral
I test my knowledge before taking an examination by answering past examination questions and questions from fellow students	3.246	Neutral
While studying, I regularly summarize course materials in my own words	3.437	Neutral
Strategic Study Habits Overall Grand Mean		**3.474**
Verbal Interpretation		**Neutral**

Table 6 shows the weighted mean and verbal interpretation for assessing the strategic study habits of the BSIT students. Generally, more students demonstrate good strategic study habits compared to other aspects as reflected in the overall grand mean of 3.474 interpreted as "neutral." More specifically, results show that more students tend to not summarize course materials in their own words (μ=3.437, SD=1.334), more students do not test their knowledge before taking examinations by answering past examination questions and questions from fellow students (μ=3.246, SD=1.184), and more students do not usually discuss course materials to their classmates while studying for examination (μ=3.157, SD=1.112). On the other hand, results revealed that students find it very beneficial that planning is the best way to handle study materials (μ=3.850, SD=0.814) and that regularly trying to find out what questions may be asked by their instructors and professors in the examination would help them very well (μ=3.680, SD=0.919).

While the results suggest a "neutral" practice between positive and negative strategic study habits, IT students are more inclined to demonstrate positive habits. IT students must effectively develop strategic study habits because developing good study skills and learning strategies would keep high motivation and enable them to achieve their goals easily and efficiently. Further, good strategic study habits would help them improve life-long skills, increase their confidence and self-esteem, and lead to better academic performance (Student Wellness Center, 2017).

3.3. The Relationship Between Cognitive Determinants and Academic Performance

Table 7: Correlation between Cognitive Determinants and Academic Performance

Variables		Cognitive Determinants	Verbal Interpretation
Academic Performance	r	0.443	Significant Relationship
	p-value	0.000	

**Correlation is significant at the 0.05 level (2-tailed)*

In Table 7, the test of the relationship between academic performance and cognitive determinants has been presented, indicating that based on the computed value *(p = 0.000)*, a significant relationship exists. The correlation coefficient or the computed r is equal to 0.443, indicating a low positive correlation between the variables. Ubaka et al. (2015) support the result of this study, indicating that cognitive determinants have significant relationships to students' high and low academic performance.

IV. CONCLUSION

Results revealed that in terms of the demographic profile of the BSIT students, the number of male students was more significant than the number of female students. There was a small gap between the number of students

who graduated from public and private secondary academic institutions; and technical-vocational track and academic track, specifically science, technology, engineering, and mathematics, are the two senior high school tracks IT students had taken. In assessing the cognitive determinants, academic competence and test competence are very evident to them, with mean ratings of 3.826 and 3.208, respectively. However, time management and strategic study habits need to be improved based on the mean ratings of 3.115 and 3.414, respectively.

In assessing the relationship between the variables, it was found out that academic performance has a significant relationship with cognitive determinants ($r = 0.443$, $p < .0.05$).

V. RECOMMENDATIONS

Based on the results, the following recommendations were made by the researchers:

1. To lessen the gender gap between male and female enrolled in computing courses, the college may strengthen information dissemination to improve the number of females engaging in computing courses;
2. Academic competence and test competence may be continuously strengthened by incessantly improving the quality of teaching-and-learning in the college to maintain very evident competencies among students;
3. Time management and strategic study habit training may be given to students to improve this area; and
4. Devise new inclusive learning strategies in Information Technology to increase the student's academic performance.

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