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Effect of Knowledge in Logical Arithmetic towards Technological Knowledge of 3rd Year Education Students Major in Mathematicsin Davao del Norte State College

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ABSTRACT:

The abstract reasoning is a thinking ability that people use to think from different edges in order to solve problems. Some computer problems involve logical thinking like mathematics structure, for relationships like the hypotheses and given statements, and for a sequence of reasoning that makes the conclusion more reasonable. Technological knowledge is the ability to think problems in an abstract manner or an ability to see more solutions opportunities. We conducted this research to determine if there is a relationship between knowledge in logical arithmetic and technological knowledge. In the results, the mean of the capacity of the student's knowledge in logical arithmetic is 1.811 with a standard deviation of 1.412. This shows that the capacity of the student's knowledge in logical arithmetic is very low while the mean capacity of the student's technological knowledge is 3.595 with a standard deviation of 0.920. This shows that the capacity of the student's technological knowledge is moderate. It has also found out that there is no significant relationship between student's knowledge in logical arithmetic and technological knowledge and also social status, age and gender has nothing to do with the student's knowledge capacity.

Keywords: Abstract Reasoning, Logical Arithmetic, Technological Knowledge, Mathematics, Philippines

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1. INTRODUCTION

Abstract Reasoning is also known as fluid intelligence or analytic intelligence. It is the ability to analyze novel problems, identify the patterns and the relationships that underpin this problems [1]. Therefore, abstract reasoning is a good enhancement on individuals thinking ability, it let the person think in different edges on figuring out the problems.

Logical thinking is the process in which one uses reasoning consistency to come to a conclusion. Some computer problems or computer states (situations) involving logical thinking always call for mathematics structure, for relationships between some hypotheses and given statements, and for a sequence of reasoning that makes the conclusion more reasonable [2]. Trends in Mathematics and Science Study (TIMSS) and International Association for the Evaluation of Educational Achievement (IEA) 2003 data revealed the alarming facts for the participating countries most especially the Philippines. The recent TIMMS 2003 data showed that Filipino students' poor mathematical performance has placed the country in the 36th rank out of 38 nations worldwide [3].

Microsoft Word is a word processing program that is used to create professional looking documents such as reports, resumes, letters, memos, and newsletters. Microsoft Excel includes the knowledge and skills required to analyze information in an electronic worksheet. Microsoft PowerPoint includes the knowledge and skills required to communicate effectively with presentation software, and to use simple functions specific to creating and editing presentations [4]. As to vast rise of technology, individuals should practice on operating the Microsoft Office, as it's the most convenient mode in delivering and presenting of lessons, through Microsoft Word, Presentation and Excel. Hardware is what the computer is physically made up of; which includes the monitor, keyboard and mouse, and all of its internal components which allows it to store, receive, and process information and data [5]. In order to successfully present a discussion, or to use the computer, it's necessary to learn the basic computing hardware parts. Having the basic potential will let you set up the devices accurately, this will also have you the privilege on fixing the computer if by chance it will be disassemble.

When we face real complex technological problems. Among computer science articles ([30], [31]), the characteristics most commonly referred to about CT are abstraction and PS. The ability to think of problems in a more abstract manner is essential to students‟ ability to see more solution opportunities. Thinking in this abstract manner, or computationally, is a way of accessing solutions that are usually outside a student's normal area of expertise or schemata [6]. According to [7], from 310,812 IE employees, 56.9 percent used computer routinely at work in 2015. This percentage was higher by 10.3 percentage points than the 46.6 percent reported in 2013. This means that professionals need to be knowledgeable with technological skills, for technology will be routinely used as to their working field. As will be further discussed in what follows, electronic computers have a deep influence on mathematics. In addition to providing previously unthinkable capacity for computation—in Ada Lovelace's wide sense of computation—they have inspired new ways of thinking about fundamental concepts in mathematics, such as the notions of proof, computation, and mathematical knowledge [8]. This study needs to be conducted to have further studies about relation of logical arithmetic knowledge to the technological knowledge

Theoretical Framework

The theory used in this research is Problem Solving and Computers in a Learning Environment Theory. It was developed by Michael Gr. Voskoglou and Sheryl Buckley. This was used to study person's logical critical thinking and computational thinking on computers. Voskoglou and Buckley also defined that "critical thinking" is considered to be higher, non-algorithmic, complex mode of thinking that often generates multiple solutions [9]. The theory indicates that computational thinking is a hybrid of other modes of thinking, like abstract thinking, logical thinking, modelling thinking, and constructive thinking [9], as applied to the study, this theory holds that It would expect our independent variables abstract reasoning and knowledge on operation of numbers to influence our dependent variables microsoft office knowledge and basic computer hardware knowledge.

When computers are used in the PS situation, the need for computational thinking (CT) is another prerequisite. CT has been coined by J. Wing [9] and broadly speaking it describes a set of thinking skills that are integral to solving complex problems using a computer. Living in a knowledge era and an ever increasing progress in technology, combining knowledge and technology to solve problems is becoming the mode rather than the exception. Creativity and innovation driven by tacit knowledge, and critical thinking driven by logic, making judgements, analysis and synthesis and so on become the tools for problem thinking and PS [10].

Conceptual Framework

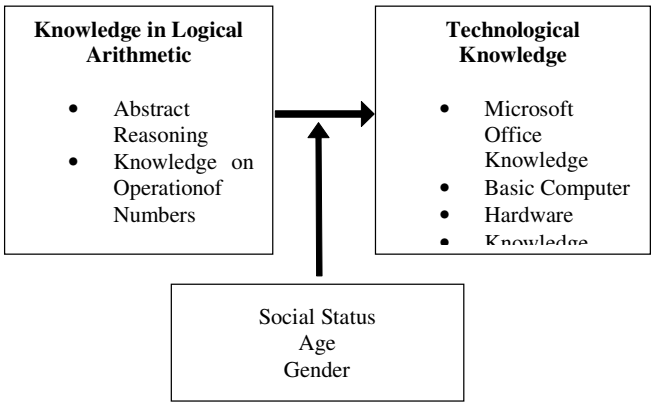

Figure 1. Conceptual Framework of the study

Figure 1 shows what are the capabilities of the 3rd Year Bachelor of Science in Education Major in Mathematics students and its Knowledge in Logical Arithmetic has the following indicators such as: Abstract Reasoning and Knowledge on Operation of Numbers. The Technological Knowledge that has its indicators such as: Microsoft Office Knowledge and Basic Computer Knowledge. The moderating variables are Social Status, Age and Gender.

Research Questions

This study aims to determine whether the Knowledge in Logical Arithmetic is related to the Technological Knowledge of 3rd Year Bachelor of Science in Education Major in Mathematics in Davao del Norte State College. Especially, this study seeks to answer the following questions:

R1. What is the capacity of the student's knowledge in logical arithmetic in terms of:

a. Abstract Reasoning

b. Knowledge on Operation of Numbers

R2. What is the capacity of the student's technological knowledge in terms of:

a. Microsoft Office Knowledge

b. Basic Computer Hardware

R3. Is there a significant difference in knowledge in logical arithmetic when grouped according to:

a. Social Status

b. Age

c. Gender

R4. Is there a significant difference in technological knowledge when grouped according to:

a. Social Status

b. Age

c. Gender

R5. Is there a significant relationship between the knowledge in logical arithmetic and technological knowledge of 3rd year Bachelor of Science in Education Major in Mathematics in Davao del Norte State College?

R6. Does logical arithmetic knowledge directly affect the technological knowledge?

Null Hypothesis

Ho1: There is no significant difference in the Logical Arithmetic Knowledge when grouped according to:

a. Social Status

b. Age

c. Gender

Ho2: There is no significant difference in the Basic Computing Skill when grouped according to:

a. Social Status

b. Age

c. Gender

Ho3: There is no significant relationship between the Knowledge in Logical Arithmetic and Technological Knowledge in 3rd YearBachelor of Science in Education Major in Mathematics in Davao del Norte State College.

Ho4: The knowledge in logical arithmetic do not significantly influence the technological knowledge of 3rd year Bachelor of Science in Education Major in Mathematics in Davao Del Norte State College.

II. METHODOLOGY

Research Design

The researchers utilize the correlational research design in will determine the correlation between knowledge in logical arithmetic with technological knowledge. Answering the research objectives is the main purpose of all the research. This method is appropriate in this study to determine if there is a correlation between knowledge in logical arithmetic and technological knowledge.

Research Locale

The study was conducted at Davao del Norte State College located at New Visayas, Panabo City Davao del Norte Philippines 8105. The place was selected with the efficiency of the study among 3rd Year Bachelor of Science in Education Major in Mathematics Students.

Participants the Study

The respondents of the study are the 3rd Year Bachelor of Science in Education Major in Mathematics Students of Davao del Norte State College. The researchers gave google form link to every person selected and answered the questions relating with the study indicators, the results were tested and evaluated with their answers with the given questions.

Sampling Techniques

Random sampling refers to a variety of selection techniques in which sample members are selected by chance, but with a known probability of selection. Most Social science, business, and agricultural surveys rely on random sampling techniques for the selection of survey participants or sample units, where the sample units may be persons, establishments, land points, or other units for analysis. Random sampling is a critical element to the overall survey research design [10]. Random Sampling was the most appropriate to use since the study's target respondents were specified with 3rd year level major in mathematics students and probably will be selected by chance. Thus, the researchers selected respondents who are willing to be part of the study, as long as their profiles are hidden and categorized as 3rd year level major in mathematics students.

Statistical Treatments

All the responses gathered from survey questionnaire of the respondents were tallied and tabulated using JASP Statistics. The researchers asked assistance from the statistician to analyze and interpret the results utilizing the appropriate statistical tool.

T-test – analysis of two populations means through the use of statistical examination. The formula used to calculate the T Test is,

$$t = \frac{\overline{x_1} - \overline{x_2}}{\sqrt{\frac{S_1^2}{N_1} + \frac{S_2^2}{N_2}}}$$

Where:

x_1 is the mean of first data set x_2 is the mean of second data set S_1^2 is the standard deviation of first data set

S_2^2 is the standard deviation of second data set

N_1 is the number of elements in the first data set N_2 is the number of elements in the second data set

ANOVA –way to find out if survey or experiment results are significant. In other words, it will help the study to figure out if you need to reject the null hypothesis or accept the alternate hypothesis. Below are the formula represents one-way ANOVA test:

$$F = \frac{MST}{MSE}$$

Where:

F = Anova Coefficient `

MST = Mean sum of squares due to treatment MSE = Mean sum of squares due to error.

Formula for MST is:

$$MST = \frac{SST}{p-1}$$

$$SST = \sum n(x - \bar{x})^2$$

Where:

SST = Sum of squares due to treatment p = Total number of populations n = The total number of samples in a population.

Formula for MSE is:

$$MSE = \frac{SSE}{N - p}$$

$$SSE = \sum(n - 1)S^2$$

Where:

SSE = Sum of squares due to error

S = Standard deviation of the samples

N = Total number of observations.

Pearson r –it is known as the best method of measuring the association between variables. It gives information about the magnitude of the association, or correlation, as well as the direction of the relationship of two variables. The formula is:

$$r = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{\sqrt{[n\Sigma x^2 - (\Sigma x)^2][n\Sigma y^2 - (\Sigma y)^2]}}$$

Where:

N = number of pairs of scores

Σxy = sum of the products of paired scores

Σx = sum of x scores

Σy = sum of y scores

Σx2 = sum of squared x scores

Σy2 = sum of squared y scores

Research Instrument

This research was adopted from the study Technology and Mathematics in Sweden by Sven Ove Hanson from Teknikrigen 76, 100 44, Stockholm Sweden from Royal Institute of Technology. This study was conducted on Sweden to outline technology to mathematics relationship. The study evaluated three important philosophical issues: how mathematical knowledge depends on technology, the definition of the hybrid concept of a (technological) computation, and the usefulness of mathematics in technology [8]. Moreover, the study's purpose was to the modern use of computers to solve both technological and mathematical problems [8]. In conclusion, it is argued that much more of interest can be found in the historically and philosophically unexplored terrains of the technology–mathematics relationship [8].

Data Collection Procedure

The researchers asked permission to the target respondents of Davao del Norte Stater College, 3rd Year Bachelor of Science in Education Major in Mathematics Student

s. Thus, the purpose of the study was indicated along the survey form why the researchers are requesting them to be part of this survey. Thereafter, research released the inform consent to the target respondents to ask permission to be granted in the knowledge of the possible consequences, their confidentiality and benefits with the research. Upon the approval from the respondents to participate with the research informed consent being signed, the researcher distributed the questionnaires through sending a link of an online survey questionnaire to the target respondents. After the distribution of the survey questionnaires, the data collected answered online, tallied, analyze and put through interpretation using the appropriate statistical tools.

Ethical Considerations

The researchers gave the informed consent to the respondents after they were being asked by the researchers to participate and explained the purpose of this research along with the survey form. The informed consent is for the protection of the respondent confidentiality the input for names is optional to if they wanted to keep their identities unidentifiable but an identification number is required to confirm the validity of the respondents. The informed consent also indicates the researches contact information's in any case the respondents have queries regarding with their rights as research participants.

III. RESULTS AND DISCUSSIONS

All participants of the survey are 20 years old and above and a student of Davao del Norte State College. The presentation of data in this research study are arranged in the following sequence: The Capacity of the student's knowledge in terms of Abstract Reasoning and Knowledge on Operation of Numbers, The Capacity of the student's knowledge in terms of Microsoft Office Knowledge and Basic Computer Hardware, The Significant Difference in Knowledge in Logical Arithmetic when grouped according to Social Status, Age and Gender, The Significant Difference in Technological Knowledge when grouped according to Social Status, Age and Gender. The Significant Relationship Between Knowledge in Logical Arithmetic and Technological Knowledge of 3rd Year Bachelor of Science in Education Major in Mathematics in Davao del Norte State College.

RQ1. What is the capacity of the student's knowledge in logical arithmetic in terms of Abstract Reasoning and Knowledge on Operation of Numbers?

Table I shows the capacity of the student's knowledge in terms of Abstract Reasoning (AN) and Knowledge on Operation of Numbers (KON). The mean of abstract reasoning score of respondents is 2.243 with a standard deviation of 1.422. This shows that the capacity of the student's knowledge in terms of abstract reasoning is low. The mean of knowledge on operation of numbers score of respondents is 1.378 with a standard deviation of 1.401. This shows that the capacity of the student's knowledge in operation of numbers is very low.

The mean of the capacity of student's knowledge in abstract reasoning is 1.811 with a standard deviation of 1.412. This shows that the capacity of student's knowledge in logical arithmetic is very low.

TABLE I.
CAPACITY OF STUDENT'S KNOWLEDGE IN TERMS OF ABSTRACT REASONING AND KNOWLEDGE ON OPERATION OF NUMBERS

	AR	KON	OVERALL MEAN
N	37	37	---
Mean	2.243	1.378	1.811
Std. Deviation	1.422	1.401	1.412

RQ2. What is the capacity of the student's technological knowledge in terms of Microsoft Office Knowledge and Basic Computer Hardware?

Table II shows the capacity of the student's knowledge in terms of Microsoft Office Knowledge (MOK) and Basic Computer Hardware (BCH). The mean of microsoft office knowledge score of respondents is 3.459 with a standard deviation of 1.070. This shows that the capacity of the student's knowledge in terms of microsoft office knowledge is moderate. The mean of basic computer hardware score of respondents is 3.730 with a standard deviation of 0.769. This shows that the capacity of the student's knowledge in terms of basic computer hardware is moderate.

The mean of the capacity of student's knowledge in technological knowledge is 3.595 with a standard deviation of 0.920. This shows that the capacity of student's knowledge in technological knowledge is moderate.

TABLE II.
CAPACITY OF STUDENT'S KNOWLEDGE IN TERMS OF MICROSOFT OFFICE KNOWLEDGE AND BASIC COMPUTER HARDWARE

	MOK	BCH	OVERALL MEAN
N	37	37	---
Mean	3.459	3.730	3.595
Std. Deviation	1.070	0.769	0.920

RQ3. Is there a significant difference in knowledge in logical arithmetic when grouped according to Social Status, Age and Gender?

Table III and Table IV shows the result that the p-value of the knowledge in logical arithmetic when grouped according to social status is 0.337>0.05, then we accept null and reject the alternative hypothesis. There is no significant difference in knowledge in logical arithmetic when grouped according to social status. This implies that the social status of a person does not affect the knowledge in logical arithmetic.

TABLE III.
SIGNIFICANT DIFFERENCE IN KNOWLEDGE IN LOGICAL ARITHMETIC WHEN GROUPED ACCORDING TO SOCIAL STATUS (ANOVA)

Cases	Sum of Squares	df	Mean Square	F	p
Social Status	144.105	4	36.026	1.184	0.337

TABLE IV.
SIGNIFICANT DIFFERENCE IN KNOWLEDGE IN LOGICAL ARITHMETIC WHEN GROUPED ACCORDING TO SOCIAL STATUS (DESCRIPTIVES)

Social Status	Mean	SD	N
Low Income	1.500	0.957	7
Middle Middle Class	6.714	12.526	7
Poor	1.738	1.254	13
Upper Income	2.300	1.255	5
Upper Middle Income	1.400	0.652	5

Table V and Table VI shows the result that the p-value of the knowledge in logical arithmetic when grouped according to age is 0.810>0.05, then we accept null and reject the alternative hypothesis. There is no significant difference in knowledge in logical arithmetic when grouped according to age. This implies that the age of a person does not affect the knowledge in logical arithmetic.

TABLE V.
SIGNIFICANT DIFFERENCE IN KNOWLEDGE IN LOGICAL ARITHMETIC WHEN GROUPED ACCORDING TO AGE (ANOVA)

Cases	Sum of Squares	df	Mean Square	F	p
Age	31.758	3	10.586	0.322	0.810

TABLE VI.
SIGNIFICANT DIFFERENCE IN KNOWLEDGE IN LOGICAL ARITHMETIC WHEN GROUPED ACCORDING TO AGE (DESCRIPTIVES)

Age	Mean	SD	N
20	3.700	8.709	15
21	1.967	1.196	12
22	1.500	0.577	7
23	3.000	1.803	3

Table VII and Table VIII shows the result that the p-value of the knowledge in logical arithmetic when grouped according to gender is 0.273>0.05, then we accept null and reject the alternative hypothesis. There is no significant difference in knowledge in logical arithmetic when grouped according to gender. This implies that the gender of a person does not affect the knowledge in logical arithmetic.

TABLE VII.
SIGNIFICANT DIFFERENCE IN KNOWLEDGE IN LOGICAL ARITHMETIC WHEN GROUPED ACCORDING TO GENDER (T-TEST)

	t	df	p
Logical Arithmetic	1.113	35	0.273

TABLE VIII. SIGNIFICANT DIFFERENCE IN KNOWLEDGE IN LOGICAL ARITHMETIC WHEN GROUPED ACCORDING TO GENDER
(DESCRIPTIVES)

	Group	N	Mean	SD	SE
Logical Arithmetic	F	13	4.046	9.362	2.597
	M	24	1.917	1.100	0.225

RQ4. Is there a significant difference in technological knowledge when grouped according to Social Status, Age and Gender?

Table IX and Table X shows the result that the p-value of the technological knowledge when grouped according to social status is 0.127>0.05, then we accept null and reject the alternative hypothesis. There is no significant difference in knowledge in technological knowledge when grouped according to social status. This implies that the social status of a person does not affect their technological knowledge.

TABLE IX.
SIGNIFICANT DIFFERENCE IN TECHNOLOGICAL KNOWLEDGE WHEN GROUPED ACCORDING TO SOCIAL STATUS
(ANOVA)

Cases	Sum of Squares	df	Mean Square	F	p
Social Status	89.592	4	22.398	1.944	0.127

TABLE X.
SIGNIFICANT DIFFERENCE IN TECHNOLOGICAL KNOWLEDGE WHEN GROUPED ACCORDING TO SOCIAL STATUS
(DESCRIPTIVES)

Social Status	Mean	SD	N
Low Income	3.429	0.535	7
Middle Middle Class	4.000	0.707	7
Poor	3.423	0.672	13
Upper Income	3.700	0.570	5
Upper Middle Income	8.100	9.450	5

Table XI and Table XII shows the result that the p-value of the technological knowledge when grouped according to age is 0.671>0.05, then we accept null and reject the alternative hypothesis. There is no significant difference in knowledge in technological knowledge when grouped according to age. This implies that the age of a person does not affect their technological knowledge.

TABLE XI. SIGNIFICANT DIFFERENCE IN TECHNOLOGICAL KNOWLEDGE WHEN GROUPED ACCORDING TO AGE
(ANOVA)

Cases	Sum of Squares	df	Mean Square	F	p
Age	20.701	3	6.900	0.520	0.671

TABLE XII. SIGNIFICANT DIFFERENCE IN TECHNOLOGICAL KNOWLEDGE WHEN GROUPED ACCORDING TO AGE
(DESCRIPTIVES)

Age	Mean	SD	N
20	5.100	5.527	15
21	3.500	0.798	12
22	3.786	0.636	7
23	3.500	0.500	3

Table XIII and Table XIV shows the result that the p-value of the technological knowledge when grouped according to gender is 0.661>0.05, then we accept null and reject the alternative hypothesis. There is no significant difference in knowledge in technological knowledge when grouped according to gender. This implies that the gender of a person does not affect their technological knowledge.

TABLE XIII. SIGNIFICANT DIFFERENCE IN TECHNOLOGICAL KNOWLEDGE WHEN GROUPED ACCORDING TO GENDER
(T-TEST)

	t	df	p
Technological Knowledge	-0.442	35	0.661

TABLE XIV. SIGNIFICANT DIFFERENCE IN TECHNOLOGICAL KNOWLEDGE WHEN GROUPED ACCORDING TO GENDER
(DESCRIPTIVES)

	Group	N	Mean	SD	SE
Technological Knowledge	F	13	3.846	0.474	0.131
	M	24	4.396	4.438	0.906

RQ5. Is there a significant relationship between the knowledge in logical arithmetic and technological knowledge of 3rd year Bachelor of Science in Education Major in Mathematics in Davao del Norte State College?

Table XV shows the result of analyzing the significant relationship between knowledge in logical arithmetic and technological knowledge of 3rd year Bachelor of Science in Education Major in Mathematics in Davao del Norte State College.

TABLE XV. SIGNIFICANT RELATIONSHIP BETWEEN THE KNOWLEDGE IN LOGICAL ARITHMETIC AND TECHNOLOGICAL KNOWLEDGE OF 3RD YEAR BACHELOR OF SCIENCE IN EDUCATION MAJOR IN MATHEMATICS IN DAVAO DEL NORTE STATE COLLEGE

Variable		Logical Arithmetic	Technological Knowledge
1. Logical Arithmetic	Pearson's r	—	
	p-value	—	
2. Technological Knowledge	Pearson's r	-0.063	—
	p-value	0.711	—

The r-value is -0.063 which means that there is no linear relationship between logical arithmetic and technological knowledge. Since the p-value 0.711>0.05, then we accept the null and reject the alternative hypothesis. Thus, there is no significant relationship between logical arithmetic and technological knowledge of 3rd year Bachelor of Science in Education Major in Mathematics students in Davao del Norte State College.

The grey dots represent the 37 coordinates which stand as the score of each respondents in the independent and dependent variables. The black line stands for the trend of relationship that represents the arrangements of the dots.

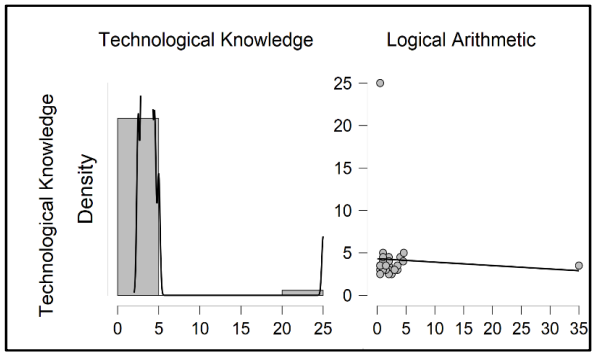

Fig. 2 Scatterplot and Density of data values

RQ6. Does logical arithmetic knowledge directly affect the technological knowledge?

TABLE XVI. SIMPLE LINEAR REGRESSION RESULTS

Source	DF	Sum of Square	Mean Square	F Statistic	P-value
Regression	1	1.8224	1.8224	0.1398	0.7108
Residual	35	456.4073	13.0402		
Total	36	458.2297	12.7286		

The linear regression model, $Y = b_0 + b_1X + \varepsilon$, does not provide a better fit than the model without the independent variable resulting in, $Y = b_0 + \varepsilon$. The Slope (a): two-tailed, T(35) = -0.3738, p-value = 0.7108. For one predictor, it is the same as the p-value for the overall model. The Y-intercept (b): two-tailed, T(35) = 6.5332, p-value = 1.542e-7. Hence b is significantly different from zero.

R Square (R^2) equals 0.003977. it means that 0.4% of the variability of technological knowledge is explained by logical arithmetic. Correlation (R) equals -0.06306, it means that there is a very weak inverse relationship between logical arithmetic and technological knowledge. Overall regression: right-tailed, F(1,35) = 0.1398, p-value = 0.7108. Since p-value 0.7108>0.05, we accept the null and reject the alternative hypothesis.

The results also relates to the study of Buladaco et al, wherein technology in general has been a large part of the students motivation in their learnings and education especially in higher education [10].

IV. CONCLUSIONS AND RECOMMENDATIONS

In this research paper, the researchers addressed that there is no significant relationship between knowledge in logical arithmetic and technological knowledge of 3rd year Bachelor of Science in Education Major in Mathematics students in Davao del Norte State College based on the student's capability. 37 out of 40 students participated as the respondents. The results found out that the

knowledge in logical arithmetic is not related to technological knowledge. Also, the social status, age and gender has nothing to do with the student's capability in logical arithmetic and technological knowledge.

Based on the results of this study, the researchers suggest further studies regarding this problems, with the use of different variable indicators to know or gain more knowledge about these problem, thus, having different samples gains different results.Sentiments analysis can also be applied with the qualitative data to gather tweets from students posting in social media which can better understand the emotions of these students when playing games. This is evident as machine learnings are used to analyze tweets in transport infrastructure [11].

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