

FRESHMEN STUDENTS' COGNITIVE DEVELOPMENT IN BASIC MATHEMATICS**Rynheart P. Atmosfera**Faculty, Abra State Institute of Sciences and Technology,
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Abstract: The study aimed to determine the level of cognitive development of the first year college students of the Abra State Institute of Sciences and Technology in Basic Mathematics. It also determined the relationship between the level of cognitive skills of the students and their level of performance in the different content areas in Basic Mathematics.

The descriptive- correlational research method was employed in analysing and interpreting the data in this study.

The respondents had a “Satisfactory” performance on Knowledge, Comprehension, Application, Synthesis, and Evaluation and as a whole while they however, performed “Fairly” in Analysis.

The respondents had a “Very Satisfactory” level of development in The Numeration System and Decimals while a “Satisfactory” performance was executed in Real Number System, Fundamentals of Number Theory, Rational Numbers, Ratio, Proportion and Percent and as a whole.

The results of the study may be used as an encouragement to students not to disregard basic concepts in Mathematics in order to achieve better understanding of the subject and have a strong foundation in Mathematics.

Keywords: Cognitive Development, Basic Mathematics, Freshmen Students

INTRODUCTION

Mathematics is like a necessity that must be learned and utilized either consciously or unconsciously. Its importance is evident throughout the world. Its applications could be seen not only inside the classroom but also in nature, and in other areas of life.

Basic mathematics skills are being mastered in the elementary and secondary levels of the basic education program in the Philippines. However, recent international competition in Mathematics and Science showed that the Philippines ranked third, fourth and second—to the last—among the countries which participated in the 1999, 2003 and 2008 Third International Mathematics and Science Study (TIMSS), respectively. The aggressiveness of the Philippines has softened down from forty seven in 2001 to seventy seven in 2007 out of 117 countries that

were evaluated. This can be attributed to issues within the country's basic education sector, that critics have represented as being in an associate dreadful state. Performance indicators have shown worsening competencies in math and science manifested by the poor performance of Filipino students in international assessment tests. (COMSTE, 2008)

With this dilemma, The Philippine Senate admitted that the students' performance in terms of Science, Math and Technology remains lacklustre which contributed to the persistence of poverty in the country. Senator Edgardo Angara, who is the chairman of the Senate Committee on Education, Arts and Culture, lamented country's poor performance in worldwide competitiveness rankings especially in the mastery of math and science. (Horario, 2012)

Further, in an analysis made by Carballo on the status of Math and Science Education in the country, the Department of Education data show that achievement rate of fourth year students in Math dropped from 50.70% in SY 2005-2006 to 47.82% in SY 2006-2007. The decline conjointly happened in Science, from 39.49% to 37.98% in the same period. A Science and Education Institute study on Trends in Mathematics and Science Study (TIMSS) in 2003 showed that Philippines' 8th grade (2nd year high school) students' skills and competencies in science hierarchic a pitiful forty second out of forty six taking part countries whereas the Philippine fourth grade students placed twenty third out of twenty five taking part countries. The 2004 government report on Philippine TIMSS showed that in four years since the Third International arithmetic and Science Study Repeat (TIMSS-R) in 1999, only seven regions showed improvements in Math competencies among the 8th grade students. Results of the coed action take a look at indicate terribly poor performance in every content domain at this early education stage. Further, analysing the facts presented by the department, elementary achievement rate in Grade 6 Math is 60.29% in SY 2006-2007, up by 6.63% compared to 53.66% posted in SY 2005-2006. Also, Science achievement rate in the same grade level rose from 46.77% in SY 2005-2006 to 51.58% in SY 2006-2007 which boasts an increase of 4.81% in their scores but within the same report, high school achievement rate in Science and Math declined in the same period. This is a minacious manifestation of children's loss of interest in Science and science as they move more within the tutorial ladder.

Students' mathematics performance in the classroom may be gauged and improved by using Bloom's Taxonomy of Questions in the Cognitive Domain. This domain involves information and also the development of intellectual skills. This includes the recall or recognition of specific facts, procedural patterns, and ideas that serve within the development of intellectual talents and skills. Knowledge means to recall data or information. Comprehension is to understand the meaning, translation and interpretation of instructions and problems or to state a problem in one's own words, Application requires the use of a concept in a new situation or unprompted use of an abstraction and applies what was learned in the classroom, Analysis involves skill to separate material or concepts into component parts so that its organizational

structure may be understood and distinguishes between facts and inferences, Synthesis involves building a structure or pattern from diverse elements and put parts together to form a whole, with emphasis on creating a new meaning or structure, and Evaluation is to make judgments about the value of ideas or materials.

Hence, it is the aim of this study to determine the level of cognitive development of the freshmen students of Abra State Institute of Sciences and Technology (ASIST) in Basic Mathematics.

METHODOLOGY

This section presents the procedures and techniques that were used in gathering and analysing the data in the study.

Research Design

This study is descriptive in nature. It described the level of cognitive development of the first year college students of Abra State Institute of Sciences and Technology in Basic Mathematics along the different cognitive skills (Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation) and content areas (The Numeration System, Real Number System, Fundamentals of Number Theory, Rational Numbers, Decimals and Ratio, Proportion and Percent).

Respondents

The respondents of this study were selected through random sampling from the first year college students of Abra State Institute of Sciences and Technology (ASIST) who had already taken the Basic Mathematics course. It is composed of 282 students coming from the different curricular programs offered in the Lagangilang Campus and Bangued Campus.

RESULTS AND DISCUSSIONS

Table 1. Level of Cognitive Development of the Respondents in the Different Cognitive Skills

Cognitive Skills	No. of Items	Campuses				As a Whole	
		Lagangilang		Bangued			
		Mean	DR	Mean	DR	Mean	DR
Knowledge	10	5.42	S	4.83	S	5.00	S
Comprehension	10	5.66	S	5.19	S	5.32	S
Application	10	6.08	VS	5.62	S	5.74	S

Analysis	5	1.96	F	1.44	F	1.57	F
Synthesis	5	3.55	VS	2.75	S	2.97	S
Evaluation	5	3.01	VS	2.15	S	2.38	S
As a Whole	45	25.55	S	21.98	S	22.95	S

Legend:

For 10 items	For 5 items	For 45 items	Descriptive Rating (DR)
8.01-10.0	4.01-5.0	36.01-45.0	Excellent (E)
6.01-8.0	3.01-4.0	27.01-36.0	Very Satisfactory (VS)
4.01-6.0	2.01-3.0	18.01-27.0	Satisfactory (S)
2.01-4.0	1.01-2.0	9.01-18.0	Fair (F)
0-2.0	0-1.0	0-9.0	Needs Improvement (NI)

The respondents from Lagangilang Campus had a “Very Satisfactory” performance in the three cognitive skills namely: Application, Synthesis and Evaluation while a “Satisfactory” performance in Knowledge and Comprehension but a “Fair” performance in Analysis. It can be summed up from that the respondents from Lagangilang Campus had an overall performance of “Satisfactory”. This implies that the respondents had a satisfactorily level of cognitive development in terms of cognitive skills. However, there is still a need to work for excellence. Greater development in Analysis is much desired.

On the other hand, “Satisfactory” performance was executed by the respondents from Bangued Campus in five cognitive skills while they performed “Fairly” in Analysis. In totality, the respondents had an overall performance of “Satisfactory”. This also means that a greater development in Analysis is needed in order to obtain a higher level of cognitive development.

Respondents in both campuses performed “Satisfactorily” in Knowledge, Comprehension, Application, Synthesis and Evaluation with a “Fair” performance in Analysis but as a whole both campuses had an overall performance of “Satisfactory”.

Table 2. Average Difficulty Indices in the Different Cognitive Skills as Measures of Strengths and Weaknesses of the Respondents

Cognitive Skills	Campuses				As a Whole	
	Lagangilang		Bangued			
	P (ave)	ND	P (ave)	ND	P (ave)	ND
Knowledge	0.55	Strong	0.51	Strong	0.53	Strong
Comprehension	0.58	Strong	0.53	Strong	0.56	Strong
Application	0.63	Strong	0.59	Strong	0.61	Strong

Analysis	0.39	Weak	0.30	Weak	0.35	Weak
Synthesis	0.60	Strong	0.59	Strong	0.60	Strong
Evaluation	0.60	Strong	0.46	Weak	0.53	Strong
As a Whole	0.57	Strong	0.51	Strong	0.54	Strong

Legend:

Nature of Difficulty (ND)

0.50-1.0 Strong

0-0.49 Weak

The respondents in Lagangilang Campus proved to be strong in Knowledge, Comprehension, Application, Synthesis and Evaluation but weak in. This shows that the respondents had difficulty in analysing and recognizing implicit statements. As a whole, they were still proved to be strong in the cognitive skills.

On the other hand, respondents strengths from Bangued Campus lay in Knowledge, Comprehension, Application and Synthesis while their weaknesses lies in Analysis and Evaluation. This means that they had difficulty in analysing things and in making judgments. Despite of the two weaknesses, as a whole they were still strong in the cognitive skills.

Further, the respondents from both campuses proved to be strong in five cognitive skills: but still weak in Analysis. This implies that students had really a hard time dealing with Analysis. In totality, the respondents obtained a difficulty index of 0.54 which shows that they were strong in cognitive skills.

Table 3. Mean Level of Cognitive Development of the Respondents in the Different Content Areas in Basic Mathematics

Content Areas	No. of Items	Campuses				As a Whole	
		Lagangilang		Bangued		Mean	DR
		Mean	DR	Mean	DR		
I. The Numeration System	8	5.47	VS	4.58	S	4.82	VS
II. Real Number System	7	4.30	VS	3.34	S	3.59	S
III. Fundamentals of Number Theory	8	3.89	S	2.97	F	3.21	S
IV. Rational Numbers	8	4.03	S	3.60	S	3.72	S
V. Decimals	7	4.86	VS	4.44	VS	4.56	VS
VI. Ratio, Proportion and Percent	7	3.14	S	3.05	S	3.07	S
As a Whole	45	25.55	S	21.98	S	22.95	S

Legend:

For 8 items	For 7 items	For 45 items	Descriptive Rating (DR)	
6.41-8.0	5.61-7.0	36.01-45.0	Excellent (E)	
4.81-6.40	4.21-5.60	27.01-36.0	Very Satisfactory (VS)	
3.21-4.80	2.81-4.20	18.01-27.0	Satisfactory (S)	
1.61-3.20	1.41-2.80	9.01-18.0	Fair (F)	
0-1.60	0-1.40	0-9.0	Needs Improvement (NI)	

Respondents in Lagangilang Campus performed “Very Satisfactorily” in three content areas: The Numeration System , Real Number System and Decimals. They executed a “Satisfactory” performance in Fundamentals of Number Theory (, Rational Numbers (and Ratio, Proportion and Percent as well as in their overall performance. This implies that the respondents are equipped with the fundamentals of Mathematics.

The respondents in Bangued Campus had a “Very Satisfactory” performance in Decimals while a “Satisfactory” performance was executed in four Content areas namely: The Numeration System, Real Number System, Rational Numbers and Ratio, Proportion and Percent. A “Fair” performance was obtained in Fundamentals of Number Theory. This shows that they tend to forget the concepts of divisibility, factorization, GCF and LCM. As a whole, the respondents still performed satisfactorily.

It can be summed up that the respondents in both campuses had an overall performance of “Very Satisfactory” in two content areas: The Numeration System and Decimals; and a “Satisfactory” performance in the other four content areas. In totality, the respondents in both campuses obtained a “Satisfactory” performance. This means that the respondents acquired a high level of cognitive development in the different content areas but they should still be continuously equipped with the fundamentals of Mathematics in order to achieve excellence.

Table 4. Average Difficulty Indices in the Different Content Areas in Basic Mathematics as Measures of Strengths and Weaknesses of the Respondents

Content Areas	Campuses				As a Whole	
	Lagangilang		Bangued		P (ave)	ND
	P (ave)	ND	P (ave)	ND		
I. The Numeration System	0.61	Strong	0.59	Strong	0.60	Strong
II. Real Number System	0.61	Strong	0.50	Strong	0.56	Strong
III. Fundamentals of Number Theory	0.49	Weak	0.41	Weak	0.45	Weak
IV. Rational Numbers	0.51	Strong	0.50	Strong	0.51	Strong

V. Decimals	0.68	Strong	0.63	Strong	0.66	Strong
VI. Ratio, Proportion and Percent	0.52	Strong	0.45	Weak	0.49	Weak
As a Whole	0.57	Strong	0.51	Strong	0.54	Strong

Legend:

Nature of Difficulty (ND)

0.50-1.0 Strong

0-0.49 Weak

The respondents from Lagangilang Campus strengths lies in five content areas but they were found to be weak in Fundamentals of Number Theory which shows that they tend to forget some of the concepts and principles in this content area. It can be summed up that they were still strong in these different content area.

Respondents from Bangued Campus proved to be strong in The Numeration System , Real Number System , Rational Numbers and Decimals. They were found out to be weak in the other two content areas which implies that they had a hard time dealing with these mathematical skills but as a whole they were still found out to be strong.

The respondents from the two campuses were proved to be strong in four content areas while their weaknesses lies in the other two content areas namely: Fundamentals of Number Theory and Ratio, Proportion and Percent but as a whole the respondents were still proved to be strong in the different content areas.

Table 5. Correlation Coefficient Between the Level of Cognitive Development of the Students in the Different Cognitive Skills and Content Areas in Basic Mathematics of Lagangilang Campus

Cognitive Skills	Content Areas						As a Whole
	I	II	III	IV	V	VI	
K	0.446**	0.231*	0.641**	0.346**	0.560**	0.467**	0.677**
C	0.451**	0.402**	0.519**	0.224	0.305**	0.547**	0.617**
Ap	0.464**	0.430**	0.421**	0.280*	0.615**	0.852**	0.805**
An	0.138	0.376**	0.370**	0.365**	0.207	0.084	0.414**
S	0.815**	0.297*	0.359**	0.237*	0.367**	0.276*	0.597**
E	0.382**	0.817**	0.442**	0.235*	0.361**	0.411**	0.681**
As a Whole	0.676**	0.601**	0.711**	0.375**	0.667**	0.707**	1.00**

Legend:

* significant at 0.05 level

where:

K- Knowledge

I- The numeration System

** at 0.01 level of significance

- C- Comprehension
- Ap- Application
- An- Analysis
- S- Synthesis
- E- Evaluation
- II- Real Number System
- III- Fundamentals of Number Theory
- IV- Rational Numbers
- V- Decimals
- VI- Ratio, Proportion and Percent

Knowledge had a significant relationship with The Numeration System, Fundamentals of Number Theory, Rational Numbers, Decimals, Ratio, Proportion and Percent and as a whole at 0.01 level of significance while a significant relationship with Real Number System at 0.05 level of significance. Comprehension had a significant relationship with The Numeration System, Real Number System, Fundamentals of Number Theory, Decimals, Ratio, Proportion and Percent and as a whole at 0.01 level of significance but had no significant relationship with Rational Numbers. Application, Synthesis and Evaluation were significantly related with all the content areas. Analysis had a significant relationship with Real Number System, Fundamentals of Number Theory, Rational Numbers and as a whole at 0.01 level of significance but not related with the other content areas.

Table 6. Correlation Coefficient Between the Level of Cognitive Development of the Students in the Different Cognitive Skills and Content Areas in Basic Mathematics of Bangued Campus

Cognitive Skills	Content Areas						As a Whole
	I	II	III	IV	V	VI	
K	0.580**	0.302**	0.359**	0.395**	0.528**	0.284**	0.666**
C	0.454**	0.433**	0.258**	0.375**	0.518**	0.547**	0.697**
Ap	0.469**	0.338**	0.237**	0.359**	0.632**	0.778**	0.761**
An	0.176**	0.293**	0.394**	0.358**	0.180**	0.220**	0.420**
S	0.813**	0.314**	0.338**	0.313**	0.404**	0.286**	0.686**
E	0.251**	0.691**	0.368**	0.331**	0.332**	0.251**	0.580**
As a Whole	0.724**	0.595**	0.482**	0.547**	0.707**	0.655**	1.00**

Legend:

* significant at 0.05 level

** at 0.01 level of significance

where:

K- Knowledge

C- Comprehension

Ap- Application

An- Analysis

S- Synthesis

E- Evaluation

I- The numeration System

II- Real Number System

III- Fundamentals of Number Theory

IV- Rational Numbers

V- Decimals

VI- Ratio, Proportion and Percent

All the cognitive skills (Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation) had a significant relationship with all the content areas (The Numeration

System, Real Number System, Fundamentals of Number Theory, Rational Numbers, Decimals and Ratio, Proportion and Percent) and as well as when taken as a whole at 0.01 level of significance.

Table 7. Correlation Coefficient Between the Level of Cognitive Development of the Students in the Different Cognitive Skills and Content Areas in Basic Mathematics of Both Campuses

Cognitive Skills	Content Areas						As a Whole
	I	II	III	IV	V	VI	
K	0.558**	0.307**	0.461**	0.397**	0.545**	0.344**	0.678**
C	0.468**	0.440**	0.340**	0.356**	0.487**	0.539**	0.682**
Ap	0.474**	0.375**	0.307**	0.348**	0.627**	0.797**	0.767**
An	0.204**	0.355**	0.420**	0.376**	0.202**	0.179**	0.447**
S	0.823**	0.363**	0.388**	0.322**	0.413**	0.277**	0.689**
E	0.325**	0.747**	0.436**	0.334**	0.357**	0.292**	0.636**
As a Whole	0.728**	0.626**	0.575**	0.522**	0.701**	0.650**	1.00**

Legend:

* significant at 0.05 level

** at 0.01 level of significance

where:

K- Knowledge

C- Comprehension

Ap- Application

An- Analysis

S- Synthesis

E- Evaluation

I- The numeration System

II- Real Number System

III- Fundamentals of Number Theory

IV- Rational Numbers

V- Decimals

VI- Ratio, Proportion and Percent

All the cognitive skills (Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation) had a significant relationship with all the content areas (The Numeration System, Real Number System, Fundamentals of Number Theory, Rational Numbers, Decimals and Ratio, Proportion and Percent) and as well as when taken as a whole at 0.01 level of significance. This means that there is a perfect relationship between the cognitive skills and the content areas. Further, the development of the students in the different cognitive skills will also equipped them with better understanding of the different content areas in Basic Mathematics.

CONCLUSIONS AND IMPLICATIONS

The respondents had a “Satisfactory” performance in Knowledge, Comprehension, Application, Synthesis, and Evaluation and on the whole while they however, performed “Fairly” in Analysis. They were found to be strong in Knowledge, Comprehension, Application, Synthesis, and Evaluation and on the whole; but they were weak in Analysis.

The respondents had a “Very Satisfactory” level of development in The Numeration System and Decimals while a “Satisfactory” performance was executed in Real Number System, Fundamentals of Number Theory, Rational Numbers, Ratio, Proportion and Percent and as a whole. Their strength lay in The Numeration System, Real Number System, Rational Numbers and Decimals as well as when taken as a whole but found weak in Fundamentals of Number Theory and Ratio, Proportion and Percent.

The findings of the study will inform educators to expose students to a positive outlook towards the subject, and develop study habits wherein their learning of the lessons will not only end in the classroom but also be extended in their homes. Mathematics educators may also be encouraged to be innovative and interdisciplinary in their instructional strategies, and help the learners to think critically and creatively.

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