

# Least Learned Competencies of Precalculus: Basis For Constructing Instructional Materials

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**Abstract:** *The study aimed to determine the least learned competencies in Grade-XI Pre-Calculus as bases to develop instructional materials. The participants of the study were the Grade-XI students of Caraga State University-Senior High School taking Pre-Calculus as their mathematics subject during the first semester of the academic year 2017-2018. A descriptive research design was used in this study. The research instrument used was a diagnostic test questionnaire to identify the performance of Grade-XI students in Pre-Calculus. Using Frequency which determined the number of correct answers of the Grade-XI students in each item in the questionnaire and Percentage which identified the top least learned competency of the Grade-XI students across first quarter topics in Pre-Calculus. These statistical treatments helped to determine the top least learned competencies of Grade-XI Pre-Calculus. Furthermore, the result of the diagnostic test of the students in the three sections showed that more than half of the participants have difficulty in answering higher-order thinking type of questions, specifically in conic sections. This means that the researchers should develop instructional materials which are all about higher-order thinking types of activities depending on the top least learned competencies.*

**Keywords:** Pre- Calculus, least competencies, and instructional materials

## 1 INTRODUCTION

The role of Mathematics in the understanding of the foundations and structure of science, technological advancement, economic development as well as in the understanding of inter-relationship between disciplines is a very significant one. Mathematical methods have strongly penetrated many fields of knowledge and human endeavor (Adelusi, 2006; Adebule, 2009; Ayoola, 2015).

However, students are biased that Mathematics is a difficult subject to understand and this is transferred to the classroom teaching, consequently, subjects where an aspect or element of Mathematics is not easily learned. Also, most of the students nowadays are more interested in surfing all day to update their social media accounts and to play online games. Many of them hate Mathematics because they always thought that it would be difficult and they don't lend space for learning and knowing the art of Mathematics. Meanwhile, Drew and Hansen (2013) stated that other students have trouble dealing with basic Mathematics and even believe that it is not essential in our day-to-day living. They usually believe that Mathematics is difficult when it comes to analyzing problems, finding the most accurate solution, and engaging with equations and variables, thus resulting in a lack of interest in the subject.

On the other side, 21<sup>st</sup>-century educators have a great advantage, they have powerful learning tools at their disposal that they didn't have before. 21<sup>st</sup> Century technology is an opportunity for students to acquire more knowledge. Teachers have the ability to move away from being the dispenser of information to

someone who can guide them and prepare them for their future. Ultimately, the 21<sup>st</sup>-century learner will be "learner-driven," where they choose how and what they want to learn. The teacher will serve as a facilitator and guide to help embrace 21<sup>st</sup>-century learning (Cox, 2014).

Furthermore, 21<sup>st</sup>-century educators should expect guidance from research on selecting and using literature in their Mathematics teaching to find books that will both engage the young learners. The need for identifying and using only high-quality books cannot be overestimated (Whitin, 2002; Nesmith and Cooper, 2010). Rather than ineffectual, real dangers for learning may come from incorporating low-quality books in learning experiences.

Improving classroom teaching and learning of Mathematics to enhance the learners' interest and performance has been the concern of some educators. In suggesting ways to improve students' interest and performance in Mathematics, Drew and Hansen (2013) stated that the use of instructional materials has an important role to play in Mathematics instructions as it allows teachers to model or demonstrates representations of mathematical understanding and thinking; hence improving learners' interest and performance.

Instructional materials are intellectual and designed to aid the teachers and give students the needed support to make development in studies. It can give the opportunity to explore various ideas and concepts that would enrich learners' understanding of varied subject matters that sharpen their competencies. It aims to reteach the lessons which are not so much clear to the learners and to help them gain mastery of the skills (Rodrigo, 2015).

Teachers should make sure that all of their teaching approaches and methods are appropriate in catering to the needs of every student. Since Mathematics has a vital role in education for it is one of the subjects that pervade life and its values go beyond the classroom. Thus, Mathematics should be learned comprehensively to enhance the development of the students that may help them understand the different concepts of Mathematics by utilizing instructional material that is appropriate for the learning process.

The purpose of this study is to construct instructional material in Pre-Calculus for the Grade-XI students of Caraga State University. Specifically, it sought answers to (a) What is the result of the diagnostic test covering the first quarter topics in Precalculus? (b) What are the least learned learning competencies of the Grade-XI students based on the result of the diagnostic test? (c) Based on the findings, what instructional materials may be designed?

The result of this study is of great importance to the School Administration, Students, Faculty, and Researchers. This study focused on determining the least learned learning competencies as bases to construct an instructional material in Pre-Calculus for Grade-XI students. This study considered the ability of the Grade-XI students of Caraga State University in answering the first quarter topics in Pre-Calculus.

The participants of this study were the Grade-XI STEM students of Caraga State University of the Academic year 2017-2018. The problems in the test administered on the participants were made by the researchers based on Pre-Calculus books of recent publication.

## 2 THEORETICAL AND CONCEPTUAL FRAMEWORKS

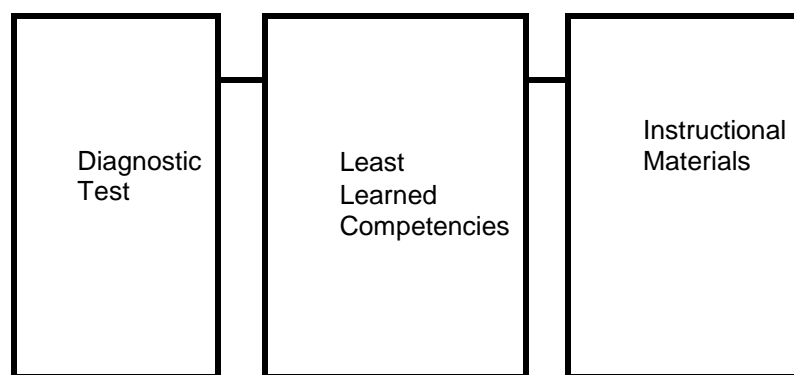
This study was based on Piaget's Theory of Developmental Constructivism (1968). He stated that children acquire number concepts and operations by construction from the inside and not by internalization. Piaget pointed out that every normal student is capable of good mathematical reasoning if attention is directed to activities of his interest, and if by this method the emotional inhibitions that too often give him a feeling of inferiority in lessons in mathematics are removed. He suggested that when children do not understand or have difficulty with a certain concept, it is due to a rapid passage from the qualitative structure of the problem and to the quantitative or mathematical formulation.

Piaget (1968) stated that the conditions that can help the child in his search for understanding are the use

of active methods that permit the child to explore spontaneously and require that "new truths" be learned, rediscovered, or at least reconstructed by the student not simply told to him. He argued that a student who achieves certain knowledge through free investigation and spontaneous effort will later be able to retain it. He will have acquired a methodology that serves him for the rest of his life and will stimulate his curiosity without the risk of exhausting it.

Moreover, this study was also anchored on Piaget's stages of intellectual development which are useful guides to the teaching. Piaget (1983) emphasized concrete operational materials that facilitate learners internalizing concepts presented to them. An important implication of Piaget's theory is the adaptation of instruction to the learner's developmental level. The content of instruction needs to be consistent with the developmental level of the learner. The teacher's role is to facilitate learning by providing a variety of experiences. Piaget emphasizes the opportunities that allow learners of different cognitive levels to work together and encourage less mature students to advance to create understanding. The further implication for instruction is the use of concrete hands-on experiences to help learners learn additional suggestions. Piaget also emphasizes that teachers should allow opportunities to classify and group information to facilitate assimilating new information with previous knowledge. Present problems that require logical understanding. Also, he further adds that understanding is important and desirable since it generally promotes retention of the concept.

### Schematic Diagram



**Figure1.** A Schematic Diagram showing the variables of the study.

## 3 RESEARCH METHODOLOGY

The researchers used the descriptive research design, which is a survey type of research. It gathered

data to assess the least learned competencies of the Grade-XI students of Caraga State University and construct instructional material. This study is based on the ADDIE model. However, for the purpose of this study, the researchers preferred to utilize only the first three phases which are ADD model (Analyze, Design, and Develop). The results and discussions were organized according to the questions posed during the conduct of the survey.

The participants involved in this study are the Grade-XI students (STEM strand) of Caraga State University Academic Year 2017-2018 who are currently taking the Precalculus course.

**Table 1.** Population and participants of the study

School	Participants	Population Size	Sample Size	Percentage of Students With Correct Responses
Caraga State University- Senior High School	Grade 11 Pre-calculus teacher	Question 1	Remembering	58.11
		Question 8	Remembering	54.05
	Grade 11 Pre-calculus students	Question 13	Understanding	82.43
		Question 20	Applying	82.43
		Question 27	Analyzing	39.19
		Question 34	Evaluating	20.27

This study was conducted at Caraga State University-Senior High School located in KM7 Ampayon, Butuan City. Presently, it has 4 colleges namely: College of Agricultural Sciences and Natural Resources (CASNR), College of Education (CED), College of Arts and Sciences (CAS), and College of Engineering Information Technology (CEIT). This University also offers undergraduate degree programs, graduate programs, and Senior High courses.

The sampling design used in surveying the Grade-XI students was a probability sampling technique which is the stratified random sampling because there are an unequal number of students per section. The research instrument that was used to obtain the needed data and information for this study is a questionnaire (see appendix). The validity of the questionnaires was also validated (see appendix).

The following were the statistical measures that were used to analyze the data of the study:

1. Frequency determined the number of correct answers of the Grade-XI students in each item in the questionnaire.
2. Percentage which identified the top least learned competency of the Grade-XI students across first quarter topics in Pre-Calculus.

#### 4 PRESENTATION, ANALYSIS, AND INTERPRETATION OF DATA

**Problem 1.** What is the result of the diagnostic test covering the first quarter topics in Pre-Calculus?

**Table 2.** Diagnostic test results for the topic - Distance and Midpoint Formula

Items	Levels of Assessment	Percentage of Students With Correct Responses
Question 1	Remembering	58.11
Question 8	Remembering	54.05
Question 13	Understanding	82.43
Question 20	Applying	82.43
Question 27	Analyzing	39.19
Question 34	Evaluating	20.27

Table 2 shows the results of the diagnostic test for the Distance and Midpoint Formula topic. It revealed that there were two items in which the percentage of the students who got the correct answer is below 50%.

Question number 34 which is under the evaluating level of assessment has the least percentage which is only 20.27% of 74 participants. Meanwhile, question number 27 which is in the analyzing level of assessment has 39.19% of 74 participants. It shows that more than half of the participants have difficulty in answering higher-order thinking type of questions.

**Table 3.** Diagnostic test results for the topic – Circles

Items	Levels of Assessment	Percentage of Students With Correct Responses
Question 2	Remembering	79.73
Question 9	Remembering	81.08
Question 14	Understanding	86.49
Question 21	Applying	64.86
Question 35	Analyzing	71.62
Question 28	Evaluating	36.49

Table 3 shows the results of the diagnostic test for the topic of Circles. It revealed that there was only one item in which the percentage of the students who got the correct answer is below 50%. Question number 28 which is under the evaluating level of assessment has the least percentage which

is only 36.49% of 74 respondents. It also shows that more than half of the participants have difficulty in answering higher-order thinking type of questions.

**Table 4.** Diagnostic test results for the topic – Ellipses

Items	Levels of Assessment	Percentage of Students With Correct Responses
Question 3	Remembering	89.19
Question 10	Remembering	83.78
Question 15	Understanding	52.70
Question 18	Understanding	79.73
Question 29	Applying	60.81
Question 32	Analyzing	54.05
Question 22	Analyzing	22.97
Question 36	Evaluating	32.43

Table 4 shows the results of the diagnostic test for the topic of Ellipses. It revealed that there were two items in which the percentage of the students who got the correct answer is below 50%. Question number 22 which is under the analyzing level of assessment has the least percentage which is only 22.97% of 74 participants. Meanwhile, question number 36 which is in the evaluating level of assessment has 32.43% of 74 participants. It shows that more than half of the participants have difficulty in answering higher-order thinking type of questions.

**Table 5.** Diagnostic test results for the topic – Parabolas

Items	Levels of Assessment
Question 4	Remembering
Question 11	Remembering
Question 23	Understanding
Question 16	Analyzing
<b>Question 30</b>	<b>Analyzing</b>
<b>Question 37</b>	<b>Evaluating</b>

Table 5 shows the results of the diagnostic test for the topic of Ellipses. It revealed that there were three items in which the percentage of the students who got the correct answer is below 50%. Question number 30 which is under the analyzing level of assessment has the least percentage which is only 18.92% of 74 participants followed by question number 37 which is in the evaluating level of assessment has 29.73% of 74 participants, and lastly, question number 16 which is in the analyzing level of assessment has 37.84% of 74 participants. It also shows that more than half of the

participants have difficulty in answering higher-order thinking type of questions.

**Table 6.** Diagnostic test results for the topic – Hyperbolas

Items	Levels of Assessment	Percentage of Students with Correct Responses
Question 5	Remembering	70.27
Question 12	Remembering	83.78
Question 19	Understanding	95.95
Question 17	Understanding	27.03
Question 24	Applying	43.24
Question 31	Analyzing	35.14
Question 33	Evaluating	31.08
Question 38	Creating	13.51

Table 6 shows the results of the diagnostic test for the topic of Hyperbolas. It revealed that there were five items in which the percentage of the students who got the correct answer is below 50%. Question number 38 which is under the analyzing level of assessment has the least percentage which is only 13.51% of 74 participants, followed by question number 17 which is in the understanding level that only has 27.03%, next is question number 33 which is in the evaluating level that has 31.08%, then question number 31 under analyzing level that has 35.14% and lastly question number 24 which is in the applying level that has 43.24%. Thus, it shows that more than half of the participants have difficulty in answering higher-order thinking type of questions.

**Table 7.** Diagnostic test results for the topic – Sequence

Items	Levels of Assessment	Percentage of Students With Correct Responses
Question 6	Remembering	59.46
Question 25	Applying	52.70
Question 39	Evaluating	72.97

Table 7 shows the results of the diagnostic test for the topic of Sequence. It revealed that there was no item in which the percentage of the students who got the correct answer is below 50%. It shows that more than half of the participants answered correctly the questions about Sequence.

**Table 8.** Diagnostic test results for the topic - Result



Items	Levels of Assessment	Percentage of Students with Correct Responses
Question40	Remembering	81.08
Question26	Applying	54.05
Question 7	Evaluating	47.30

Table 8 shows the results of the diagnostic test for the topic of Series. It revealed that there were three items in which the percentage of the students who got the correct answer is below 50%. Question number 7 which is under the analyzing level of assessment has the least percentage which is only 47.30% of 74 participants. It shows that more than half of the participants have difficulty in answering higher order thinking type of questions.

### Problem 2. What are the least learned learning competencies of the Grade-11 students based on the result of the diagnostic test?

**Table 9.** Top least learned competencies across first quarter topics in Pre-Calculus

Items	Levels of Assessment	Percentage of Students with Correct Responses
Question38. Learns will solve situational problems involving hyperbola.	Evaluating	13.51
Question30. Learners will determine the standard form of equation of a parabola.	Applying	54.05
Question 34. Learners will solve situational problems involving distance formula and midpoint formula	Evaluating	20.27
Question22. Learners will determine the standard form of equation of an ellipse	Analyzing	22.97

Question17. Learners will determine the standard form of equation of a hyperbola	Understanding	27.03
Question37. Learners will solve situational problems involving parabola	Evaluating	29.73

Table 8 shows the top least learned competency in Pre-Calculus across first quarter topics. It revealed that there were six items in which the percentage of the students who got the correct answer is below 30%. Question number 38 which is under the analyzing level of assessment has the least percentage which is only 13.51% of 74 participants, with a corresponding competency which is “learners will solve situational problems involving hyperbola”. Followed by question number 30 which is in the analyzing level that has only 18.92% with corresponding competency “learners will determine the standard form of equation of a parabola”. Next is question number 34 which is in the evaluating level that has 20.27% with a corresponding competency “learners will solve situational problems involving distance formula and midpoint formula”. Then question number 22 under analyzing level that has 22.97% with corresponding competency “learners will determine the standard form of equation of an ellipse”. Next, question number 17 under understanding level that has 27.03% with corresponding competency “learners will determine the standard form of equation of a hyperbola”. And lastly, question number 37 which is in the evaluating level that has 29.73%.

## 5 CONCLUSIONS

Based on the findings of the study, the following conclusions were drawn: GradeXI students encountered more difficulties in answering the topics about conic sections which resulted as the top least learned competencies. Next, Grade-XI students have difficulties in answering higher order thinking type of questions in Pre-Calculus, for in every topic in the diagnostic test, there were below 50% of students who have got the correct answer when it comes to analyzing, evaluating and creating level of assessment. And lastly, researchers were encouraged to construct instructional materials which are all about higher order thinking type of activities depending on the top least learned competencies.

## Recommendations

Based on the findings and conclusions, these recommendations were formulated: First, students are encouraged to explore and read books in library or in the internet, to learn more about the difficult topics they have

encountered. Second, least learned competencies of students in other subject are suggested to include as independent variables for future researchers. Next, instructional materials in this research are suggested to be implemented and evaluated by the future researchers. Fourth, the school administration are encouraged to conduct intensive trainings

and workshops for students and faculties about crafting instructional materials. And lastly, future researchers are suggested to conduct similar nature of the study but on different scope to get comparisons in this study. Also, they are further suggested to be well-informed in the coverage taken by their participants.

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