

Bernido & Boyon, 2020

Volume 5 Issue 3, pp. 767-781

Date of Publication: 28<sup>th</sup> January 2020

DOI- <https://doi.org/10.20319/pijss.2020.53.767781>

This paper can be cited as: Bernido, R. B., & Boyon, C. L., (2020). Guided Inquiry-Based Learning of Trigonometric Identities. *PEOPLE: International Journal of Social Sciences*, 5(3), 767-781.

This work is licensed under the Creative Commons Attribution-Non Commercial 4.0 International License. To view a copy of this license, visit <http://creativecommons.org/licenses/by-nc/4.0/> or send a letter to Creative Commons, PO Box 1866, Mountain View, CA 94042, USA.

## **GUIDED INQUIRY-BASED LEARNING OF TRIGONOMETRIC IDENTITIES**

**Ryan B. Bernido**

Graduate Student, Bicol University, Legazpi City, Philippines  
[bernido101@gmail.com](mailto:bernido101@gmail.com)

**Ma. Carolina L. Boyon**

Professor, Bicol University, Legazpi City, Philippines  
[mclboyon@bicol-u.edu.ph](mailto:mclboyon@bicol-u.edu.ph)

---

### **Abstract**

*The implementation of K-12 basic education curriculum brought some concerns in the educational sector of the Philippines such as shortage in teaching and learning materials, and the required teaching-learning approach that would cater for the development of 21<sup>st</sup> century skills among learners. This study developed and validated guided inquiry-based learning materials in understanding the trigonometric identities in Grade 11 Pre-calculus to promote self-directed, independent, and inquiry-based learning, and to verify its effects in student learning. The guided inquiry-based learning materials underwent evaluation and validation, and were evaluated as Highly Acceptable to teachers and students. This study utilized the descriptive method using the 7-point scale. Quasi-experimental design was adopted to measure the effects of the validated learning materials and the use of inquiry-based learning in student's performance. Results confirmed that students are equally able to develop cognitive skills in trigonometric identities through IBL and conventional learning modality. Thus, the validated guided inquiry-based materials developed and used in this study can be adopted in its original form to promote 11<sup>th</sup> graders' self-directed, independent, and inquiry learning necessary for developing 21<sup>st</sup> century skills such as critical thinking.*

## **Keywords**

Development, Validation, Inquiry-Based Learning, Trigonometric Identities

---

## **1. Introduction**

The Philippines implemented the K-12 curriculum through Republic Act 10533 of 2013 which aimed to provide quality education to Filipino learners at par with international standards. However, this new curriculum brought several problems such as lack of sufficient teachers, classrooms, facilities, equipment and other instructional and teaching materials (Umil, 2017). Data from the Department of Education (DepEd), as of November 2016, showed that the agency was short of 235 million instructional and other learning materials (Umil, 2017). This study sought to address this shortage by developing and validating guided inquiry-based learning materials. The use of inquiry-based approach is anchored on section 5 of RA 10533 which focuses on curriculum development and stresses that “the curriculum shall use pedagogical approaches that are constructivist, inquiry-based, reflective, collaborative, and integrative”.

Based on the World Economic Forum’s (WEF) Global Competitiveness 2011-2012 Report, as cited by Tandoc Jr.(2012), the Philippines ranked 115<sup>th</sup> out of 142 countries in perceived quality of Math and Science Education. Previous studies also revealed the Philippines ranked 42<sup>nd</sup> in 45 countries in math in the Trends in International Mathematics and Science Study (TIMSS), the quadrennial international assessment of math and science skills among primary and secondary schools, conducted in 2003 (Dulay, 2015). Among nine Southeast Asian countries, Philippines ranked 7<sup>th</sup> in the area of education and innovation (Sala-i-Martin, 2011).

These foregoing data show that there must be measures employed in the Philippine Education System to increase the country’s performance in education and innovation especially in the field of Mathematics. Hence, in 2011, DepEd introduced the K-12 program which made kindergarten a prerequisite to basic education. This program replaces the 10-year basic education curriculum and incorporates basic lessons in basic science and technology, engineering, mathematics, accountancy, business and management, humanities and social sciences, and general academic courses such as technical-vocational-livelihood, arts and design, and sports (Barlongo, 2015).

In Science, Technology, Engineering and Mathematics (STEM) track, learning areas like General Mathematics, Statistics and Probability, Pre-calculus, and Basic Calculus are taught to 11<sup>th</sup> and 12<sup>th</sup> graders. The inclusion of these courses aims to increase students’ mathematics proficiency level before they enter tertiary education. It is important to increase students’ proficiency in Mathematics because studies show that it has significant roles in their lives. Mathematics helps

students to succeed in their career because it helps them be prepared in adulthood, and in their participation in society (Breslich, 1996). This is supported by the results of PISA's 2012 survey conducted by Organization for Economic Cooperation and Development (OECD) which advance that proficiency in mathematics is a predictor of young adults' achievements.

To increase students' proficiency level, especially in Mathematics, Filipino teachers and other stakeholders of education provide much effort in implementing strategies that would help achieve the competencies needed by these students. Various teaching and learning strategies are suggested by authorities to teachers which include inclusive education, differentiated instruction, individual learning styles and multiple intelligences and collaborative learning (DepEd Order no. 39 s. 2016). Teaching and learning approaches like inquiry-based, discovery, project-based learning, reality pedagogy, and flipped classroom are also essential in helping students increase mathematics proficiency.

There are many claims that inquiry-based approach has positive effects on proficiency development. Brune (2010) suggested that to maintain quality education for students and to help them build a relational understanding, mathematics teachers should incorporate inquiry-based instructional methods into their classrooms. This method creates a more engaging learning environment (Friesen and Scott, 2013) which is an important factor to students' proficiency. Abdi (2014) advanced that students who have been educated by inquiry-based instruction supported by the 5E learning cycle method have become more successful than students who have been educated using traditional teaching methods.

Hotchkiss and Fleron (2014) defined inquiry-based learning (IBL) as an approach in which the classroom environment is characterized by the student being the active participant while the teacher's role is decentralized. In addition, 'in an IBL classroom students are the most active mathematical participants in the room, which make it much harder for students to just passively sit and drift through the course'. In an IBL classroom, 'the students are the ones asking questions, making conjectures, and proving mathematical statements instead of the teacher'. It is also defined in mathematics as a form of active learning in which students are given a carefully scaffolded sequence of mathematical tasks and are asked to solve and make sense of them, working individually or in groups (Ernst, Hodge and Yoshinubu, 2017). In addition, IBL teaching-learning approach possesses five characteristics which are *process focus*, *investigation*, *group learning*, *discussion monitoring*, and *real-life application* (UOTAO, 2017).

The researcher of this study used guided inquiry-based learning materials in instruction giving emphasis on inquiry-based learning approach. The use of such approach aims to increase students'

performance in Mathematics by contributing meaningful mode of improving the performance of the Philippines as to rank better in ‘perceived quality Mathematics Education’ and innovation in succeeding international educational systems monitoring. Hence, it is hoped that this study would introduce and propose teaching and learning materials that may increase students’ performance in Mathematics. Consequently, it is hoped to help the Philippines in gradually building a globally competitive mathematics education.

This research generated information on: (a) The effects of guided inquiry-based learning materials on the development of students’ proficiency in Trigonometric Identities; and (b) The learning proficiencies of students exposed to inquiry-based learning and conventional instruction along levels of cognitive domain.

## **2. Methodology**

This study used the quasi-experimental research method utilizing the pre-test and post-test approach to measure the effect of inquiry-based learning using the developed guided IBL materials and to determine the learning proficiencies of the experimental and control groups along cognitive domains. The experimental group used inquiry-based learning through the developed guided IBL materials while the control group used conventional learning utilizing the learner’s module provided by DepEd.

### **2.1 Instruments**

The researcher employed the following instruments: (1) Teacher’s Evaluation Sheet for Guided IBL Materials, (2) Teacher’s Evaluation Sheet for Pre-test Post-test, and (3) Pre-test and Post-test of the experimental and control groups. Teacher’s evaluation sheets for guided IBL materials were used to validate the researcher-made instructional materials prior to their implementation. Teacher’s evaluation sheet for pre-test and post-test was used to validate the assessment tools used in measuring learners’ performance. The validated assessment tools were used during pre-test and post-test to measure learners’ performance before and after the implementation.

### **2.2 Sampling**

Respondents of this study are two randomly selected Grade 11 STEM classes, based on the Mathematics grades earned in the previous grade level subjected to statistical treatment for comparability, in a National secondary school purposively chosen. The two randomly selected comparable classes were both taking Pre-calculus as major course of the STEM strand. Class A, composed of 43 students, served as the experimental group, was implemented with inquiry-based approach utilizing the developed and validated guided IBL materials and was not allowed to use the

learner's module provided by DepEd. Class B, composed of 45 students and served as the control group, was implemented with the conventional instruction using the DepEd learner's module. Further, two students from class B were randomly deleted for an equal number of respondents for both groups. Learning competencies taught for both groups were based on the curriculum guide of DepEd. Additionally, the two comparable classes were given pre-test prior to the study and  $t - test$  results for the pre-test scores confirmed that there is statistically no significant difference between the two groups; hence, they are comparable.

Six (6) secondary mathematics teachers from DepEd and two (2) mathematics professors from a State University who have expertise on the subject matter were also respondents. They served as evaluators in the validation of the developed guided IBL materials prior to the implementation.

### **2.3 Data Collection**

The data collection process used on this study was in four phases.

#### *Phase 1: (Analysis of Needed learning competencies)*

The researcher examined the DepEd curriculum guide for Pre-calculus in 11<sup>th</sup> grade to identify which competencies are to be demonstrated in the development of draft guided IBL materials. The researcher's goal was to identify the learning materials and learning competencies needed in the preliminary draft of the materials.

#### *Phase 2: (Construction and Development)*

After identifying the competencies and topics for use in the guided IBL materials, the researcher structured its format. In the process of developing the guided IBL materials, the researcher modified some parts used by Torre Franca (2017).

#### *Phase 3: (Validation)*

To gather evidence that would support the validity and acceptability of the guided IBL materials, teachers' assessment were solicited. The prints out of the first drafts of the guided IBL materials were presented to the research adviser and peers in mathematics teaching. Then, the researcher revised said materials based on their suggestions. The revised exemplars and guided IBL materials were validated by eight (8) teachers.

#### *Phase 4: (Implementation and Analysis of Result)*

The validated guided IBL materials were used in teaching Trigonometric Identities to verify their effect on students' performance in comparison to the control group which was exposed to conventional instruction using the learner's module from DepEd. Pre-test was administered to both

groups prior to research implementation and post-test was given post implementation. Additionally, the experimental group evaluated and rated the guided IBL materials used post implementation.

**2.4 Data Analysis**

For the validation of the guided IBL materials, a 7-point scale was used to describe the assessment ratings by teachers and students (subjects): 6.5 -7.00 (*Highly Acceptable*), 5.5-6.49 (*Acceptable*), 4.5-5.49 (*Moderately Acceptable*), 3.5-4.49 (*Between Acceptable and Unacceptable*), 2.5-3.49 (*Moderately Unacceptable*), 1.5-2.49 (*Unacceptable*), and 1.00-1.49 (*Highly Unacceptable*).

The data collected through the pre-test post-test were subjected to inferential statistics using the t-test. Descriptive statistics such as mean, N-gain, percent difference were also utilized to describe performance levels of the subjects before and after implementation of IBL. Additionally, performance levels of the subjects were interpreted and analyzed using the score interpretation of the National Education Testing and Research Center (NETRC): 96-100% (*Mastered or Competent*), 86-95% (*Closely Approximating Mastery or Closely Approximating Competence*), 66-85% (*Moving Towards Mastery or Moving Towards Competence*), 35-65% (*Average Mastery or Average Competence*), 16-34% (*Low Mastery or Low Competence*), 5-15% (*Very Low Mastery or Very Low Competence*), and 0-4% (*Absolutely No Mastery or Absolutely Not Competent*).

**3. Results and Discussions**

**3.1 Development and Validation of Guided Inquiry-Based Learning Materials**

Ten (10) guided inquiry-based learning materials were developed and subjected to validation process. Results of the assessment by the teachers and students are presented in Table 1.

**Table 1: Summary of Teachers’ and Students’ Assessment of Guided IBL Materials along the Five Aspects**

Aspects of Guided IBL Materials	SD		Mean			
	S	T	S	I	T	I
1. Alignment of the Objectives, Activities and Assessments		0.48			6.59	HA
2. Guided Inquiry Process		0.64			6.53	HA
3. Content	0.34	0.63	6.71	HA	6.56	HA
4. Format and Language	0.26	0.46	6.76	HA	6.68	HA
5. Usefulness	0.48	0.83	6.62	HA	6.46	Ac
Over-all Mean	0.36	0.61	6.70	HA	6.56	HA

*S-Student, T- Teachers, SD- Standard Deviation, I-Interpretation, HA- Highly Acceptable, Ac- Acceptable*

*Note: The first two aspects were not assessed by the students.*

Teachers evaluated the guided IBL materials along five aspects namely: (a) alignment of the objectives, activities, and assessments, (b) guided inquiry process, (c) content, (d) format and language, and (e) usefulness; while students from the experimental group rated the guided IBL materials along (a) content, (b) format and language, and (c) usefulness only. Table 1 shows that teachers and students rated the 10 guided IBL materials Highly Acceptable with mean ratings of 6.56 and 6.70, respectively. Hence, the developed and validated guided IBL materials for the understanding of trigonometric identities are valid and acceptable for use. Further, Table 1 shows that guided IBL material 1 through 10 can be used in the original form. Hence, the enhanced guided IBL material 1 through 10 can be inferred to be directly adapted for the understanding of trigonometric identities in Pre-calculus for 11<sup>th</sup> graders.

### 3.2 Effects of Guided Inquiry-Based Learning Materials on Experimental Group’s Learning

The validated guided IBL materials were utilized as learning tool among the subjects in the experimental group. Then, after implementation, an assessment tool was used for post-test of both groups.

Table 2 reveals the positive effects of the guided IBL materials on the experimental group’s learning as validated by the pre-test and post-test.

**Table 2:** Comparison of the Pre-test and Post-test Results of the Experimental Group t-Test Paired Two Sample Means

	<i>Pre-test</i>	<i>Post-test</i>
Mean	18.581	43.721
Variance	84.249	25.396
Observations	43	43
Pearson Correlation	0.296	
Hypothesized Mean Difference	0	
df	42	
<b>t Stat</b>	<b>-18.181</b>	
<b>P(T&lt;=t) one-tail</b>	<b>0.000</b>	
t Critical one-tail	1.682	
<b>P(T&lt;=t)two-tail</b>	<b>0.000</b>	
<b>t Critical two-tail</b>	<b>2.018</b>	

Note: Significant at  $\alpha=0.05$

Table 2 reveals that the pre-test (18.58) and post-test (43.72) are statistically significantly different confirming improvement in class performance indicative of learning progression on the understanding of Trigonometric Identities. The p-value less than 0.05 confirm that use of inquiry-based learning through guided IBL materials is effective in understanding the trigonometric identities in Pre-calculus.

**Table 3a:** Mean Score and N-gain of Experimental Group

Test	Mean Score	N-gain <g>	Interpretation
Pre-test	18.58139535	0.308768923	Moderate Learning Gain
Post-Test	43.72093023		

**Table 3b:** Classification of N-gain Interpretation

Score	Interpretation
$g > 0.7$	High
$0.3 < g < 0.7$	Moderate
$g < 0.3$	Low

Table 3a reveals that there is improvement in terms of class mean score from pre-test of 18.58 to post-test of 43.72 and a positive gain of 0.31 was obtained for the students’ cognitive learning which measures: remembering, understanding, applying, analyzing, evaluating and creating. This positive gain implies that there is moderate gain in the learning performance of the experimental group in terms of their cognitive ability, based on Table 3b. These results attest that the inquiry-based learning, through guided IBL materials, is an effective and acceptable pedagogy for the understanding of trigonometric identities in Pre-calculus. This positive effect on student performance through IBL confirms the previous studies of Koksal and Berberoglu (2012), Wang, Yen, and Wu (2013), Duran and Dokme (2016), Aulia, Poedjiastoeti, and Agustini (2018), and Suwono, Susanti, and Lestari (2017).

Table 4 presents the performance level of the experimental group for each lesson or topic. There are ten (10) lessons in this study, namely: Domain of an Expression: A Review, Identity and Conditional Equations, Eight Fundamental Trigonometric Identities, Trigonometric Values using the Eight Fundamental Trigonometric Identities, Proving Trigonometric Identities, Cosine Sum and Difference Identities, Sine Sum and Difference Identities, Tangent Sum and Difference Identities, Double Measure Identities, and Half Measure Identities.



**Table 4:** Performance Level of Experimental Group by Lesson or Topic

Topic	NOI	Pre-test				Post-test			
		SD	MS	PL(%)	I	SD	MS	PL(%)	I
Domain of an Expression: A Review	3	0.3	1.09	36.43	AM	0.17	2.67	89.15	CAM
Identity and Conditional Equation	6	0.2	3.09	51.55	AM	0.09	5.65	94.18	CAM
Eight Fundamental Identities	6	0.3	2.47	41.09	M	0.19	5.35	89.15	M
Trigonometric Function Values using the Eight Fundamental Trigonometric Identities	3	0.3	1.58	52.71	AM	0.23	2.60	86.82	MTM
Proving Trigonometric Identities	6	0.4	3.11	51.94	AM	0.13	5.88	98.06	MTM
Cosine Sum and Difference Identities	6	0.3	1.60	26.74	LM	0.25	4.98	82.95	MTM
Co-Function, Sine Sum and Difference Identities	6	0.3	2.16	36.05	AM	0.21	5.09	84.88	MTM
Tangent Sum and Difference Identities	6	0.3	1.91	31.78	AM	0.13	5.14	85.66	MTM
Double Measure Identities	5	0.3	0.88	17.67	LM	0.15	4.18	83.72	MTM
Half-Measure Identities	3	0.4	0.67	22.48	LM	0.29	2.16	72.09	MTM
	<b>50</b>	<b>0.2</b>	<b>18.58</b>	<b>37.16</b>	<b>AM</b>	<b>0.1</b>	<b>43.7</b>	<b>87.44</b>	<b>CAM</b>

*NOI- Number of Items, SD- Standard Deviation, MS- Mean Score, PL- Performance Level, I- Interpretation, AM- Average Mastery, LM- Low Mastery, CAM- Closely Approximating Mastery, M- Mastered, MTM- Moving Towards Mastery*

Table 4 reflects the performance level of the experimental group per lesson. It reveals that among the lessons, proving trigonometric identities was mastered lesson at performance level of 98.06 from 51.94 or Average Mastery. Lessons (1) Domain of an Expression: A Review, (2) Identity and Conditional Equation, (3) Eight Fundamental Trigonometric Identities, and (4) Trigonometric Function Values Using the Eight Fundamental Trigonometric Identities, were lessons on where students earned performance levels of Closely Approximating Mastery from previously Average Mastery. Lessons on Sum and Difference Identities, and Double and Half-Measure Identities registered performance levels of Moving towards Mastery from previously Low Mastery to Average Mastery. In addition, results for these lessons are inferred to be influenced by the fact that students in the experimental group were not familiar with the values of special angles needed for these lessons. Moreover, the experimental group earned a performance level, on the post-test, of closely approximating mastery from an average mastery on the pre-test.

Table 5 presents the performance level of the experimental group by level of cognitive domain: remembering, understanding, applying, analyzing, evaluating and creating.

**Table 5: Performance Level of Experimental Group by Domain Level**

(Domain Level)*	(%)	NOI	Pre-test			Post-test			PL Gain
			Mean Score	PL(%)	I	Mean Score	PL(%)	I	
Remembering	30	15	5.00	33.33	LM	13.47	89.77	CAM	56.43
Understanding	20	10	2.67	26.74	LM	8.30	83.02	MTM	56.28
Applying	20	10	4.98	49.77	AM	8.95	89.53	CAM	39.77
Analyzing	10	5	1.84	36.74	AM	4.63	92.56	CAM	55.81
Evaluating	10	5	1.49	29.77	LM	3.49	69.77	MTM	40.00
Creating	10	5	2.60	52.09	AM	4.88	97.67	M	45.58
	<b>100</b>	<b>50</b>	<b>18.58</b>	<b>37.16</b>	<b>AM</b>	<b>43.72</b>	<b>87.44</b>	<b>CAM</b>	<b>50.28</b>

\*Based on DepEd Order No.15 s. 2015 for concept development (Balderas, 2018)

NOI- Number of Items, PL- Performance Level, I- Interpretation, LM- Low Mastery, AM- Average Mastery, CAM- Closely Approximating Mastery, MTM- Moving Towards Mastery, M- Mastered

Data above reveal that among the levels of cognitive domain, based on the PL gain, remembering earned the highest with PL gain of 56.43, while applying was lowest with PL gain of 39.77. Applying exhibits lowest PL gain however, this level has the highest numerical performance level during pre-test which is 49.77. Hence, it implies that students still performed well on this level as they are already in Closely Approximating Mastery from previously Average Mastery.

Further, domain levels for remembering, applying, and analyzing were Closely Approximating Mastery from previously Low Mastery, Average Mastery and Average Mastery, respectively. Levels for understanding and evaluating earned Moving towards Mastery which from previously on Low Mastery. However, among levels of cognitive domain measured by the post-test, evaluating had the lowest student performance level on the post-test. This level includes items that focused on concepts of deriving the Sum and Difference Identities for Cosine, Sine and Tangent Functions. These items required reasoning ability, and evaluation skills because the choices used were in a statement form of reasons for the right answers. Hence, the results for the evaluating level of cognitive domain imply that students still need to improve this ability, as well as improve their mathematical reasoning skills.

### 3.3 Learning Proficiencies of Students Exposed to Inquiry-Based Learning and Conventional Instruction along Levels of Cognitive Domain

The study is composed of two groups as respondents, the experimental and the control groups. The experimental group was subjected to the use of developed and validated guided IBL materials and

inquiry-based instruction while the control group used the DepEd learner’s module and conventional instruction.

This section presents the learning proficiencies of students exposed to the inquiry-based learning and conventional learning. Table 6 provides pretest and post test results of the experimental and the control groups. Results validate that the groups are comparable before exposure to different learning approaches. Further, it implies that the two learning approaches used in instruction are equally effective in promoting learning on Trigonometric Identities among students, post implementation.

**Table 6: Comparison of Pre-test Post-test Results of Experimental and Control Group**

Group	Test	TS	Mean	SD	GPPD	OPD	PDM	PD SD	N-gain	I
Experimental	Pre-test*	799	18.58	9.18	1081	135.29	160.43	147.95	0.31	M
	Post-test**	1880	43.72	5.04						
Control	Pre-test*	660	15.35	6.51	1224	185.45	258.80	224.32	0.34	M
	Post-test**	1884	43.81	3.91						

*TS-Total Score, SD- Standard Deviation, GPPD- Group Pretest and Posttest Difference, OPD- Overall Percent Difference, PDM- Percent Difference Mean, PD SD- Percent Difference Standard Deviation, I- Interpretation, M- Moderate Learning Gain*

*\*Not Significant at alpha 0.05 with p-value= 0.06306*

*\*\*Not Significant at alpha 0.05 with p-value= 0.92400*

Table 6 shows that the mean score of the control group is higher than that of the experimental group by 0.09 with standard deviation of the experimental group at 5.04 the control group’s at 3.91. These results confirm that the scores of the experimental group on their post-test are more variable or dissimilar than that of the control group indicating that the experimental group performance is less homogenous than the control group’s.

Results from Table 6 indicate no statistically significant difference on the post-tests performance of the experimental and the control groups at alpha 0.05. This finding implies that students who were exposed to inquiry-based learning and guided IBL materials performed equally well as students who were exposed to conventional learning or instruction using the DepEd learner’s module. This further implies that the developed and validated guided IBL materials can be used as alternative learning materials. These results contrast those of previous studies by Koksai and Berberoglu (2012), Duran and Dokme (2016), Abdi (2014), Aulia et al. (2018), Cooper, Bailey, and Briggs (2015), Brune (2010), Ferguson (2010), Fan (2015) who regarded IBL more effective than non-IBL approach like the conventional method. However, Lynn (2012) supports the results of this

study with her finding that students learn equally and effectively through both inquiry-based and traditional teaching.

Based on the normalized gain on the pre-test and post-test performance, Table 6 reveals also that both groups have moderate learning gains. However, based on the  $N - gain$  value, the control group achieved 0.34 slightly higher than 0.31  $N - gain$  of the experimental group, such difference is statistically not significant at  $\alpha = 0.05$ . Based on the over-all percent difference the control group is 50% higher than the experimental group's. This finding arises from the pretest score of control group slightly lower, but statistically insignificant, than the experimental groups at pre-test score difference of 139 but their post test scores differ only by 4 which statistically not significant.

#### **4. Conclusions and Recommendations**

Over-all and individually, all ten (10) guided IBL materials are Highly Acceptable for use by Grade 11 Mathematics teachers and learners. Results confirmed that inquiry-based learning using the guided IBL materials has a positive effect on the performance level of students and learning proficiency; hence, can be used as alternative or supplementary materials in teaching Trigonometric Identities. Further, the use of inquiry-based learning, using the guided IBL materials, and conventional learning, using the DepEd learner's module, are equally effective. Both have positive effect on the performance level of students and learning proficiency on Trigonometric Identities. However, in promoting the 21<sup>st</sup> century skills, IBL is a valid and effective pedagogy therefore is a recommended teaching modality for learning Trigonometric Identities.

Thus, it is advanced that the use of the guided IBL materials should be recommended in Philippine secondary schools once necessary refinements or revisions are made to meet or exceed standards set by DepEd. The develop and validated ten (10) guided IBL materials can be used by teachers in teaching Pre-calculus or Trigonometric Identities; refinements in their content are encouraged. The use of guided IBL materials and inquiry-based learning in classroom must be utilized and implemented properly to guide students in their independent inquiry-based tasks with minimal guidance from the teacher. Further, the teachers are encouraged to develop guided IBL materials, and use inquiry-based learning to promote the development of 21<sup>st</sup> century skills expected of students to improve the Philippines' performance in future international assessments on perceived quality of mathematics education.

It should be noted that this study focused only the development, validation, and implementation of guided inquiry-based learning materials in trigonometric identities to verify the effects of guided

inquiry-based learning in student learning. Hence, it is recommended that further studies should be made on other mathematical concepts in Pre-calculus to better verify the effects of the said approach in learning and in promoting the 21<sup>st</sup> century skills among learners.

## **Reference**

- (2017). "How Inquiry-Based Learning can Work in a Math Classroom", University of Texas Arlington Online, retrieved on February 7, 2018 at [www.academic.partnerships/uta.edu/articles/education/inquiry-based-learning-math-classroom.aspx](http://www.academic.partnerships/uta.edu/articles/education/inquiry-based-learning-math-classroom.aspx)
- Abdi, A. (2014). "The Effect of Inquiry-based Learning Method on Students' Academic Achievement in science Course", Universal journal of Educational Research 2(1):37-41
- Aulia, E.V et.al (2018). The Effectiveness of Guided Inquiry-Based Learning Material on Students' Science Literacy Skills, Journal of Physics: Conference Series 947 1-7
- Balderas, D. (2018). Training-Workshop on Table of Specifications relative to Constructing Test Questions, retrieved on January 15, 2019 at [depedpang2.com](http://depedpang2.com)
- Barlongo, C.J. (2015). "Reforms in the Philippines education system: The K to 12 program", retrieved on February 6, 2018 at [www.bussinessmirror.com.ph/reforms-in-the-philippine-education-system-k-to-12-program/](http://www.bussinessmirror.com.ph/reforms-in-the-philippine-education-system-k-to-12-program/)
- Breslich, E.R (1996). "Importance of Mathematics in General Education", retrieved on February 6, 2018 at <https://www.istor.org/stable/27957386>
- Brune, M. (2010). The Inquiry Learning Model as an Approach to Mathematics Instruction (Master's Degree Thesis), Boise State University
- Cooper, T. et.al (2015). Gender Differences in Achievement in an Inquiry-Based Learning Precalculus Course, Mathematics Education 10(2) 97-110
- Deped Order no. 29 s. 2017, Policy Guidelines on System Assessment in the K to 12 Basic Education Program, [www.deped.gov.ph](http://www.deped.gov.ph)
- DepEd order no.39 s. 2016 (2016). "Adoption of the Basic Education Research Agenda"
- Dulay, B. (2015). "Math as a way out of poverty", retrieved on February 6, 2018 at [www.manilatimes.net/math-as-a-way-out-of-poverty/175451/](http://www.manilatimes.net/math-as-a-way-out-of-poverty/175451/)
- Duran, M. and Dokme, I. (2016). The effect of the inquiry-based learning approach on student's critical thinking skills, Eurasia Journal of Mathematics, Science and Technology Education 12(12)2887-2908

- Ernst, D. et al. (2017). "What Is Inquiry-Based Learning?", DOCEAMUS, Volume 64, number 6
- Fan, X. (2015). Effectiveness of an Inquiry-based Learning using Interactive Simulations for Enhancing Students' Conceptual Understanding in Physics, University of Queensland, School of Education
- Ferguson, K. (2010). Inquiry Bases Mathematics Instruction Versus Traditional Mathematics Instruction: The Effect on Student Understanding and Comprehension in an Eighth Grade Pre-Algebra Classroom, Master of Education Research Theses 26.  
[http://digitalcommons.cedarville.edu/education\\_these/26](http://digitalcommons.cedarville.edu/education_these/26)
- Friesen, S. and Scott, D. (2013). "Inquiry-Based Learning: A Review of the Research Literature", Alberta Ministry of Education
- Hotchkiss, P. and Fleron, J.(2014). "What is Inquiry-Based Learning?", retrieved on February 5, 2016 at [www.artofmathematics.org/blogs/jfleron/what-is-inquiry-based-learning](http://www.artofmathematics.org/blogs/jfleron/what-is-inquiry-based-learning)
- Koksal, E. and Berberoglu, G. (2012). The Effect of Guided-Inquiry Instruction on 6<sup>th</sup> Grade Turkish Students' Achievement, Science Process Skills, and Attitudes Toward Science, International Journal of Science Education 36 (1)
- Lynn, H. (2012). Guided Inquiry Using the 5E Instructional Model ith High School Physics , Montana State University.
- OECD(2013). "Asian countries top OECD's latest PISA survey in state of global education", retrieved on February 6, 2018 at [www.oecd.org/newsroom/asian-countries-top-oecd-s-latest-pisa-surveyy-on-state-of-global-education.htm](http://www.oecd.org/newsroom/asian-countries-top-oecd-s-latest-pisa-surveyy-on-state-of-global-education.htm).
- Sal-i-Matin, Xavier (2011). "The Global Competitiveness Report 2011-2012", World Economic Forum, Geneva Switzerland 2011
- Suwono, H. et.al (2017). Guided Inquiry Facilitated Blended Learning to Improve Metacognitive and Learning Outcome of High School Students, Journal of Physics: Conference Series 824 1-10.
- Tandoc Jr., Edson C. (2012). "Do the math: Why Filipino students don't fit the Asian stereotype", retrieved on February 6, 2018 at <http://globalnation.inquirer.net/4623/do-the-math-why-filipino-students-dont-fit-the-asian-stereotype>
- TorreFranca, E. (2017). Development and Validation of Instructional Modules on Rational Expressions and Variations, The Normal Lights 11(1) 43-73
- UATAO (2017). "How Inquiry- Based Learning can Work in a Math Classroom", University of Texas Arlington Online, retrieved on February 7, 2018 at

[www.academic.partnerships/uta.edu/articles/education/inquiry-based-learning-math-classroom.aspx](http://www.academic.partnerships/uta.edu/articles/education/inquiry-based-learning-math-classroom.aspx)

Umil, A. (2001). “New school year, same old problems: K to 12, shortages in classrooms, teachers”, retrieved on February 6, 2018 at [www.bultalat.com/main/2017/06/06/new-school-year-old-problems-k-12-shortages-classrooms-teachers/](http://www.bultalat.com/main/2017/06/06/new-school-year-old-problems-k-12-shortages-classrooms-teachers/)

Wang, P. et.al (2013). The Learning Effectiveness of Inquiry-Based Instruction Among Vocational High School Students, *Educational Research International* 2(2) 16-23

Republic Act 10533 of 2013”, retrieved on February 6, 2018 at [www.officialgazette.gov.ph](http://www.officialgazette.gov.ph)