IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

THE USE OF ETHNOMATHEMATICS MODULE IN TEACHING SELECTED TOPICS IN GEOMETRY AMONG TEDURAY LEARNERS

Author: PAULINE L. FRANCISCO, Teacher II, Mangudadatu National High School-Villa Monte Annex
Co-Authors: JIEZEL A. FABELLA, Instructor I, Mindanao State Univeristy–Maguindao
NAJIEVA S. IBRAHIM, Instructor, Mindanao State University–Marawi

Abstract: This experimental study focuses on the use of Ethnomathematics module in teaching selected topics in Geometry among Teduray learners at Mangudadatu National High School-Villamonte Annex, S.Y. 2019-2020. There are 22 Teduray learners under the Teduray-crafted Module group who utilized the intervention and 21 non-Teduray learners under the Conventional Module group. The significant difference on the mean gain scores between the groups, the significant difference on the pre and post test scores of the Teduray learners, and the perception of the learners are determined. Results of the mean gain scores show that the Teduray-crafted Module group performs better than the Conventional Module group. There is no significant difference on the mean gain scores between the two groups of learners because they both increase in Knowledge, Understanding and Process. However, the significant difference between the pre-test and post-test scores of the Teduray learners who previously performed lower than the non-Teduray means that the intervention is effective. In addition, the Ethnomathematics module helps by giving positive impact in the way the learners view and learn Mathematics. Thus, the use of Ethnomathematics module as intervention in teaching selected topics on Circles is effective in improving the performance the learners.

I. INTRODUCTION

1.1 The Background of the Study

Geometry is one of the longest and most important branches of mathematics because of its range of applications in the real world and in education (Tyas, Pangesti and Retnowati, 2017). Its importance is not just in the field of mathematics but also in life and nature because geometrical shapes are observed almost everywhere and used in daily life (Cherif, Gialamas and Stamati, 2017). It is an area of mathematics that is challenging to learn and comprehend (Tyas *et al.*, 2017; Fitriyani, Widodo and Hendroanto, 2018; Siregar, Rosli and Maat, 2019). It is abstract in nature and uses unfamiliar language (Katsap and Silverman, 2008; Ly and Malone, 2011). Its contribution to the poor performance of mathematics as a whole indicates that focusing on the topics in geometry is necessary (Adolphus, 2011; Sunzuma and Maharaj, 2019).

The Ethnomathematics approach is the most effective teaching method which links geometry teaching to the cultural environment of the learners. It means studying the concepts of the cultural groups (Rubio, 2016). Integrating it into the curriculum results in higher achievement in geometry (Aikpityani and Erhaikuremen, 2017; as cited in Sunzumah and Maharaj, 2019). Despite its effectiveness, it is rarely used in the classroom (Mosimege, 2012; Mogari, 2014; Madusise, 2015) because of teachers' limited awareness and it is not included in the prescribed curriculum (Bridge, Day and Hurell, 2012).

The patterns and concepts of geometry are not just present in the formal school but are also already observed and practiced in communities. Findings from the Agta community revealed their indigenous quantification techniques wherein geometric concepts are used in their products and materials for livelihood (Cardona, 2015). Another study is from the Kabihug Tribe where one of the cited practices is modeling patterns arising from their environment. From basic needs like the building of houses to the making of instruments for leisure, all have a connection to geometry (Rubio, 2016).

The module is one of the learning materials that helps learners study independently and construct their knowledge and learning experiences (Febriana, Haryono and Yusri, 2017; Prendergast, *et al.*, 2017). Incorporating ethnomathematics-basedgeometry modules provides knowledge about mathematics and cultural objects (Fouze and Amit, 2018).The Department of Education issued DO 103, s. 2011 or "Creation of Indigenous Peoples Education Office (IPsEO)" to serve as the center for the production of modules, indigenized curriculum, and other related materials to address the needs of the IP learners (Indigenous Peoples and the Sustainable Development Goals-Philippines, 2019). The use of ethnomathematics-based geometry modules as instructional materials is being recommended by researchers to curriculum makers and school administrators to be used by the IP learners themselves. Usage of these materials makes the IP learners understand their ways of doing mathematics and contributes to gaining knowledge in formal Mathematics Education. In this way, the culture of each community is preserved and sustained despite the changing technology in education. The teacher's knowledge of the learner's cultural background, however, is one of the factors that contribute to how these materials are appropriately used (Cardona, 2015; Rubio, 2016).

1.2 The Objectives of the Study

This study focuses on using Ethnomathematics module in teaching selected topics in Geometry among Teduray learners of Mangudadatu National High School-Villamonte Annex, Salangsang, Lebak, Sultan Kudarat during SY 2019-2020.

Specifically, it answers the following:

1. What are the mean gain scores of non-Teduray and Teduray learners on the 30-point teacher-made assessment tests in:
   a. knowledge;
   b. understanding; and,
   c. process?
2. Is there a significant difference in mean gain scores between Teduray and non-Teduray learners?
3. What is the level of perception of the respondents on:
   a. the use of the Ethnomathematics module;
   b. the impact on learning the concepts of Circles; and
   c. attitude towards Mathematics?

1.3 The Hypothesis of the Study

H_0**:** There is no significant difference in the mean gain scores between Teduray and non-Teduray learners.

1.4 The Significance of the Study

This study includes the Ethnomathematics Module which contains indigenized instructions that will serve as a guide to attaining desired Mathematics competencies. This is beneficial for the school administrators who have responsibilities to manage students' services like guidance programs and provide the schools with learning instruments. This helps the Division of Sultan Kudarat as an additional contextualized learning material. This is utilizable to IP schools as a tool in the teaching-learning process.

The Ethnomathematics module aids the teachers in class evaluations and assignments. It unburdens the teachers in facilitating school tasks since the students do the activities with less supervision (Ebuk and Bamijoko, 2016). It helps the parents to monitor their child's work and progress in Mathematics and to assist them in some concepts encountered so that their beliefs and attitudes about mathematics may also change (Westenskow, Boyer-Thurgood and Moyer- Packenham, 2015 as cited in Forbes, 2018).

The students are ensured of independent learning because of simplified and indigenized instructions. Mathematics concepts are derived and merged from their terminologies and daily cultural practices. Multiple intelligence is also developed based on the diverse activities included. Thus, this study serves as a reference for other more researchers on the Ethnomathematics Curriculum approach.

1.5 The Scope of the Study

This study focuses on using Ethnomathematics module in teaching selected topics in Geometry among Teduray learners of Mangudadatu National High School-Villamonte Annex, Salangsang, Lebak, Sultan Kudarat during SY 2019-2020.

This study is limited to the selected Grade 10 Teduray learners since it is advantageous to the researcher to facilitate the said grade level. Geometry topics are covered specifically on Circles (Chords, Arcs, Central Angles, and Inscribed Angles), excluding the proving parts in the theorems.

1.6 Definition of Terms

The following terms and terminologies are defined operationally:

Assessment Test is a teacher-made multiple-choice objective test that assesses knowledge and understanding, and a subjective test that assesses the process of the respondents.

Attitude towards Mathematics is a way of thinking that affects the respondent's behavior toward Mathematics.

Conventional Module is the traditional Grade 10 learning module issued by the Department of Education.

Ethnomathematics Module is a student's learning module wherein instruction, exercises, and questions into the concept of Circles are indigenized or based on the Teduray learner's dialect and cultural practices.

The **Impact on Learning** is the strong effect of the intervention on the learning behaviors of the respondents.

Knowledge describes a learning outcome where learners know the basic information, concepts, and performance tasks.

Mean Gain Score is the difference in the average scores between the pre-test and post-tests of each of the non-Teduray and Teduray groups of learners.

Post-test is a 30-item combination of multiple-choice and problem-solving assessment tests administered after the use of the intervention which covers the topic of Circles, specifically Chords, Arcs, Central Angles, and Inscribed Angles.

Pre-test is a 30-item combination of multiple-choice and problem-solving assessment tests administered before the use of the intervention which covers the topic of Circles, specifically Chords, Arcs, Central Angles, and Inscribed Angles.

Perception is a personal interpretation of the respondents on the information or treatments received.

Process describes a learning outcome where learners use skills based on facts and information for making meaning and understanding.

Non-Teduray Learners are learners with no Teduray blood studying in the upper portion of Lebak, Sultan Kudarat.

Teduray Learners are members of the Teduray cultural community studying in the upper portion of Lebak, Sultan Kudarat.

Understanding describes a learning outcome where learners can explain big ideas or concepts.

Use of Ethnomathematics is a way of doing mathematical class activities with concepts connected to Teduray cultural activities.

II. REVIEW OF RELATED LITERATURE

2.1Teaching Geometry

Geometry is a branch of mathematics that deals with shape and space. Its connection to life and nature gains the most attention from people because geometrical shapes are observed almost everywhere and used in daily lives (Cherif *et al*., 2017). It develops the critical thinking and problem-solving skills of the learners (Serin, 2018). The core skills of logic and reasoning in geometry are great factors to success in school, work, and many other aspects of life (Tanton, 2016).

Geometry is important in teaching mathematics and is very challenging to learn and comprehend (Tyas *et al*., 2017; Fitriyani *et al*., 2018; Siregar *et al*., 2019). It is abstract and its language confuses the learners when solving related problems (Katsap and Silverman, 2008; Ly and Malone, 2011). The difficulty in geometry results in failure in examinations which contributes to poor performance in Mathematics as a whole. Thus, focusing on the topics in geometry will improve the overall mathematics performance of the learners (Adolphus, 2011; Sunzuma and Maharaj, 2019).

The other problems encountered in teaching geometry have been identified by several studies. Geometry is being taught in a school that is not culture-sensitive as evidenced by the lack of practical sessions or real-life experiences in the activities and lessons (Adolphus, 2011; Sunzuma and Maharaj, 2019). Teachers use the wrong instructional approach, less innovative learning methods, and dull teaching materials which are rooted in teachers' lack of content knowledge (Madusise, 2015). Students have less positive attitude towards learning the subject (Bora and Ahmed, 2018). Hence, the current study reduces the abstract nature of geometry by relating the lesson to real-life situations and developing learning materials that change the learners' perception as some ways to address the problems.

2.2 Ethnomathematics

The Ethnomathematics approach is the most effective teaching method which links geometry teaching to the learner's familiar practices found in the cultural environment. It is a learner-centered approach that uses learners' previous learning experiences to enhance the understanding of concepts in mathematics. Local examples are highlighted using a familiar or indigenous language where knowledge is rooted. The integration of ethnomathematics- based methods and principles into the formal curriculum is found to help the learners in understanding and apply the principles of mathematics based on their own mathematical experience, simplifying and improving retention and efficient learning that result in higher achievement in geometry (Aikpityani and Eraikhuremen, 2017 as cited in Sunzumah and Maharaj, 2019).

Ethnomathematics is termed from the prefix "Ethno" that refers to the language, codes, beliefs, ideologies, and daily practices of cultural groups, and the term "mathematics" that refers to the art or technique of counting, classifying, ordering, inferring, and modelling (accordingly termed by a Brazilian Mathematics educator, Ubitaran D'Ambrosio in 1986 as cited by Rubio, 2016). The term means studying mathematics in the concept of cultural groups (University of Hawai'i, 2013; Rubio, 2016). In addition, ethnomathematics has an "enriched meaning" and it gives an impact on the Western educational curriculum since it applies to every individual for a specific group (Sunzuma and Maharaj, 2019). Due to this impact, there have been several studies for teachers about the nature of ethnomathematics to deeply understand its dimensions (Tiquis, 2019).

Despite several studies about the effectiveness of the ethnomathematics approach, it is still rarely used in the classroom (Mosimege, 2012; Madusise 2015, Mogari, 2014). A study finds that teachers' awareness of ethnomathematics is limited or relatively low. It is challenging to use because it is not aligned with the prescribed curriculum (Bridge *et al*., 2012). In the Philippines, particularly in San Pablo City, it is stated that there is no record of an Ethnomathematical system in the place except their old way of doing mathematics. A series of interviews and workshops have been done so some Filipino educators were able to design their contextualized and culture-based learning materials to be used in the teaching-learning process (Tiquis, 2019).

2.3 Teaching Geometry within the Community

Mathematical techniques and concepts are previously practiced in the community before formal education could have been introduced to individuals who enter school. It is supported by different papers which revealed that the daily activities of different tribes are connected to geometry (Cardona, 2015; Rubio, 2016; Alangui, 2017). Geometry is already taught in indigenous communities but it is unnoticed because geometrical language is different from the daily language used. Using indigenous language and the culturally responsive context in geometry is highly mentioned by researchers to be adopted (ZIMSEC, 2015).

The activities of some tribes in the Philippines have been studied, collected, and blended with the Department of Education's mathematics curriculum. The building of local boats, making of wooden houses, and estimation of time using the sundial of the Agta in the Sierra Madre Mountains are used to introduce the concepts of triangles and angles (Cardona, 2015). In addition, the geometrical patterns which are present in the Kabihug tribe's art of weaving, instruments, making of nipa hut, and other indigenous techniques can be connected to the idea of the circle and other geometric concepts (Rubio, 2016). Concepts of circles are also present in the indigenous beliefs and activities of the Mangyan in San Jose, Mindoro (Alangui, 2017). Preserving the activities of the tribes while learning modern mathematics helps lessen the risk of indigenous techniques becoming extinct because of the existence of the modern tools (Cardona, 2015).

2.4 Ethnomathematics-based Learning Modules

A module is one of the learning materials used to improve and facilitate teaching and learning instruction (Matarazzo, Durik and Delaney, 2010). It consists of concepts, activities, and practice questions designed for individuals or groups. It is arranged according to learning objectives that promote the learner's performance in content-knowledge acquisition (Auditor and Naval, 2014). A learning module also helps learners learn independently and directly construct learning experiences (Prendergast, 2017; Schwarz, 2017; Surya and Syahputra, 2017).

Culture-based mathematics instructional modules are developed by researchers to serve as alternatives to the mainstream curriculum-designed learning materials. The perceptions and responses of teachers during the process of conducting culture-based modules include alternative ways of teaching mathematics, positive energy of both teachers and learners, very good teacher-student interaction, enhancement of learners' self-confidence, and application of daily life activities which are not only textbook-based knowledge (Yao, 2016). The use of developed cultural modules has also been concluded through the results of completeness of problem-solving ability, learners' active activities, and positive learners' responses (Nurjehan et al., 2017).

Ethnomathematics-based geometry module is found to be more effective than other learning modules in general. It enhances skills and provides better knowledge of geometry and cultural objects at the same time (Fouze and Amit, 2018; Ambarawati and Agustin, 2019; Mauluah and Marsigit, 2019). It helps retain the losing culture of the learners because of fast-changing technology in mathematics. However, these kinds of indigenous teaching materials are not often available in libraries or schools, especially in secondary schools (Yao, 2016).

2.5 The Teduray and the Indigenous Community

In recent years, the Indigenous People have been the subject of the government in terms of education. One of the major Indigenous People of the Southern Philippines who are still striving for poverty and education is the Teduray community. Generally, they are very attached to farming and mentioned to have poor education because it is not their priority (Peace Direct, 2015). With an indigenized basic education, the IP youth will be better equipped to assert their rights in mainstream society, as confidently believed by Timuay Hilario Tanzo of the Teduray Tribe, a deputy governor for Indigenous People in the Autonomous Region in Muslim Mindanao (Calunsod, 2013).

Records by different studies show that the academic performance of IP students is relatively low. The low performance is due to inappropriate pedagogies and instructional materials introduced by the teachers who are also unknowledgeable enough about how the IP learns (Guiab and Guiab, 2016). In support of this, the main factor why IP students have low academic performance is the way the lessons are delivered. The IP parents cannot help their children with understanding conventional concepts because of their educational attainment and the lessons are not familiar to them (Andaya, 2016).

IP became alien to their place because all inputs including the language in the formal school are based on the Western concepts (Longboat, 2012; Wa- Mbaleka, 2013; Alangui, 2017). The students learn more and embrace the languages that are foreign including their behavior and their way of life. The IP students learn more about others' cultures and the IP elders have no more voice to share the tribe's stories, histories, and other traditional practices (Tolentino, 2017). Language cannot be separated from culture since language speaks the identity of the Indigenous People (as cited further in Tolentino, 2017).

2.5 Theoretical Framework

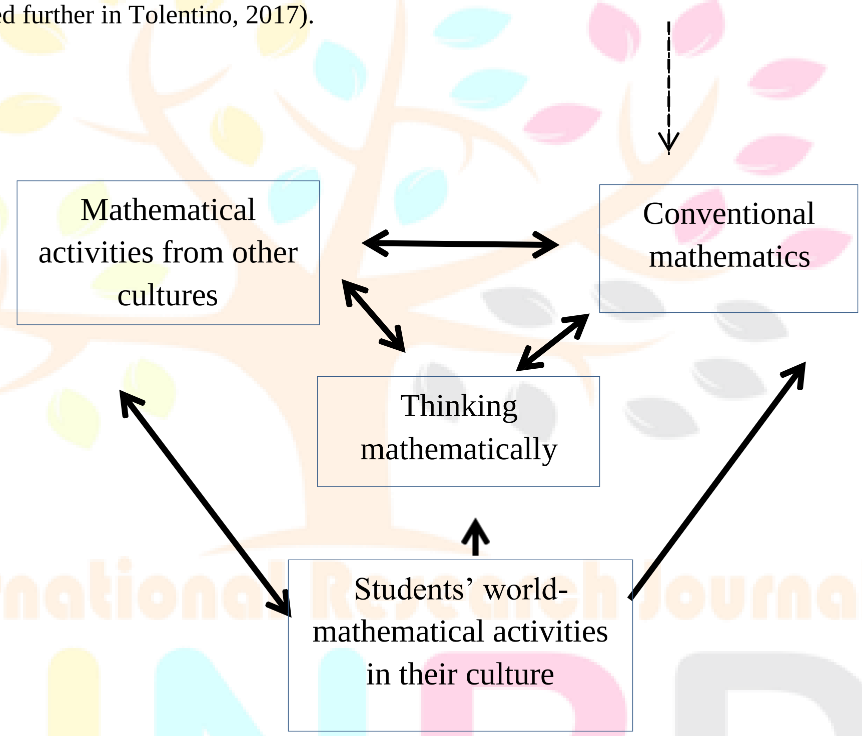

Figure 1. Ethnomathematical curriculum model (Adam's (2004)

The ethnomathematical curriculum model supports indigenous knowledge to improve the performance of IP learners. In this model, the learners start from the experiences they have in the environment, build upon these mathematical ideas, and ultimately realize and understand the need for accuracy and the use of formulas in mathematics and real-life situations (Alangui, 2017).

The Ethnomathematical curriculum model motivates students to (1) recognize mathematics as part of their everyday life; (2) enhance students' ability to make meaningful mathematical connections, and (3) deepen their understanding of all forms of mathematics.

This model is used to connect the culture of the Teduray learners with the DepEd curriculum. The instructions used to the learners are based on their dialect and the context of the lessons is taken from their daily economical and cultural practices which are used to introduce concepts in Mathematics (Alangui, 2017).

2.7 Conceptual Framework

<u>Conventional Module Group</u> ***<u>Teduray-Crafted Module Group</u>***

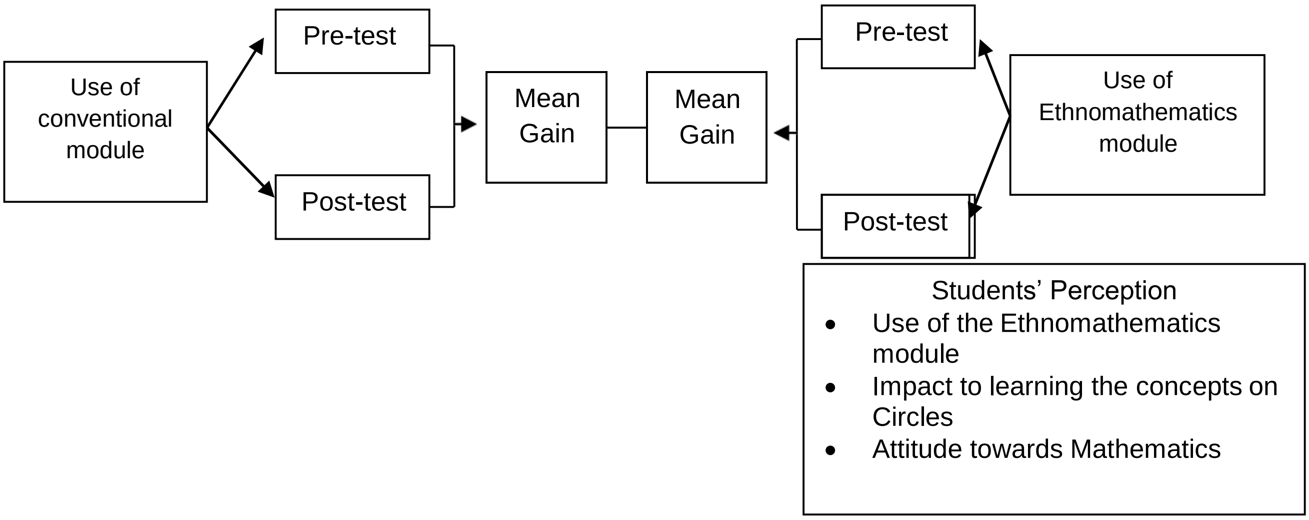

Figure 2. The conceptual framework of the study.

The framework of the study starts with giving the students a pretest to both the Conventional Module and Teduray-crafted Module groups to assess their behavior on knowledge, understanding, and process. This is used in determining their current knowledge and readiness on specific topics. During the lesson proper, the conventional learning module issued by the Department of Education is used for the Conventional Module group in the teaching-learning process while the Ethnomathematics module is used as an intervention for the experiment group. The intervention is an indigenized module that includes instruction, exercises, and questions on the concept of Circles. The class is observed if there is an improvement in the engagement and interaction towards the topics presented. Both groups are given a post-test. This is a strategy to compare the mean gain scores between the learners that are taught using the conventional module and those that are taught using the Ethnomathematics module. In connection, a questionnaire is also given to the students to determine their perception of the use of the Ethnomathematics module, the impact of learning the concepts on specific topics on Circles, and their attitude towards Mathematics.

III. METHODOLOGY

3.1 Research Design of the Study

The experimental design was used in this study, specifically, the Pretest- Posttest Equivalent Groups Design. The class of Teduray learners' performances was compared to the non-Teduray learners using the Ethnomathematics module as the intervention. The significant difference between mean gain scores of the Teduray and non-Teduray learners was determined in terms of knowledge, understanding, and process. Furthermore, the significant difference in the pre and post-test scores of the respondents was also determined. A questionnaire was also administered to determine their perception of the use of the Ethnomathematics module, the impact of learning the concepts on specific topics on Circles, and their attitude towards Mathematics.

3.2 Locale of the Study

The study was conducted at Mangudadatu National High School- Villamonte Annex, Salangsang, Lebak, Sultan Kudarat. The school is located in the upper part of the municipality approximately 25 km away from the town proper. The school was established in the year 2006 with 3 teachers and 56 students in a makeshift building as the classroom. The opening of the school allowed fresh graduates and out-of-school youths within the barangay and its neighboring places.

3.3 Respondents of the Study

The respondents of the study were the Grade 10 learners enrolled in Mangudadatu National High School-Villamonte Annex during the school year 2019-2020. The Conventional Module group was composed of 23 non-Teduray learners and the Teduray-crafted Module group was composed of 21 Teduray learners.

3.4 Instrumentation of the Study

The research instruments employed in this study were the teacher-made assessment test, the Ethnomathematics module, questionnaires on the perception of students, content validity instruments, and letters. The first instrument used was a teacher-made assessment test utilized in both the pretest and the posttest. A table of specification was prepared for the 30-item test.

The respondents were instructed to encircle the letter of the correct answer to the questions involving selected topics on Circles written in the English language. The test was used to measure the impact of the intervention and the respondents' performance in terms of knowledge, understanding, and process. The ethnomathematics module was made by this researcher and used as a teaching and learning tool during the research. It was based on the learning competencies prescribed in the curriculum of the Department of Education and incorporated the IP Competencies.

Existing modules and worksheets were downloaded and used as a reference to indigenize the lessons in the module. The instructions, names, images, and problems included were taken from the language, personalities, and daily practices of the Teduray people. The terms and terminologies in all of the tools were carefully chosen, analyzed, and confirmed through available resources with the help of the Teduray elders to ensure the correct usage and to make sure the respondents were able to understand their meaning considering their ethnolinguistic distinctiveness. The module was written in the English language and indigenized using the Teduray vernacular.

To measure the perception of the respondents on the use of the Ethnomathematics module, the impact on learning, and attitude towards mathematics, a questionnaire was adopted. They were asked to decide whether they agree or disagree with the statements provided by putting a check on the appropriate number scale.

The Ethnomathematics Module, Lesson Plan, and Assessment Test Questionnaire were validated using a Content Validity instrument. The experts were asked whether they agree or disagree with the statements provided by putting a check on the appropriate number scale. The overall rating of the experts was 3.73, 3.64, and 3.43, respectively, which means that the instruments were valid. The test of validity was adopted from Adora (2014) who studied the Development and Validation of a Workbook in Elementary Mathematics.

Lastly, letters were written addressed to the Schools Division Superintendent and the School Principal where the study was conducted. This was signed by the researcher and the research adviser and was sent before the conduct of the study.

3.5 Data Gathering Procedures

Letters were sent to the Sultan Kudarat School's Division Superintendent the principal of Mangudadatu National High School and the adviser of the Grade 10 students regarding the conduct of the study. The selected section was divided into two without letting them know that they were the respondents of the study. One group, composed of non-Teduray learners was for the Conventional Module group and the other group, composed of Teduray learners was for the Teduray-crafted Module group. They were given orientation about the activities to be undergone during the data gathering period.

The respondents were given a pretest. The scores recorded were used as a basis to determine their current knowledge and readiness about the topic. The usual or conventional learning module was used in teaching the Conventional Module group while an Ethnomathematics module was introduced to the Teduray-crafted Module group. After the three-week lesson, a posttest was administered and checked to determine the effectiveness of the learning material. The scores were presented to the statistician for tabulation and interpretation. The analysis was performed by the researcher.

3.6 Statistical Treatment of Data

The data gathered were tallied and tabulated to facilitate the analysis and interpretation of the data. Descriptive statistics was used to analyze the data. The frequency distribution, mean, and standard deviation were used to describe the mean gain scores of the non-Teduray and Teduray learners in a 30-item assessment test in terms of a) knowledge, b) understanding, and c) process; and the perception of the respondents on a) the use of ethnomathematics module, b) the impact to learning concepts on Circles, and c) the attitude towards Mathematics.

The data gathered from the questionnaires on the perception of students were interpreted according to the following range of scores:

Range of Scores	**Description**
3.5-4.00	Strongly Agree
2.5-3.49	Agree
1.5-2.49	Disagree
1.0-1.49	Strongly Disagree

Moreover, the Multi-Analysis of Variance (MANOVA) test was used to determine the significant difference between the mean gain scores of the non- Teduray and Teduray learners and the significant difference between the pre-test and post-test scores of the Teduray learners in terms of knowledge, process, and understanding. The scores gathered from the administration of the pretest and posttest were interpreted according to the following range of scores:

Level of Score Range and Its Description		
Knowledge (16 Items)		**60 %**
Score Range	**Description**	**Interpretation**
15- 16	Outstanding	Passed
14	Very Satisfactory	Passed
13	Satisfactory	Passed
12	Fairly Satisfactory	Passed
0-11	Did not meet expectation	Failed
Understanding (9 items)		**30%**
Score Range	**Description**	**Interpretation**
9	Outstanding	Passed
8	Very Satisfactory	Passed
7	Satisfactory	Passed
6	Fairly Satisfactory	Passed

0-5	Did not meet expectation	Failed
Process (3 items)		**10%**
Score Range	**Description**	**Interpretation**
3	Outstanding	Passed
0-2	Did not meet expectation	Failed

IV. PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA

4.1 Learners' Mean Scores on the Assessment Tests in Terms of Knowledge, Understanding, and Process

Assessment Tests in Terms of Knowledge

The pre-test and post-test mean scores of Teduray and non-Teduray learners in terms of knowledge are as follows (Table 1).

Learner	Pre-test Mean Score	Description	Post- test Mean Score	Description	Mean Gain
Teduray	7.00	Did not meet expectation	12.00	Fairly Satisfactory	5.00
Non-Teduray	8.00	Did not meet expectation	12.00	Fairly Satisfactory	4.00

Table 1. Pre-test and Post-test mean scores of Teduray and Non-Teduray learners in terms of knowledge (n=44).

Based on knowledge, the mean score of the Teduray learners in the pre- test which is 7.00 is lower than that of the non-Teduray learners which is 8.00, although both are described as "did not meet expectation." While, the mean score of both the Teduray and non-Teduray learners in the post-test which is 12 is higher than their pre-test scores, and both are described as "fairly satisfactory." The two groups show mean gain scores of 5.00 and 4.00, respectively.

Both groups have an increase in mean scores which suggest that both the conventional module and Ethnomathematics module enhance their knowledge inthe topics on Circles. Although the mean gain score of 5.0 for the Teduray- crafted module group is observably higher than the mean gain score of 4.0 for the non-Teduray-module group, both scores have the same description.

Particularly, the Teduray-crafted module group (Teduray learners) as discerned from their mean gain score, has the increase in knowledge with the help of the intervention given to them. The students acquired information easily because they had identified, defined and described situations based on their individual capacity. A short assessment from the module are given after each discussion and it is observed that they remembered the terms and concepts well when they were first stated in their own dialect before giving them time to state it in English or Mathematical language. Language is the root of knowledge and using indigenous language helps in the higher achievement in geometry (ZIMSEC, 2015; Craig *et al.*, 2019). It is also right to provide assessments with feedbacks and a non-threatening classroom for the students to gain interest in their subject (Magno, 2014).

The higher result in the mean gain score (difference of 1.00) of the Teduray learners imply that the Ethnomathematics module is effective in terms of achieving high scores in knowledge.

Assessment Tests in Terms of Understanding

The pre-test and post-test mean scores of Teduray and non-Teduray learners in terms of understanding (Table 2).

Learner	Pre- test Mean Score	Description	Post-test Mean Score	Description	Mean Gain

Teduray	1.00	Did not meet expectation	5.00	Did not meet expectation	4.00
Non-Teduray	2.00	Did not meet expectation	4.00	Did not meet expectation	2.00

Table 2. Pre-test and Post-test mean scores of Teduray and non-Teduray learners in terms of understanding (n=44).

Based on understanding, the mean score of the Teduray learners in the pre-test which is 1.00 is lower than that of the non-Teduray learners which is 2.00, although both are described as “did not meet expectation.” While, the mean score of the Teduray and non-Teduray learners in the post-test which are 5.0 and 4.0, respectively, are higher than their pre-test scores, although both post-test scores are described as “did not meet expectation.”

The observable increase in the mean scores suggests that both the conventional module and Ethnomathematics module enhance their understanding in the topics on Circles. Both groups of learners increased in mean scores despite not meeting the expected scores. This indicates that both groups still benefited from the modules, whether conventional or Teduray-crafted, with Teduray learners having better post-test performance than non-Teduray learners. Moreover, the Teduray learners show higher mean gain scores than non-Teduray learners, implying a higher degree of effectiveness with the use of Ethnomathematics module.

The increase in the mean scores of the Teduray and non-Teduray learners is due to the instructional modules they used as learning materials. The modules help them learn independently and construct their own learning experiences (Schwarz, 2017; Surya and Syahputra, 2017; Prendergast, 2017). A higher mean gain from the Teduray-crafted module group may suggest that the involvement of the Ethnomathematics module in the teaching-learning process has a considerable effectiveness. An Ethnomathematics-based geometry module provides better learning performances than other modules in general (Mahazir and Arif, 2015). The higher mean gain of 4.00 by the Teduray learners than the mean gain of 2.00 by the non-Teduray learners indicates better performance using Ethnomathematics module in the aspect of understanding.

Assessment Tests in Terms of Process

The pre-test and post-test mean scores of Teduray and non-Teduray learners are reflected in terms of process (Table 3).

Learner	Pre- test Mean Score	Description	Post-test Mean Score	Description	Mean Gain
Teduray	0	Did not meet expectation	1.00	Did not meet expectation	1.00
Non-Teduray	0	Did not meet expectation	1.00	Did not meet expectation	1.00

Table 3. Pre-test and Post-test Mean Scores of Teduray and non-Teduray Learners in Terms of Process (n=44)

Both the Teduray and non-Teduray learners get zero (0) in the pretest and increase with a mean score of 1.00 in the post-test. They did not meet the expected scores in both tests.

The table tells that both groups found difficulty in answering the test questions. After the intervention, it is observed from the post-test Assessment questionnaire of the Teduray learners that even if they are not able to answer all the questions, they are able to write considerable steps that would solve the problems given. In the Ethnomathematics module, cultural activities of the community are presented as motivation before discussing math concepts. The integration of Ethnomathematics helps the learners in applying principles that lead to higher achievement in geometry (Aikpityani and Eraikhuremen, 2017).

The mean gain 1.00 of the Teduray and non-Teduray learners suggests that the conventional and Ethnomathematics modules are effective.

4.2 MANOVA Results of Difference on the Mean Gain Scores between Teduray and non-Teduray Learners

Table 4 shows the difference on the mean gain scores between the Teduray and non-Teduray learners.

Independent Variables	Dependent Variables	F value	p value	Interpretation	Decision
Teduray vs. Non-Teduray	Knowledge	2.588	.115	Not Significant	Do not reject Ho
	Understanding	1.453	.235	Not Significant	Do not reject Ho
	Process	1.595	.214	Not Significant	Do not reject Ho
	Total	***1.658*** (Wilk's)	***.192***	***Not Significant***	***Do not reject Ho***

Legend: $p < 0.05$ is significant at 0.05 level (two-tailed)

Table 4. MANOVA Results of Difference on the Mean Gain Scores Between Teduray and non-Teduray Learners (n=44).

The p-values of Knowledge, Understanding, and Process are 0.115, 0.235, and 0.214, respectively. They show that in all behaviors or placements the p-values are greater than the significance level which is 0.05. Such results from Tables 1 to 3 show that as the Teduray learners' scores increase, there is also an increase in the scores of the non-Teduray learners. That is why the compared variables are interpreted as not significant which leads to the acceptance of the null hypothesis that "there is no significant difference in the mean gain scores between Teduray and non-Teduray learners."

With these data obtained, it can be interpreted that the use of the Ethnomathematics module as an intervention to the Teduray learners help them increase their scores in all placements of the Assessment Test. However, as observed in the scores of the non-Teduray learners, there is also an increase in their scores even if their lessons are not indigenized. This implies that whether indigenized or not, still the non-Teduray learners can cope with the lessons given in the conventional classroom. It is taken consideration that the achievers or the students with Honors are from the non-Teduray learners, that is why even before the intervention they had already the edge compared to the Teduray learners.

The Teduray group is observed to have enhanced and had higher increase of scores from the Ethnomathematics module which is indigenized and it can be considered effective also to the non-Teduray group who can easily cope with the lessons. This coincides with the study conducted in Pangasinan State University where they found out that contextualized and localized or indigenized method of teaching is effective in teaching subjects (Garin *et al*., 2017).

The compared results of the mean gain scores of the Teduray and non- Teduray learners in terms of knowledge, understanding and process indicate no significant difference, implying that both conventional and Ethnomatics-based modules are effective in increasing performances in learning Circles.

4.3 MANOVA Results on Mean Difference of the Pre and Post-test of the Teduray Learners

Table 5 shows the difference between the mean of the pre and post-test scores of the Teduray learners.

Indepen-dent Varia-Bles	Dependent Variables	Test	Mean	MD	SD	t value	p value	Interpretation	Decision
Pre-test vs. Post- test	Knowledge	Pre Post	7.00 12.00	5.0	2.5	-10.15	0.00	Signifi-cant	Reject Ho
	Understanding	Pre Post	1.00 5.00	4.0	2.38	-6.54	0.00	Signifi-cant	Reject Ho
	Process	Pre Post	0.00 1.00	1.0	0.999	-4.91	0.00	Signifi-cant	Reject Ho

Legend: $p < 0.05$ is significant at 0.05 level (two-tailed)

Table 5. MANOVA Results on mean difference of the pre and post-test of the Teduray learners (n=22).

There is a mean difference in Knowledge, Understanding and Process between the pre-test and post-test of the Teduray learners. These differences are significant since the p-value in all the placements is 0.00.

It is evident from the results discussed from Table 1 to Table 3 that in all the placements, majority of the Teduray gain increasing scores. The significant increase from pre-test to post-test is obtained because the Ethnomathematics module is considered user-friendly; it guides them in the way that they feel they are engaged while reading and answering the culture-related activities. The translated or indigenized explanation of the concepts make the topics understood better with less supervision from the teacher. Students who are engaged with module strategies by the teachers are superior over students under conventional approach (Alelaimat and Ghoneem, 2016). Using indigenized teaching materials, teachers can motivate learners to solve problems and boost their interest in their subject areas (Muhammad, Lodhi, Munawar, Muhammad, Khan, Bhatti and Ibrar, 2019).

There is a strong evidence that the intervention improves the performance of the Teduray learners. Hence the null hypothesis "there is no significant difference of the mean of the pre and post-test of the Teduray learners" is rejected.

V. SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Findings

The following are the results of the study:

1. The Teduray-crafted Module Group had higher mean gain score than the Conventional Module Group.
2. There is no significant difference on the mean gain scores between the Teduray and non-Teduray learners (t value=1.658, p value=0.192).
3. There is a significant increase in the pre and post-test scores of the Teduray-crafted Module group in Knowledge, Understanding and Process. This is attributed to the use of Ethnomathematics module as intervention.
4. The use of Ethnomathematics module helped in learning the lessons as perceived by the learners. Generally, the intervention made a positive impact on learning the concept of Circles. It changed the way they view and value Mathematics.

5.2 Conclusion

The use of Ethnomathematics module as intervention in teaching selected topics on Circles is effective in improving the performance of the learners. It gains a positive impression from the learners.

5.3 Recommendations

The following aspects could be done and explored based from the results and conclusion of this study.

1. The school administrators should provide the IP schools with existing indigenized modules to be used in the teaching-learning process. The teachers are encouraged to use both conventional and Ethnomathematics modules in teaching topics on Circles and other topics in Mathematics.
2. The researcher may complete or finish the module for the entire topic of Grade 10.
3. A similar study may be conducted on the use and impact of Ethnomathematics module using other topics in Mathematics.
4. A similar study may also be conducted using other IP dialect such as Dulangan of the Manobo tribe.

REFERENCES

ABO, J. 2018. Use of Culturally-Inspired Materials as Models: Effects of Learning Solids in Geometry. Mindanao State University-Maguindanao, Graduate School.

ADOLPHUS, T. 2011. Problems in Teaching and Learning of Geometry in Secondary Schools in Rivers State State, Nigeria. Int. J. Emerg. Sci., 1(2), 143-152.

ADORA, N. 2014. Development and Validation of a Workbook in Elementary Mathematics VI. International Journal of Humanities and Management Sciences Volume 2, Issue 3.

AIKPITANYI, L.A., and L. ERAIKHUEMEN. 2017. Mathematics Teachers' Use of Ethnomathematics Approach in Mathematics Teaching in Edo State. Journal of Education and Practice, 8, 34-38.

ALANGUI, W.V. 2017. Ethnomathematics and Culturally Relevant Mathematics Education in the Philippines. https://doi.org/10.1007/978-3-319-59220- 6_8.

ALCOBER, N. 2018. DepEd strengthens programs for basic indigenous communities. Retrieved from www.manilatimes.net.

ALELAIMAT, A.R. and K.A.A GHONEEM. 2012. The Effect of Educational Modules Strategy on the Direct and Postponed Study's Achievement of Seventh Primary Grade Students in Science, in Comparison with the Conventional Approach. Higher Education Studies, Vol.2, No. 2.

AMBARAWATI, M. and R.D. AGUSTIN. 2019. Ethnomathematics as Indonesia Batik Artworks in Mathematics Learning Two-dimensional Figure Materials. International Journal of Scientific Research Publications (I) SRP, 9(9), p9305. https://doi.org/10.29332/ijsrp.9.09.2019.p930.

ANDAYA, O.J. 2016. Factors that Affect the Academic Performance of Indigenous People (IP) Students of Philippine Normal University-North Luzon. Asia Pacific Journal of Research.

AUDITOR, E. and D.J. NAVAL. 2014. Development and Validation of Tenth Grade Physics Modules Based on Selected Least Mastered Competencies. International Journal of Education and Research. Vol. 2 No. 12.

BORA, A. and S. AHMED. 2018. Secondary School Students' Attitude Towards Their Learning Geometry: A Survey Of Diphu Town Secondary Schools. International Journal of Research and Analytical Reviews Volume 5, Issue 3. E-ISSN 2348-1269, P- ISSN 2349-5138.

BRIDGE, C., DAY, L. and D. HURRELL. 2012. From routine to rich: Developing an algebraic reasoning task for a middle/upper primary class. Australian Primary Mathematics Classroom, Canberra, v. 17, n. 4, p. 8-12.

CALUNSOD, R. 2013. Philippines 'indigenizes' basic education. Kyodo News. CARDONA, R. 2015. Indigenous Quantification Techniques of the Agta in Sierra Madre Mountains, Philippines.Academic Research Journal of History and Culture. Retrievednfrom http://www.academicresearchjournals.org/ARJHC/Index.html.

CHERIF, A., GIALAMAS, S. and A. STAMATI. 2017. Developing Mathematical Knowledge and Skills through the Awareness Approach of Teaching and Learning. https://www.researchgate.net/publication/317570207_Developing_Mathematical_Knowledge_and_Skills_through_the_Awareness_Approach_of_T eaching_and_Learning.

EBUK, L.E and O. BAMIJOKO. 2016. The effective management of mathematics workbook: Sure remedy to students' performance in mathematics. Retrieved from http://s-o-i.org/1.15/ijarm-2016-3-4-9.

Espinar, M.J. and R. Ballado. 2017. Content Validity and Acceptability of a Developed Worktext in Basic Mathematics 2. Asia Pacific Journal of Multidisciplinary Research, Vol. 5 No. 1.

Ethnomathematics Curriculum Textbook: Lesson Plans in Symbolic Reasoning and Quantitative Literacy. 2013. University of Hawai'i, West O'ahu.

FEBRIANA, R., HARYONO, Y. and R. YUSRI. 2017. Effectiveness of Discovery Learning-Based Transformation Geometry Module. Journal of Physics Conference Series 895. doi:10.1088/1742-6596/895/1/012003.

FITRIYANI, H., WIDODO, S.A. and A. HENDROANTO. 2018. Students' Geometric Thinking Based on Heile's Theory. Infinity Journal, 7(1), 55- 60. https://doi.org/10.22460/infinity.v7i1.p55-60.

FORBES, W.A. 2018. Using Ethnomathemtaics Principles in the Classroom: A Handbook for Mathematics Educators.

FOUZE, A.Q. and M. AMIT. 2018. Development of Mathematical Thinking Through Integration of Ethnomathematic Folklore Game in Math Instruction. EURASIA Journal of Mathematics, Science and Technology Education, 14(2), 617-630. https://doi.org/10.12973/ejmste/80626.

GUIAB, M. and R. GUIAB. 2016. Learning Strategies of the Indigenous Peoples Students of the Philippine Normal University: Basis for a Proposed Pedagogical Model.Asia Pacific Journal of Research.

GARIN, R. 2017. Contextualized and Localized Teaching as A Technique in Teaching Basic Statistics. Asia Pacific Journal of Education, Arts and Sciences, Vol. 4 No.1, 62-67.

Indigenous Peoples and the Sustainable Development Goals, Philippines. 2019. KATSAP, L. and F.L. SILVERMAN. 2008. A Case Study of the Role of Ethnomathematics Among Teacher Education Students from Highly Diverse Cultural Backgrounds. The Journal of Mathematics and Culture, 3(1), 67-102.

LY, R., and J. MALONE. 2010. Teachers' Perceptions of Geometry Instruction and the Learning Environment in Years 9-10 ESL Classrooms. Curtin University of Technology.

MADUSISE, S. 2015. Cultural Villages as Contexts for Mediating Culture and Mathematics Education in the South African Curriculum. Revista Latinoamericana de Etnomatematica, 8(2), 11-31.

MAGNO, C. 2014. A Guide in Assessing Knowledge, Process, Understanding, and Performance/Product (KPUP). Retrieve from https://www.researchgate.net/publication/277405280.

MAHAZIR, I., NORAZAH, M.N., ROSENNI, D., ARIF, A.R. and C.R. RIDZWAN. 2015. Design and Development Performance-based mobile learning for TVET. Procedia-Social Behavioral Sciences, 174.https://doi.org/10.1016/j.sbspro.2015.01.835

MATARAZZO, K. & DURIK, A. and M. DELANEY. 2010. The effect of humorous instructional materials on interest in a math task. Motivation and Emotion. 34. 293-305 10.1007/s11031-010-9178-5.

MAULUAH, L., and MARSIGIT. 2019. Ethnomathematics for Elementary Student: Exploration the Learning Resources at Kraton Yogyakarta. International Journal of Scientific and Technology Research, 8, 776-780.

MOGARI, D. 2014. An In-service Programme for Introducing an Ethnomathematical Approach to Mathematics Teachers. Africa Education Review, 11(3),348-364. https://doi.org/10.1080.18146627.2014.934992.

MOSIMEGE, M.D. 2012. Methodogical Challenges in Doing the Ethnomathematical Research. International Journal of African Renaissance Studies-Multi-Inter and Transdisciplinary, 7(2), 59-78. https://doi.org/10.1080.18186874.2013.774698.

MUHAMMAD, A., LODHI, M.A., MUNAWAR, R., MUHAMMAD, A., KHAN, BHATTI, A.G., and S.M. IBRAR, SYEDA. 2019. Impact of indigenization of English materials on reading and writing proficiency of ESL learners. 5. 65-73.

NURJEHAN, R., SINAGA, N. and S. MURSID. 2017. Development of Module Based On Malay Culture as a Leaning Resource Students in Tanjung Pura City. Bunga Rampai Usia Emas. Vol. 3 No. 2

PRENDERGAST, M., SPASSIANI N.A. and J. ROCHE. 2017. Developing a Mathematics Module for Students with Intellectual Disability in Higher Education. International Journal of Higher Education. https://doi.org/10.5430/ijhe.v6n3p169.

Region XII SOCCSKSARGEN. Regional Education Development Plan 2015- 2019. Retrieved from depedroxii.org

ROSA, M. and D. C. OREY. 2011. Ethnomathematics: the cultural aspects of mathematics. Revista Latinoamericana de Etnomatemática, 4(2). 32-54.

RUBIO, J. 2016. The Ethnomathematics of the Kabihug Tribe in Jose Panganiban, Camarines Norte, Philippines.Malaysian Journal of Mathematics and Sciences.

SERIN, H. 2018. Perspectives on the Teaching of Geometry: Teaching and Learning Methods. Journal of Education and Training. 5. 1. 10.5296/jet.v5i1.12115.

SUNZUMA, G. and A. MAHARAJ. 2019. In-service Secondary Teachers' Teaching Approaches and Views towards Integrating Ethnomathematics Approaches into GeometryTeaching https://www.redalyc.org/journal/2912/291265339004/html/.

SUNZUMA, G. and A. MAHARAJ. 2019. Teacher-related Challenges Affecting the Integration of Ethnomathematics Approaches into the Teaching of Geometry. EURASIA Journal of Mathematics, Science and Technology Education, 15(9), em1744. https://doi.org/10.29333/ejmste/108457.

SIREGAR, N.C., ROSLI, R., and S. M. MAAT. 2019. Development of the D- Geometry Module Based on Discovery Learning International Journal of Academic Research in Progressive Education and Development, 8(3), 99–109. https://doi.org/10.6007/IJARPED/v8-i3/6290.

TANTON, J. 2016. Geometry: An Interactive Journey to Mastry. The Great Course Lectures. Course No. 1444. www.Thegreatlectures.com

The IPEd Curriculum Framework of the DepEd. 2015. Retrieved from udyong.gov.

The Teduray.National Commission for Culture and Arts.Retrieved from https://ncca.gov.ph/about-ncca-3/subcommissions/subcommission-on- cultural- communities-and-traditional-arts-sccta/central-cultural- communities/the-teduray/.

TIQUIS, M.V. 2019. Awareness of Ethnomathematics: Enabling Teachers to Design Culture- Based Materials.

TOLENTINO, M. 2017. The Role of Elderly on IP Education and Self- Determination: A Mini Ethnographic Study in Aeta Community. DLSU Research Congress.

TYAS, F., PANGESTI, P. and E. RETNOWATI. 2017. Pengembangan Bahan Ajar Geometri SMP Berbasis Cognitive Load Theory Berorientasi pada Prestasi Belajar Siswa Developing Geometry Learning Materials for Junior High School Based on Cognitive Load Theory with Regard to Student' s Achievement. Pythagoras: Jurnal Pendidikan Matematika, 12(1), 33–46.

WA-MBALEKA, S. 2013. Quality Education for Native Filipinos: A Phenomenological Case Study of Indigenous Learners. Retrieved from https://www.researchgate.net/publication/263280144

WESTENSKOW, A., BOYER-THURGOOD, J. and P. S. MOYER-PACKENHAM. 2015. A window intomathematical support: How parents' perceptions change following observations of mathematics tutoring. Journal of Research in Childhood Education, 29(4), 458-475. doi:10.1080/02568543.2015.1073816

YAO, R. 2016. Creating Learning Environments for Indigenous Students through Culture-based Math Modules. Universal Journal of education Research 4(8):1809-1814