

In Math, Culture Also Counts: A Case Study on the Integration of Ilokano Culture in Teaching Mathematics

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Abstract – Mathematics education should become holistic, relevant, and connected with learners' everyday lives, including their culture. This qualitative study aimed to explore the integration of the Ilokano culture in Teaching Mathematics at the University of Northern Philippines (UNP) in Vigan City, Ilocos Sur, through a case study qualitative research approach. Findings showed that there is an integration of Ilokano culture in teaching mathematics in UNP. Ilokano culture is primarily used to motivate students or introduce new concepts. The integration of Ilokano culture establishes connections between the faculty and their students and their cultural heritage. The faculty participants also used culture-related examples and problems to emphasize mathematical concepts. Various elements of Ilokano culture are embedded in the teaching-learning process, the language, practices, values, known figures, landmarks, and crafts included. A culture-responsive structure exists in UNP as evidenced by its vision, mission, and developmental goals, which stress preserving and promoting its rich cultural heritage. Difficulties in Ilokano culture integration include inadequacy in knowledge about culture and formal preparation in culture integration and culture-relevant resource materials. The integration of culture into the mathematics curriculum makes it more relevant to the students; thus, it is recommended that teachers design learning experiences in mathematics classes based on the students' cultural background.

Keywords: Curriculum planning, mathematics, culture integration, education

1. Introduction

Mathematics, often viewed as a challenging subject, is taught traditionally with just formulas, rules, and procedures. In recent years, mathematics education has become more holistic, relevant, and connected with the learners' everyday lives, their culture included.

Stemn (2008) describes Mathematics as a dynamic and cultural product and should be reflected in the curriculum and instructional practices and taught in a meaningful and relevant context. While some consider mathematics a non-cultural subject, some educators began to integrate historical or cultural elements in mathematics education. Efforts are initiated to make a culturally-responsive education in Alaska, New Zealand, Australia, and other places (Alangui,

2017). Some even explore mathematical patterns found in people's way of dividing lots, in creating arts and crafts, and even music, and use these examples in teaching. Different approaches and degrees of including culture in the mathematics classroom have been made.

Cultural integration is highlighted by the Commission on Higher Education (CHED) through its series of Memorandum Orders on policies, standards, and guidelines for different curricular programs offered in the Philippines. Preservation and promotion of historical and cultural heritage are indicated as one learning outcome common to all baccalaureate programs, the Mathematics curricula included (Commission on Higher Education, 2017).

For the Philippine basic education, one significant change in mathematics education is the use of the mother tongue in teaching mathematics. For Ilokano children, that would mean learning mathematical concepts and processes in the Iloko language. Higher education institutions, on the other hand, may offer courses in English and Filipino. For instance, the course "Mathematics in the Modern World" may also be taught as "Matematika sa Makabagong Daigdig."

Aligned to the call for cultural integration, the University of Northern Philippines (UNP) had set as its mission the production of "globally skilled and morally upright professionals instilled with rich cultural values."

Many studies have explored the cultural contexts of mathematics and on culture-responsive mathematics education. Studies are scarce, however, in terms of capturing the integration of Ilokano culture in teaching mathematics and the difficulties related to it.

This study's findings may benefit Mathematics curriculum planners in exploring ways of improving the curriculum by integrating cultural history, heritage, and values and thus making Mathematics more holistic, relevant, and meaningful.

1.1. Objectives of the Study

This study aimed to explore how Ilokano culture is embedded in teaching Mathematics, and the best practices employed by Mathematics teachers to integrate Ilocano culture in teaching mathematics. Further, it intended to discover the challenges met on cultural integration in their teaching experiences. Ultimately, it aimed to present a model that could help integrate Ilokano culture in teaching mathematics.

1.2. Theoretical Framework

This study is anchored on various education theories, specifically, Social Constructivism, Culturally Relevant Pedagogy, and Contextualized Teaching and Learning.

Vygotsky (1978) rejected the assumption that learning can be separated from its social context;

he emphasized that learning is collaborative and language and culture have integral roles in one's intellectual development and perception of the world. In view of social constructivism, learning is a collaborative process, and knowledge is developed from the learners' interactions with their culture and society. Culturally-responsive teaching was suggested first by Erickson and Mohatt in 1982.

Ladson-Billings, on the other hand, developed a grounded theory of Culturally Relevant Pedagogy. Ladson-Billings (1995) argued that culturally relevant teaching must develop students academically, nurture and support cultural competence and develop critical consciousness.

Another theory relevant to cultural integration in teaching mathematics is Contextualization Teaching and Learning (CTL), also called Contextualized Instruction. In CTL, according to Berns and Ericson (2001), teachers are helped to relate the subject matter content to situations in the real world. Kalchik and Oertle (2010) also relates the Motivation Theory to CTL and emphasizes encouraging students to reflect on their ideas and experiences related to the materials being learned.

2. Methodology

2.1. Research Design

This study employed the qualitative research approach. According to Cropley (2019), qualitative research examines how people make sense of their life experiences in their own minds and their own words. It aims to understand opinions, experiences, and words, rather than numbers (Creswell, 2014). In this study, the researchers explored the experiences of Mathematics teachers. They gathered insights regarding the integration of the Ilokano culture in their respective classes.

Specifically, the case study was used as QLR research design. Case study, according to Merriam (2009), is "an in-depth description and analysis of a bounded system." Flyvbjerg (2011) cited Merriam-Webster Dictionary's definition as an intensive analysis of an individual unit, whether

a person or community, stressing developmental factors related to the environment.

2.2. Subjects of the Study

The setting of this study is the University of Northern Philippines, which is a university with a strong sense of cultural heritage, as evidenced in its vision, mission, core values, and developmental goals.

This study employed the purposive sampling technique. Purposive sampling, according to Patton (2002), is a widely-used technique in qualitative research for identifying and selecting information-rich cases for the most effective use of limited resources. It involves identifying and selecting individuals that are especially knowledgeable about or experienced with a phenomenon (Cresswell & Clark, 2011).

There were six participants in this study selected using the purposive sampling technique. Four are faculty participants who have taught math subjects and have experienced integrating Ilokano culture in the teaching-learning process. One of them holds a supervisory position as program chair, who heads curriculum revision and syllabi review. Two are student participants who have been enrolled in the classes of the faculty participants. All participants are willing to take part in this case study.

2.3. Data Gathering Tools

To obtain insights regarding the integration of Ilokano culture in mathematics classes, the study used several modes of acquiring information. Data collection methods used were: (1) interviews (semi-structured) and (2) documentary analysis. The primary source of information was from semi-structured interviews. Documentary analysis provided additional data.

This study used in-depth interviews with the participants, with each interview lasting at most 30 minutes. Considering the local restrictions against the COVID-19 virus, interviews were done through video conferences or chats.

Documentary analysis was done on CHED CMOs, mathematics syllabi, and the faculty participants' learning materials and tasks.

2.4. Data Gathering Procedure

This study consists of the following phases:

Phase I: Interviews. Interviews were carried out with teachers and students individually. Although a written interview protocol was followed, the interview method's flexibility allowed the researchers to ask additional questions to elicit further clarification or other information from the respondents.

Phase II: Review of Course Syllabi. Syllabi of the math courses taught by the participants were reviewed to gather information about the infusion of the Ilokano culture in the curriculum.

2.5. Data Analysis

The method used for data analysis was a general qualitative approach using constant comparative analysis to uncover patterns and themes within the data. Specifically, thematic analysis was done.

Thematic analysis (Braun & Clarke, 2006) was used to analyze the interview data in this study. The data analysis phases involved familiarizing with the data, searching for themes, and reviewing, defining, and naming the themes. To complement the data coming from the interviews, course syllabuses were also looked into.

Interviews with the participants were transcribed and were analyzed to identify regularities and patterns emerging from the data. When the transcribed data are ready, the researcher identified emerging themes and categories.

First, from the individual experiences, codes were formulated. From the codes, categories were identified. After which, themes were finalized.

2.6. Ethical Considerations

The researchers observed ethical practices throughout the conduct of this study. Before and during the survey, the rights of the participants were always respected. Informed consent was obtained before any data were collected to allow the participants to understand the purpose, processes, timeframe, benefits, and risks of this study. Withdrawal from the research study is a

right given to the participants. All information shared by the participants were treated with respect and confidentiality. No raw data were disclosed to any other individual, other than the researchers.

3.Results and Discussions

3.1. Embedding Ilokano Culture in Teaching Mathematics

Three themes emerged in terms of embedding Ilokano culture in mathematics teaching: as motivation, as connection, and for emphasis.

3.1.1. As Motivation

When asked how they use Ilokano culture in their Mathematics classes, the faculty participants expressed they use it as motivation or introduction before they go about their lessons.

One faculty participant said, "I sometimes use trivia or bits of information about local practices like the '*panagruar ti ipon*' (hatching of a species of small fish) as motivations or introduction of lessons." '*Panagruar ti ipon*' is a local phenomenon that refers to the hatching of small fish species. The faculty participant shares in his class how such phenomenon can be computed based on the number of days after the full moon on certain months.

Another participant mentioned that integrating Ilokano culture in her class could be a "bridge to build a strong mathematical foundation for lifelong learning."

One student participant agrees with cultural integration in the mathematics classroom, describing it as "fun and relevant."

Mathematics is perceived as a difficult subject; hence, students must be motivated and encouraged. With culture-related motivation, students see that is Mathematics learning can be fun and easy. This finding is in accordance with d'Entremont (2015) study, where she claimed that aesthetic and geometric aspects of cultural symbols could be used to develop mathematical concepts and motivate children to learn mathematics as they learn about their culture.

Neupane and Sharma (2016) posited that with culturally relevant pedagogy, students would see mathematics in their everyday lives, and they feel that mathematics is flexible, thus encouraging them to understand mathematical concepts. Balamurugan (2015) also emphasized that students' attitudes towards classroom activities can be determined by culture.

3.1.2. As Connection

The faculty participants were also able to establish the relevance of the Ilokano culture and the mathematical concepts being learned.

According to one faculty participant, cultural integration is done by "relating our lessons with examples about Ilokano culture..."

One faculty participant felt that she is closer to her students when she relates the lessons to the local culture. She said, "*Para kahit dun man lang mejo malapit lapit ako sa students ko...*"

The students also feel closer to what they are learning through culture-related examples. She expressed, "*Hindi masyadong detached yung feeling namin sa math topics.*"

3.1.3. For Emphasis

The most common use of Ilokano culture in mathematics education is to emphasize the concepts.

One faculty participant averred, "For example, in Mathematics in the Modern World, we were discussing patterns in nature. I cite examples of patterns based on ilocano products such as patterns on abel, designs on ilocano handicrafts, etc..." In his other classes, local games such as Sungka are also analyzed for emphasis of the topics.

Another faculty participant had used the local weaving industry in geometrical concepts. She asked her students to check the transformations used in the work designs of weavers.

The student participants confirmed that their teachers indeed emphasize concepts through elements of the Ilokano culture. One student said, "*...inask po ni Sir na mag-identify kami ng geometrical objects in our surroundings as well as patterns na makikita namin in nature.*"

Examples are always the best way to emphasize a topic. It is good to note that the participants had used varied examples related to Ilokano culture, including the abel, famous landmarks, and popular personalities.

One student shared that in their graph theory class, they were once asked to find the shortest path from UNP to Calle Crisologo, a famous landmark in Vigan City flocked by tourists for its Spanish-era houses and roads.

In mathematical problems involving places, one faculty participant claimed that instead of foreign places or landmarks unknown to them, he uses landmarks familiar to them like Mestizo River and Bantay Abut. Also, for examples and exercises involving people, he uses famous Ilokano figures such as Diego and Gabriela.

In their integration of Ilokano culture in their mathematics class, there were best practices that emerged.

3.2. Best Practices in Ilokano Culture Integration

From the field notes gathered during the interview, three themes emerged: the use of the Iloko language and Iloko values and the existence of a culture-relevant structure.

3.2.1. The Language I Understand

The most common and useful practice of cultural integration is the use of the Iloko language. People often find it easier to learn a new concept when learning it in their native language.

Mathematics is traditionally taught in English. The faculty participants successfully used Iloko and English in their classes, which was much appreciated by the students.

One student participant shared that the use of the Iloko language helped her to understand the concepts better. She also appreciates how their teachers allow them to answer in any language comfortable to them, Iloko included.

The student describes the usage of the Iloko language as helpful to them by saying, "*...mas maiintindihan po namin yung topic kase mas familiar po yung feeling ng concepts pag sinasalita sa language na lagi naming naririnig.*"

The use of Iloko language in explaining further the concepts or to facilitate better understanding is considered by the participants as a form of culture integration. Consequently, the participants noticed that mathematical problems translated in Iloko were easily comprehended by the students.

This finding supports what the United Nations Educational, Scientific and Cultural Organization or UNESCO encouraged almost seven decades ago. According to UNESCO (1953), there is a need to use the vernacular language in education since the child's mother tongue is the best medium for teaching.

Embedding other elements of the Ilokano culture was also deemed as a best practice, such as the Ilokano values.

3.2.2. The Ilokano Values

The Ilokano values are integrated as part of the hidden curriculum.

One faculty participant said, "Being industrious is one of the Ilocano culture that I can integrate to my Math class. Since mathematics requires a lot of computations, students should be industrious enough to find ways answering those given problems." He highlighted that if students are able to work hard to answer mathematical problems and will not easily give up, they will succeed in any career they wish to pursue in life.

One faculty participant emphasized to her students to respect their ancestors' legacy to protect the Ilokano culture and practices.

One student participant shared that when their teachers mention students' commendable traits and habits as examples, they feel that that Ilokano culture is already integrated in the curriculum.

3.2.3. Culture-Relevant Structure

Careful analysis of mathematics syllabi depicts that the University of Northern Philippines has established a culture-relevant structure.

UNP envisions itself to become "a globally recognized university in a heritage city by 2030", clearly showing its desire to be globally known while identifying its roots in a known heritage city in the world, the Vigan City. UNP, in its mission statement, gives emphasis on instilling rich

cultural values to its graduates along with global skills and moral integrity.

Culture is also embedded in UNP's developmental goals. Specifically, UNP aims for the preservation, promotion, and development of cultural heritage, bringing arts and culture to the people.

Cultural integration is also explicitly embedded in the objectives of the College of Arts and Sciences (CAS), the academic unit offering the BS Mathematics program and general Mathematics education courses.

Overall, the use of the Iloko language and emphasis on Ilokano values is aligned with CHED's call for cultural preservation and promotion. There are difficulties, however, that are hinder the easy and effective integration of the Ilokano culture.

3.3. Challenges Met in Integrating Ilokano Culture in Teaching Mathematics

The researchers found recurring themes along challenges or difficulties in integration of Ilokano culture. These are the teachers' own perspectives of the practice, culture literacy, and the need to teach themselves first.

3.3.1. What I Think About Ilokano Culture Integration

How Mathematics teachers perceive or view culture integration in teaching can also become an obstacle.

One faculty participant said, "I agree on integrating Iloko culture in teaching Math ... maybe in primary school?" While she approves of such culture-responsive practice in teaching Mathematics in college, she thought that it should be done more while learners are in their primary education.

Resistance to change by teachers is among the perceived difficulties in integrating culture in mathematics, along with lack of knowledge on integrating culture-related approaches into teaching (Sunzuma & Maharaj, 2019).

3.3.2. Culture Literacy

The participants considered themselves to have little knowledge about the Ilokano culture and at times find it difficult on how to incorporate the different components of culture in their mathematics lessons.

One faculty participant said that the challenge among teachers is to study first the Ilokano culture so that they are able to effectively integrate it while teaching. He said that the key is having a "rich background" of the culture.

Despite being Ilokanos, the participants find themselves not that fluent in the Iloko language. Also, there are mathematical symbols and concepts which are hardly translated into Iloko.

One faculty participant revealed that while she does her best, at times she finds it challenging to use the Ilokano language in her class. According to her, she is not really exposed with Iloko terms and that she can express herself better using the English language. She also said that it is "...hard to pick Ilokano words for math terms."

Another faculty participant noted that is hard to express math symbols or expressions in the Iloko language.

It is encouraging to note that while the faculty participants find it difficult to use the Iloko language to explain Mathematical concepts, they still do it to help their students learn the concepts better.

3.3.3. The Need to Be Taught First

Another difficulty that the faculty see as a challenge is their lack of preparation. Although it is mandated by policies and guidelines to integrate culture in the curriculum, the faculty participants lamented that they did not have any formal preparation on cultural integration.

They have not attended any seminar or forum on how to integrate Ilokano culture in their classes. Any resource or reference material relative to culture and culture integration, the teacher participants say, would have been helpful. Thus, the theme, they need to be taught first before they are able to share the Ilokano culture to their learners.

According to one faculty participant, another challenge is the lack of resources or references. He expressed, "We are not trained specifically regarding the integration of culture in teaching mathematics." But despite these difficulties, he said that he has become "more conscious or mindful to inject Ilokano culture in any possible topic" in his mathematics class.

Hence, the need for a model to effectively integrate Ilokano culture in Mathematics education.

3.4. Proposed Model for Integration of Ilokano Culture in Mathematics Education

After carefully analyzing the existing practices of teaching Mathematics in UNP which is culturally-responsive as well as the challenges encountered by the Mathematics faculty, the following model was designed for the effective integration of Ilokano culture in Mathematics education.

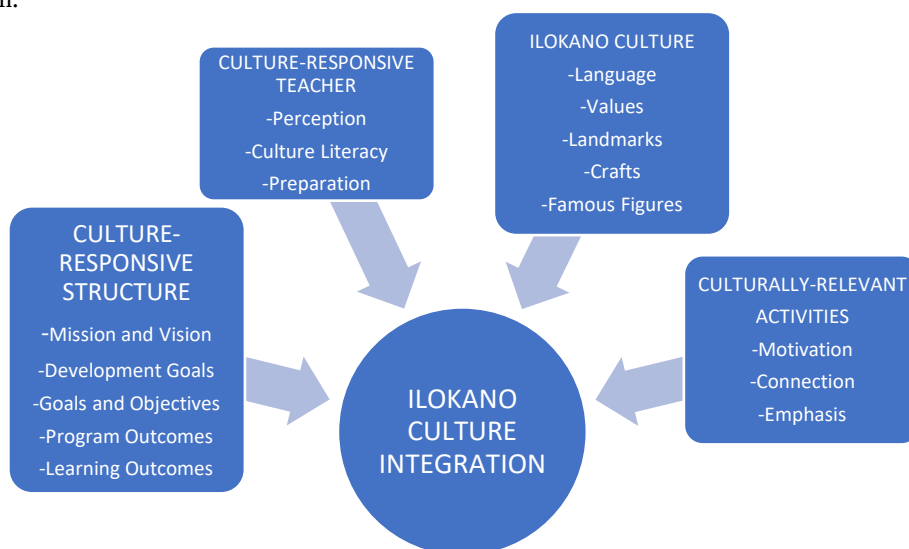


Figure 1. Model for Effective Integration of Ilokano Culture in Teaching Mathematics

As shown in Figure 1, an effective Ilokano culture integration in the Mathematics curriculum depends on the elements of the Ilokano culture which can be embedded and the organization's structure, the mathematics teacher, and the activities within the teaching-learning process.

The drive to integrate culture is established at the core – the structure of the academic institution, explicitly reflected on its VMGO and developmental goals, the graduate outcomes of its academic programs, and intended learning outcomes of its offered courses.

To be able to relate mathematical concepts to Ilokano culture, the faculty must know well the culture themselves and need to be trained and collaborate with others along culture integration. Various elements of culture can be appropriately

used such as the language, values, landmarks, crafts, and prominent figures. Ilokano culture can be used for various aspects of the teaching-and-learning activities, such as motivation, connection, and emphasis.

4. Conclusions and Recommendations

The researchers were able to explore the integration of Ilokano culture in Mathematics education in the University of Northern Philippines.

There are varying purposes of integration of the local culture. The faculty use it as motivation or introduction before they start a new lesson or topic. They also use it to establish a connection with their students and their students to their

cultural heritage and to emphasize or reinforce a concept which is difficult to understand.

Considering that most students find Mathematics as difficult, it is deemed an exemplary practice to relate Mathematics concepts in things that they are familiar with such as their native language, landmarks, personalities, and crafts and the values or traditions ingrained in them.

The Mathematics faculty are becoming aware of the need to integrate culture into the Mathematics curriculum. However, they have to overcome challenges to effectively do so, such as difficulty in the language and the lack of formal preparation for such integration. The model presented in this study is recommended to improve the integration of Ilokano culture in teaching mathematics.

REFERENCES

- Alangui, W. V. (2017). Ethnomathematics and Culturally Relevant Mathematics Education in the Philippines. In M. Rosa, L. Shirley, M. Gavarrete, & W. Alangui, *Ethnomathematics and its Diverse Approaches for Mathematics Educational* (pp. 183-208). Springer. doi:10.1007/978-3-319-59220-6_8
- Balamurugan, M. (2015). Ethnomathematics: An Approach for Learning Mathematics from Multicultural Perspectives. *International Journal of Modern Research and Reviews*, 3(6), 716-720. Retrieved from <http://journalijmrr.com/wp-content/uploads/2015/08/IJMRR-175.pdf>
- Berns, R., & Ericson, P. (2001). *Contextual teaching and learning: Preparing students for the new economy*. Washington: National Academy Press.
- Braun, V. and Clarke, V. (2006) Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3 (2). pp. 77-101.
- Creswell, J.W. (2014). *Research Design: Qualitative, Quantitative and Mixed Methods Approaches* (4th ed.) Sage.
- Cresswell J.W & Clark, V.L. *Designing and conducting mixed method research*. 2nd Sage.
- Cropley, A. J. (2019). *Qualitative research methods: A practice-oriented introduction for students of psychology and education*. Zinātne. (open access – doi: 10.13140/RG.2.1.3095.6888)
- Erickson, F., & Mohatt, C. (1982). Cultural organization and participation structures in two classrooms of Indian students. In G. Spindler (Ed.), *Doing the ethnography of schooling* (pp. 131-174). New York: Holt, Rineholt, & Winston
- Commission on Higher Education. (2017). *CMO 48 Series of 2017*. Retrieved from Commission on Higher Education: <https://ched.gov.ph/wp-content/uploads/2017/10/CMO-48-s-2017.pdf>
- d'Entremont, Y. (2015, February 12). Linking mathematics, culture, and community. *Procedia - Social and Behavioral Sciences*, 174, 2818-2824. doi:<https://doi.org/10.1016/j.sbspro.2015.01.973>
- Flyvbjerg, B. (2011). Norman K. Denzin and Yvonna S. Lincoln, eds., *The Sage Handbook of Qualitative Research*, (4th ed.). Sage. Available at SSRN: <https://ssrn.com/abstract=2278194>
- Kalchik, S., & Oertle, K. (2010). *The Theory and Application of Contextualized Teaching and Learning in Relation to Programs of Study and Career Pathways*. Office of Community College Research and Leadership.
- Ladson-Billings, G. (1995). Toward a Theory of Culturally Relevant Pedagogy. *American Educational Research Journal*, 465-491. Retrieved from <https://doi.org/10.2307/1163320>
- Neupane, R., & Sharma, T. (2016). Crafting Cultural Intelligence in School Mathematics Curricula: A Paradigm Shift in Nepali School Education. *RIPEM*, 285-308.
- Merriam, S. B. (2009). *Qualitative research: A guide to design and implementation* (2nd ed.). San Francisco, CA: Jossey-Bass.
- Stemn, B. (2008). Building middle school students' understanding of proportional reasoning through mathematical investigation. *Education*, 3- 13, 36(4):383-392.
- Patton, M.Q (2002). *Qualitative research and evaluation methods*. 3rd Sage Publications.
- Sunzuma, G., & Maharaj, A. (2019). Teacher-related Challenges Affecting the Integration of Ethnomathematics Approaches Into the Teaching of Geometry. *Eurasia Journal of Mathematics, Science and Technology*, 15(9). Retrieved from <https://doi.org/10.29333/ejmste/108457>
- UNESCO. (1953). *The Use of Vernacular Languages in Education*. Paris: UNESCO.
- University of Northern Philippines. (2020). *Vision-Mission-Core Values*. Retrieved from University of Northern Philippines: <http://unp.edu.ph/vision-mission/>
- Vygotsky, L. (1978). *Mind in Society*. London: Harvard University Press.