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The Impact of Culture and Language Sensitive Physics on Concept Attainment

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Abstract. The study was designed to determine gains in student concept attainment using culture and language sensitive physics. Pangasinan learners of the Philippines were culturally profiled by determining the cultural dimensions, epistemological beliefs and students' views on integration of culture and language in the teaching and learning process. The unique cultural profile of the learners was used to design culture and language sensitive curriculum materials in physics. The designed culture and language sensitive curriculum materials presented physics lessons and activities using the traditions, beliefs, practices, artifacts and the native language. Implementation of culture and language sensitive curriculum materials was done to determine if integration of culture and language would result to better attainment of physics concepts of the experimental participants. Pre-test and post-test comparisons of the concept attainment of the experimental participants showed significant statistical differences in favor of the experimental participants. The group showed better concept development with greater percentages of correct responses in the concept tests administered. Qualitative data deduced from interviews, focus-group-discussions, journal logs, and classroom observations showed the same trend in favor of the experimental participants. Insights deduced from the study included the idea that the use of native language must be complemented by the use of culture of the learner to achieve better concept attainment in physics.

Keywords: Cultural Profiling; Culture Sensitivity; Language Sensitivity; Concept Attainment

Introduction

Education is believed to play a fundamental role in human, social and economic development. It has been identified by UNESCO (2012) as one of the principal activity to contribute to peace building, poverty eradication, lasting development and inter-cultural dialogue. These aims are global in perspective but localized in approach. The localization approach is known to bring significant effects to sustainability. In consonance to the decade of education for sustainable education by UNESCO, preservation of i*ndigenous knowledge*

highlights the education of the young. These and other thematic sustainable development priorities of the organization are extensions of their initial projects that include Literacy for All (LFA) in 2000 which highlights *scientific and technological literacy for all* (Torres, 2000). The cultural pillar will be able to achieve its goal to integrate the principles, values, and practices of sustainable development into all aspects of education to address the social, economic, cultural and environmental issues the world has to face in the 21st century. This is the current theme known as life-long learning and learning for life. Literacy, accordingly, is the foundation of life-long learning and is considered as the key element of inter- and cross-generational learning (Torres, 2000).

The Philippine's new basic education curriculum envisions education as "going global by being local". This theme conforms to those pursued by the basic education sector through its – basic education sector reform agenda - BESRA (2006-2010). Congruent with the directions of the reform agenda is the major plan of the new curriculum to integrate culture and language sensitivity into the curriculum through the inclusion of the mother tongue based multilingual education and localized senior high school curriculum (DepEd Order No. 74, s.2010). Our education sector recognized that Filipino culture is highly identified with languages and language diversity. House bill 3719 known as the multilingual education and literacy bill was crafted by legislators to promote literacy and learning by making the native language as the medium of instruction during the formative years of basic education. This was a consequence of the success of the mother tongue based instruction through the Lubuagan first language component multilingual education in 1998 (Castillo-Llaneta, 2010). In response to this progress, the Department of Education (DepEd) mandated the use of the native language through DepEd Order No. 74 (s. 2009). The agency aimed to promote the use of more than two languages for literacy and instruction as a fundamental policy in the whole stretch of formal education including pre-school years. Part of the agency's plan was full scale implementation where the native language will be taught as a separate subject from pre-school to Grade 3 and one of the media of instruction in the whole stretch of formal education. Mother tongue based instruction emphasizes the ethnic group's native language as the mode of communication, mode of instruction and the language of the curriculum materials used by the students. The same objectives were revealed in several researches (Agnihotri, 2008; Collier, 2004; Fafunwa&Soyinka,1989; and Benson, 2002) which gave evidences that the longer a child is taught in his or her home language, the higher is his or her academic achievement in school.

Jordan, Carlile, & Stack (2008) argued that formal education reproduces culture. Students' cultural perspectives influence how they construct knowledge while cultural background influences cognitive style and motivation. Aikenhead (2001) believed that cross-cultural strategies or cultural integration provides opportunities for students to learn western science content taught in the context of local community's traditions. They adhere to "autonomous acculturation" that emphasizes learning western science content but still adhering to one's culture and tradition. In the Philippines, the science education institute, a

government agency managing science education in the country has started to look at new tracks to better scientifically literate learners. The agency foresees a new theme focused on "learning according to cultural background" to promote sustainability and preservation of indigenous knowledge This attempt conforms to the major goals and aims of the 21stcentury skills framework (P21) which included three key elements to learning: *21st Century Interdisciplinary Themes*: Global awareness, financial, economic, business and entrepreneurial literacy, civic literacy, health literacy, and environmental literacy; *Learning and Innovation Skills:* Communication, collaboration, critical thinking, and creativity; and *Information Media and Technology Skills:* Information literacy, media literacy, and ICT literacy. Each one of these skills implementation requires the development of the core academic subject knowledge and understanding among all students. Within the context of core knowledge instruction, students must also learn the essential skills for success in today's world, such as critical thinking, problem solving, communication and collaboration (P21-Framework, 2008). The new curriculum envisions attaining these skills through localization of senior high school. Localization includes a curriculum emphasizing the community's practices, traditions, source of living and livelihood as the major focus of learning. Learners from the Ilocos region for example would promote weaving and other traditions as part of their curriculum. Students of Batangas will be trained to cultivate their traditions in coffee making and Ifugao for terracing.

The aim of the study is to determine the impact of culture and language sensitive curriculum materials in physics to the concept attainment of the students. Specifically, the objectives of the study are as follows:

1. Determine the cultural dimensions, epistemological beliefs and learner's views on culture and language integration which will serve as bases in the development of culture and language sensitive curriculum materials in physics.
2. Describe how effective are the culture and language sensitive curriculum materials in physics in the concept attainment of learners.

Framework and Literature

The cultural or indigenous preferences of the learners were the bases of development of culture and language sensitive curriculum materials in physics. This included their unique cultural dimension, epistemological beliefs, and student beliefs and views on the use of culture and language sensitive curriculum materials in learning physics concepts. Existing frameworks used in the development of the culturally-sensitive curriculum materials in physics (CS-CMIP) included instructional congruence framework, cross-cultural strategy, P21 or 21st Century Framework, technological-pedagogical-content-knowledge, and understanding by design frameworks.

Cultural Profile of Learners

Culture was defined in several ways by Raul Pertierra (2002). It is a framework for organizing the world. It is a set of principles that locate and orient human beings within their existential realities. It is an invisible lens through which we see reality. Its categories are pre-given as language, notions of identity, gender,

nature and religion. Culture can also be a set of ideas, values, and practices as well as orientation and predisposition towards the world. He claimed that culture is consciously territorial (e.g. Ilocos for the Ilocanos). National cultures can be ethnicized or racialized while ethnic cultures can be nationalized (e.g. Bangsa Moro). Finally, he believed that ethnicity uses culture for organizational purposes.

Filipino learners like other countries in Asia are culturally diverse. By ethnicity, Filipinos have 20 major ethnic groups inclusive of the minorities. The 9 major groups were Cebuano, Tagalog, Ilocano, Hiligaynon, Central Bicolano, Waray, Kapampangan, Albay-Bicolano, and Pangasinan. This cultural diversity among Filipino learners suggests that cultural or indigenous preferences are unique in each ethnic group. Distinguishing each unique cultural preference will profile the culture and language background of the ethnic group. Hofstede's Value Survey Module has imbedded characteristics for identifying the distinct cultural preference of a group. The module presents five cultural dimensions as power distance index (PDI), individualism index (IDV), masculinity index (MAS), uncertainty avoidance index (UAI), and long-term orientation index (LTO).This was originally designed to survey employees of different positions in corporation. Replications of the research led to application of the model to other fields such as education and learning. The module was used to establish the connection between the students' perception of science classroom learning environment and teacher-student interaction within the cultural perspective in the study conducted by Koul and Fisher (2004). Correlation study done by Holtbruggs&Morh (2009) matched the learning preference of management students and their cultural dimension. Other researches on cultural profiling were able to form concrete use of VSM 08 interpretation to educational dimensions. Power distance according to Cronje (2006) explained students' lack of self-confidence and does not take initiative. Rather, they prefer to let the apparently more powerful professor to take the responsibility. Further, he suggested that the high level of avoidance justifies why students require much guidance in terms of requirement and assessment rubric. The major differences of the cultural indices from an education perspective to describe the learning characteristics of students were determined by Baron (2008). Low power index was related to student-centered learning preference while high power index highlighted teacher-centered learning preference. Low individualism index is associated to collaboration, self-concept in terms of groups, education is learning how to do and association of students to pre-existing ties. High individualism was related to learners doing on their own initiative. The purpose of education is learning how to learn and students prefer to associate according to tasks and current needs. Low masculinity index is associated with equal treatment among sexes or genders in the classroom while high masculinity index emphasize gender bias in favor of the male gender.

The forms of epistemological beliefs in learning and academic development originated from the work of Perry (1970). Perry (Schrommer, 1990) argued that an individual navigates series of sequences or positions in developing epistemological beliefs. This starts from being dualist, recognizing multiplicity,

relativist until the individual attains commitment within relativism. Epistemology was defined by Phan (2006) as a branch of philosophy concerned with the nature of knowledge and justification of beliefs. Epistemological beliefs are held beliefs about nature, nature of science and the justification of beliefs of the students. These were described in five dimensions of beliefs: stability of knowledge, structure of knowledge, source of knowledge, malleability of knowledge, and speed of learning. These five dimensions of beliefs are categorized as epistemological beliefs on knowledge and epistemological beliefs on learning (Schrommer, 1990). Magno (2011) mentioned that beliefs about knowledge and learning had a great deal of influence with the learners' approach in dealing with and constructing information. Several other researches indicated that epistemological beliefs predicted numerous constructs of academic performance such as comprehension, meta-comprehension, interpretation of information, higher order thinking skills, persistence in working on different academic tasks and problem-solving approaches. Beliefs about structures and certainty of knowledge predicted comprehension and interpretation of information. Beliefs about speed of learning and the ability to learn were identified to predict comprehension, valuing of education and over-all performance (Phan, 2006). Stathopoulon and Vosniadu (2006) revealed that epistemological beliefs may be better predictors of conceptual change in Physics than their physics grades. Students focused exclusively on experimental evidence, logical reasoning, practice and authority (May and Etkina, 2002). Low conceptual gainers were more likely than others to mention learning activities that were epistemologically less desirable learning formulas without heading their conceptual implications, learning from authority and predicting and testing without interpretation. High gainers were more frequently referred to preference to reasoning and interpretation of experimental results and showed more concern for the coherence of knowledge than their counter parts implying that when it comes to learning physics concepts, epistemology of students mattered (May &Etkina, 2002). There were several researches (You, Yang & Choi, 2001; Bernardo, 2008; Chan & Elliot, 2004) on epistemological beliefs explored through cross-cultural studies. Beliefs on the nature of knowledge and learning were argued to be culturally-specific particularly comparing Western and Asian educational systems.

Bernardo and Calleja (2005) found out that epistemology of learning in the Philippines is basically guided by how educators teach subjects in schools. Filipino instructors created "simple lesson plan" and "taught with minimal effort" by employing "simple and light" forms of classroom discussion and activities. While these teachers are said to be more effective in simple-thinking task, findings revealed that these teachers still regarded learning as a complicated process. Bernardo (2008) revealed that pre-service teachers experienced difficulty in shifting to and implementing complex learning in their classroom practices since they have always been exposed to the Philippine educational system concentration on "simple learning". Filipino pre-service teachers according to Bernardo (2008) took into consideration their beliefs, values, and feelings as they evaluate which options will bring about optimal teaching-learning outcome. The state of cognitive processing of teachers may

influence students' thinking which would result to non-critical and non-creative science learners creating low concept gainers in science. This may be revoked if cultural view is integrated in the teaching and learning process grounded on the fact that learners and pre-service teachers evaluate learning through their beliefs, values and feelings which are culturally influenced.

Instructional Congruence Framework

Learning science should be implemented in the context of students' culture and experience (Basu and Barton, 2007). Students' culture as a relevant source and strategies of teaching and learning was expected to result to more interesting and meaningful teaching of science. Mediating the nature of academic content with the students' language and cultural experience is the highlight of instructional congruence framework (Lee, Maerten-Rivera, Penfield, LeRoy, &Secada, 2007 and Johnson, 2005). The framework presents an approach of using students' cultural background to enhance learning of the content. This framework includes four major characteristics to ensure that prototype curriculum materials would acquire the needed properties for cultural integration. The four main features are teacher's role in learning, delivery of the content, relating learning of science content and learning literacy, and the principles of constructivism. Many researchers believed that integrating culture in the curriculum have a good future in the attainment of success in terms of learning content. Cultural experiences were the knowledge that students have obtained from their community. Students' language experiences are the languages used in their daily life. Lee &Lykx (2005) suggested that when the knowledge of science were incorporated with students' language and experiences, students would be more engaged in the learning process and science would be easier, meaningful and relevant to students. Learning environment that puts emphasis on instructional congruence could make students become bicultural, bilingual and bi-literate person not only in terms of knowledge, values and practice in science, but also in aspects of their language and culture.

Other Frameworks

Aikenhead's (2001) cross-cultural strategy familiarized students with different cultural ways to describe and explain nature. Students were presumed to feel easier and more comfortable to appreciate western science knowledge without being forced to accept and embrace the western ways of appreciating nature. The approach provided the useful processes in developing physics lessons guided by context-based models in cultural perspective. Looking into cultural learning as a means to achieve the goals of physics education a close look on the *21st Century Framework (P21)* was done to ensure that the developed curriculum material are close to the preference of our students who are known as digital natives. Refining of the coherence of goals, assessment, plan, and lesson delivery would be the concern of *Technological-Pedagogical Content Knowledge (TPACK)* and *Understanding by Design (UBD)*. These frameworks were used as guide in the design of culture and language sensitive curriculum materials in physics envisioned to improve student concept attainment of learners to attain higher percentage of scientific and technological literacy.

The cultural aspect of the learner and the learning process is viewed as an alternative route to achieving higher scientific and technological literacy. The knowledge of learners' values, traditions and beliefs can bring significant contributions in instructional design. Cultural dimension of the learners could help establish their learning characteristics in the cultural perspective. Epistemology of knowledge also highly related to the learners' cultural background. Being aware of how students would perceive a learning environment that injects culture and language may bring better groundwork in the design of curriculum materials. With the indexed characteristics of the learners, instructional designs could be anchored on models that focus on the use of local community's traditions, technological influence, and coherent designs while learning the western science content. These conditions, however, may be enhanced by gaining benefits from the use of the learners' native language.

Methodology

This study is focused on descriptive-analytical design presented in Table 1. The first stage highlights the profiling of learners. Determination of the cultural dimension, epistemological beliefs and beliefs & views on the cultural and language integration were conducted in this section. The results of the first stage were used as heart of the design and development of the culture and language sensitive curriculum materials in Physics. The second stage was an experimental study to determine the impact of culture and language sensitive curriculum materials on students' concept attainment.

Table 1: Summary

Stages of the Study	Dimensions	Data Collection/ Instruments	Acronym	Data Analysis
Cultural Profiling	Cultural Dimensions • Power distance index • Individualism index • Masculinity Index • Uncertainty Avoidance Index • Long Term Orientation index	Value Survey Module 2008	VSM 08	Computations and analysis of data were based on VSM 08 administration module
	Epistemological Beliefs • Stability of knowledge • Structure of knowledge • Source of knowledge • Malleability of knowledge • Speed of learning	Epistemological Beliefs Assessment in Physical Sciences	EBAPS	Computations and analysis of data were based on EBAPS excel template

	Student Views on Culture and Language Integration • Use of vernacular and culture • Students' views and beliefs on the integration of culture and Language • Learning Science and Learning Literacy • Teacher's role • Constructivism	Culturally-Sensitive Physics Learning Environment Survey	CS-PLES	Average ratings
CS-CMIP Development	• Culture and language-based principles • Emphasis on Learning Science and Learning Culture, Language, and Literacy	Interview protocol Focus Group Discussion protocol Journal Log Coding Culturally Sensitive–Curriculum Material Evaluation Tool	CS-CMET	Transcriptions Codings Averages
Investigation of Students' Concept Attainment	• Quantitative constructs • Qualitative constructs	Pre Tests Post Test Modules for Units 1 & 2 (Culturally Sensitive Curriculum Material in Physics) Journal Logs Departmental Exam* Current Curriculum Materials*	CS-CMIP CCM	Ratings Scores Transcriptions Codings Averages Post Test Comparison of student concept attainment using unit test and departmental exam (t-test) Paired sample t-test Graph of correct responses

***adopted/adapted**

Pre-Implementation

Pilot tests were done to determine the reliability and appropriateness of the adopted instruments to the intended participants of the study. The Value Survey Module 2008 (VSM 08) is a 34-item paper-and-pencil questionnaire for comparing culturally influenced values and sentiments of similar respondents from two or more countries or regions within countries. Twenty-eight of these questions were content questions influenced by the nationality or ethnicity of the respondents. Six of these are about the demography of the respondents. Next to nationality, answers to the 28 content questions will reflect other characteristics of the respondents such as gender, age, level of education, and the point in time when they answered the questions.

The instrument for determination of epistemological beliefs is a thirty-item questionnaire on a five-point Likert scale intended to measure the epistemological beliefs of students. The instrument was intentionally designed for high school and college students taking introductory physics, chemistry or physical science. It is also optimized for algebra-based courses which makes it very adapted to the Filipino physics students. The 20-item 5–point-Likert scale survey (CS-PLES) designed to determine students' perceptions, views or beliefs on the use of culture, traditions and language in the teaching and learning of physics concepts was validated and standardized with an internal reliability measure of α=0.88. Below are sample items for CS-PLES:

In general, I think that…

1. *Using my community's culture and language in learning Physics concepts can improve my language literacy in science while learning the physics concepts.*
2. *Alternative Assessments like projects and actual creative outputs would promote and preserve the culture, traditions and language of my community while learning physics concepts.*
3. *Learning physics in English as well as in the vernacular also improves my oral and writing skills which I can use when presenting science reports and results of investigations.*

The instruments were administered a week after the start of classes of the department of education in June of 2012 before implementing the culture and language sensitive curriculum materials. Outcomes of the pre-instruction administration of these instruments were interpreted in education perspective. The unique cultural characteristics and cultural preference of the learners identified from the interpretation were made use as bases in the development of culture and language sensitive curriculum materials in physics.

Development of culture and language sensitive curriculum materials in physics

The culture and language sensitive curriculum materials are presented in two sets for every unit or major theme: the student module and the teacher's guide. The first two major themes of physics subject were 'Energy in the Society' and 'Energy in the Environment'. This thematic presentation of high school physics subject is a standard implemented by the department of education.

The student module was developed to match the existing format of science modules in the Philippines. Included parts of the student module are pre-test & post-test; discussions of the topics in cultural perspective using traditions, beliefs and practices of the learners; use of the native language (Pangasinan); activities using indigenous materials together with worksheets; journal logs where students can write their insights and views; summary; and references. An example of how culture and language was integrated is shown in the discussion on scientific method. This was presented using the native language and the discussions highlight the use of Lingayen Gulf context. Another example is a discussion on intensity of light using the lighting systems (petromax) used by the fisher folks of Pangasinan.

Journal log sheets were inserted every after a major lesson of the unit. Questions in the journal log sheets were expressed in the native language. Sample questions from the journal log sheets are translated as follows:

> *What have you learned in the lesson presented?*
> *What were your experiences in this lesson and which ones are good experiences that brought about learning?*
> *Which part(s) of the module were very useful to you or encouraged you to learn physics concepts?*

The last journal log sheet required the student to shift from the native language to English. This guaranteed that students are trained to easily shift to the standard language used in school (English) in preparation to the common assessment (quarterly or departmental examination) given to all participants of the study which are written in English.

Wiggins' and McTighe's (2005) '*Understanding by Design*' framework influenced the design of the teachers' guide. The inclusions of the teacher's guide were identified goals, enduring understanding, key questions, activity listing, assessment, key to correction, summary, references, and teaching tips. Assessments in the modules and teachers' guide are combination of paper-and-pencil test and performance tasks highlighting the Goal-Role-Audience-Situation-Product-Standard model. The three major parts of the teachers' guide are Phase 1- Setting the Learning: Identified goals, enduring understanding, &key questions; Phase 2 – Assessing Learning: Assessment which included the combination of paper-and-pencil test and performance tasks; and Phase 3- Facilitating Learning: Activity listing and Teaching tips. Key to corrections was included as part of the teacher's guide together with summary of concepts and some references.

Descriptive and quantitative content validation of the culture and language sensitive curriculum materials was conducted by physics and language experts who are also natives of Pangasinan. Revision of the materials was guided by the suggestions and comments of the validators. Other groups of learners from the same school where the participants are connected were interviewed to check the readability & appropriateness of the mother-tongue words and terms used. They were able to identify difficult words and had also helped in changing these words or terms appropriate to the context. Twenty one high school Physics

teacher rated one of the curriculum materials and five Physics experts rated both curriculum materials. Most of the evaluators rated the culture and language sensitive curriculum materials in physics with high marks with an overall rating of 4.65 out of 5.00 using the culture and language sensitive curriculum material evaluation tool developed by Morales (2013). For each of the component of the evaluation tool, averages over the number of items were done that resulted to high marks of 4.62 out of 5.0 for component 1 and 4.67 out of 5.00 for component 2. This meant that the modules had projected constructivism and language-based principles (component 1) and had shown emphasis on learning science while learning culture, language and literacy (component 2). After integrating all the corrections and suggestions, the final copies of the culture and language sensitive curriculum materials in physics and teacher's guides were printed in book form and soft copies were made available online at *http://cliphysicsed.weebly.com*.

Statistical Analysis

Cultural indices were calculated by taking the mean of the scores of the participants on an item in the VSM 08. Interpretations of the computed cultural indices were done using the research results of Baron (2008). The epistemological beliefs of the participants were determined by taking the average of the students' scaled scores on all 30 items of the EBAPS. Each item is scored on a scale of 0 (least sophisticated) to 4 (most sophisticated). Scores in each subscale was determined by taking the mean of the scores of all the items in the identified subscale. Comparison of students' scores in the unit test and departmental examination were established using pre-test and post-test gains, t-tests for independent sample, t-tests for paired samples and averages to determine attainment of concept by the students. Comparisons of correct responses prior to-and post- implementation of the modules were presented in graphical format.

In addition, coding and analysis of verbatim answers of students in the activities included in the culture and language sensitive curriculum materials were done. Manual coding method was done to encrypt students' verbatim answers in the journal log sheets. Color code scheme was used using strips of paper for the language preference. The student modules were classified according to language preference (English or native language). After the classification based on language, a second layer of color coding was done to identify the specific activities that captured students' interest. Third layer color coding was done to match what cultural dimension, practices or beliefs are these student-chosen activities fall. The last layer of coding system was done to match the student-chosen activities with their frequency of correct responses in that particular topic.

The Participants

A unique set of participants were purposively identified in each stage of the study. This is presented in table 2 which includes the sampling procedure used.

Table 2: Participants of the Study

Stages of the Study	Participants/Sample	Sampling Process
Cultural Profiling	• 385 senior high school students (age group: 15-16) ○ 50 high school students from Pangasinan National High School	Sample size computation Purposive sampling based on percentage of population of Pangasinan natives over the whole population
Development of CS-CMIP	• 3 natives and old folks of Pangasinan • 3 Physics experts who are natives of Pangasinan • 1 Physics expert who is well-versed in the native language • Other groups of learners from the same school	Purposive sampling
Investigation of Enhancement of Science Attitude	• 89 students for the control group (IV- C Blaise Pascal & IV-A Benjamin Franklin) • 39 students for experimental group (IV-B Alessandro Volta • 1 teacher participant	Purposive sampling

One of the intentions of this study is to enhance the use of the traditions, beliefs and native dialect to preserve and conserve the culture and the native language. The researcher herself is a native speaker of the language (Pangasinan). Participants in the design of the culture and language sensitive modules were purposively chosen on the basis of their being natives and their expertise in physics. The three native folks were chosen for interview to gather data on practices, traditions and beliefs. The three physics teachers and the physics expert who is well-versed in the native language were invited to validate the developed culture and language sensitive curriculum materials.

Implementing culture and language sensitive curriculum materials in physics
The culture and language sensitive curriculum materials were implemented to the experimental participants during the first quarter of the school year 2012-2013. Simultaneously, the current curriculum materials were employed to the control participants. The current curriculum materials included experiments, activities, materials and text found in Science and Technology IV text book distributed to all public high school as the prescribed materials in the department of education. Text in the current curriculum materials were about concepts, activities, worksheets, seat works and performance tasks intended for the Science IV curriculum.

Only one teacher was assigned to teach physics to the chosen participants. Incidentally, the teacher assigned to teach the participants do have the following characteristics necessary to properly implement the standard curriculum and the culture and language sensitive curriculum. The teacher has specialized in Physics teaching, had trainings for practical work, inquiry-based and others. He

is a native just like the chosen participants and he has already taught physics for a decade. Also it can be said that the participants' science content knowledge is comparable. They were identified as part of the special science classes of the fourth level of Pangasinan National High School following the special science class curriculum. As basis of qualification in special science class, the student should attain a passing mark in the science-oriented qualifying examination administered by the school. The science qualifying test is a national test developed by the science education institute in the Philippines.

Procedure

The value survey module was administered to extract the cultural dimensions of the learners. CS-PLES developed by Morales (2013) was used to identify the cultural inclination and the expectations of the learners on the use of culture and language sensitive curriculum materials in physics in the teaching and learning process. To completely profile and identify the cultural preferences of the learners, their epistemological beliefs were extracted using EBAPS. The complete set of cultural profile or cultural preferences of the learners was used in the design of the culture and language sensitive curriculum materials in physics.

A pilot study was done to complement the cultural profile of learners in order to develop and design the culture and language sensitive curriculum materials. Old folks were interviewed to discover existing culture, artifacts, traditions, beliefs, practices and relics. From the interview transcriptions, analysis of the culture, artifacts, traditions, practices, beliefs and relics was done to determine which culture can be used in the development of the topics that were included in the curriculum materials. Document analysis was also done to complement the data culled from the interviews and the cultural profile of the participants. The first curriculum material is thematically termed as Energy in the Society. This included introductory topics such as the nature of science, products of science such as laws, theories, concepts and principles, scientific method, and measurement. Interconnection of science, technology, society and physics was the first lesson designed using the best remembered products of Pangasinan such as bagoong, bangus and bucayoand tourist spots (beach - Lingayen Gulf). These products and places form the 4 bests of Pangasinan. Other topics in this unit were developed using the same product or others found in the place. Measurement was designed using the concept of 'bucayo making' and 'bagoong production' and scientific method using the power plants in San Roque and Sual. These are towns located in Pangasinan.

The heart of the design of the curriculum materials are culture and native language. Thus, the medium of instruction and communication of the culture and language sensitive curriculum materials is the native language. Validation included both descriptive and qualitative aspects. Three Physics experts who are fluent in Pangasinan and are natives of the place were invited to validate and re-validate the curriculum materials. Two others, a classroom Physics teacher of and a regional supervisor were invited to look into the use of the vernacular or native language in the culture and language sensitive curriculum material. Twenty one classroom teachers and four Physics experts were invited to

evaluate the culture and language sensitive curriculum materials using the culture and language sensitive curriculum material evaluation tool (Morales, 2013).

The other developed instruments were also validated. Three physics content experts and one social science expert were invited to descriptively and quantitatively validate the culturally sensitive physics learning environment survey, interview and focus group discussion protocols, rubric scoring guide, and the culturally sensitive curriculum material evaluation tool. Together with the adopted instruments, these were pilot-tested to students of the same age group as the intended participant to determine the reliability.

To determine how effective the culture and language sensitive curriculum on student concept attainment, experimental design was done. Prior to implementation, pre-test in two modules were administered to both groups. Implementation of the culture and language sensitive curriculum materials (modules) in physics to experimental participants lasted for a quarter. A quarter of the school year was also utilized for the implementation of the current curriculum materials to the control participants. English language was the medium of instruction used in the control group of 89 participants. They also made to use current curriculum materials as their major reference or text as prescribed by the department of education. The experimental group of 39 participants made use of the culture and language sensitive curriculum materials in physics in which the medium of communication and instruction was the native language. Rubric scoring guides, journal log sheets, interviews with selected student-participants, classroom observations, video and audio tape recordings were used to extract important observations regarding the learning process focused on concept attainment in both groups. A post-instruction administration of post-test (unit tests) was done to both groups of participants. Quarterly test or the department test was also administered as post-implementation protocol.

Results and Discussion

The major objective of the study was to determine the effect of culture and language sensitive curriculum materials on student concept attainment. Results of the study are presented below in two broad concepts: cultural profiling of learners and concept attainment of the learners using the culture and language sensitive curriculum material in physics focused on the learning aspect.

Cultural Profiling of Learners

The cultural profile of the learners was determined using the value survey module (CVSM 08), EBAPS and CS-PLES. The profile presented in Table 3 was used as ground footing in the design of the culture and language sensitive curriculum materials in physics.

Table 3: Cultural Profile of Learners

Cultural Inclination	Epistemological Belief	Views of Students
• Student-centered • Collectivist • Gender equality • Rule-oriented classroom • Persistence, perseverance and thriftiness	• Perceive science as bits of knowledge, fact and formulas • Movement towards higher order thinking skills • Science is important in real-life. • Physics knowledge is evidence-based • Good work and practice promotes learning	• Students like the integration of culture and language in the learning process. • They want to be consulted about the topic and the style of teaching they are most adopted to • They want to give insights on the conduct of the lesson. • They like use of Mother Tongue as medium of instruction. • Students prefer a teacher with the following cultural traits as familiarity with the culture, practices, and tradition of the group of learners; fluency in mother tongue; and familiarity with the misconceptions brought about by the cultural background of the learners. • Students would want to be empowered in terms of the conduct of teaching and learning process to achieve meaningful learning.

The culture and language sensitive curriculum materials were designed based on the cultural profile of the learners. Based from Table 3, the participants were student-centered, thus more inquiry-based activities were provided in the learning modules. The included activities boosted the learners' epistemological belief that Physics is evidenced-based. Their cultural dimension is suggestive of their being collectivist. Activities were designed and conducted in groups and not individualistic in approach. Their epistemological belief placed limits on the kind of questions that would be asked of them. These questions should be categorized as higher order thinking skills questions rather than convergent questions asking for facts. Excerpt from students' post-instruction interview answers suggests their inclination to higher order thinking skills questions.

Students: *Andi madam mas mainumay ta agmo la nunuten no antoy usaren mo ta mainumay ya salitaen. Makapan-focus ka ed samay tepet tan say gabay kon tepet aramay makapankonekta na aaralen ed samay kultura tayo.*

(No mam, it is easier to answer or recite when you do not anymore think of the words to use because we are so fluent in Pangasinan. We are not conscious about grammar not like when using English. We can focus on thinking and stating answers to the questions. We better appreciate application questions relating physics and our culture.)

Students: *Medyo agka mi balet tanton manebat no say tepet nen sir et singa ibaten mo labat na yes tan no. Pero no manpaeksplika aman mainumay tan mas gabay mi.*
(We seldom answer when our teacher ask us questions that only require a "yes" or a "no" answer. But if we are asked to explain, we are very eager to answer because we use the native language.

Teacher*:* *Say naincounter kod sikara very expressive so ugaw no Pangasinan so usaren. Ta no English so pan-rerecite da irequest da ya Pangsinan la. Pangasinan la sir kwanda ray arum anggad ed arum ya section madam. Ta agda met na-express so gabay da. Is-are, subject-verb agreement so problema tan say grammar da no duga o andi. No man paliwawa ra say gabay da Pangasinan. Ta agda naipaliwawa no English. No maminsan aga la man-recite so ugaw na nanairapan ed English. Insan say laba-labay da amay pantutungtungan so tradisyon dya ed Pangasinan. Gabay da may activity ya inpankokonekta'y physics amay inusar yo may bagoong, bucayo, tan dayat. Ayaki dakdakel ni inbaga tan produkto'y Pangasinan.*
(What I encountered was students were very expressive when the native language is used. They are not conscious with the is-are verb agreement during recitation. They cannot recite and they refuse to recite when they are required to speak in English. The acitvities they like most are those that use their culture and traditions. They like the "Inpan-kokonekta'y physics" acivity where you used the concept in bagoong and bucayo making and the gulf to connect physics, environment, tehcnology. They even mentioned about all other native porducts of Pangasinan which were not included in the module.)

The learners are expressive of their need and appreciation to connect science in real-life scenarios. They like the idea that they are able to make inputs on how learning inside the classroom can be made better. The teacher claimed that the students even suggested including other native products in the discussion.

Student Concept Attainment

In the study, concept attainment is defined as the condition where the students were able to display or show that they were able to arrive at the scientifically accepted physics concepts. The focus of the principle of concept attainment was the changes in the students' held concepts in physics. These changes can happen as corrections of erroneously held prior concepts or completion of incompletely held prior knowledge. It was also perceived as the state of arriving at the scientifically accepted physics concept. Quantitatively, concept attainment was expressed through gains in pre-test and post-test in each of the culture and language sensitive module presented in Table 4.

Table 4. Paired Sample t-test of Concept Tests for Experimental Group

Concept Test (CT)	N	Pre Test Mean	Post Test Mean	Std. Deviation	t	p-value
CS-CMIP for Unit 1 (Energy in the Society)	39	3.69	5.25	1.09	-8.92	0.00*
CS-CMIP for Unit 2 (Energy in the Environment)	39	11.36	18.00	4.41	-9.26	0.00*

**significant (p<0.05)*

The implementation of the culture and language sensitive curriculum materials to the experimental group resulted to significant mean difference between the pre-test and the post test in both modules. Culture and language sensitive curriculum materials worked well with the group resulting to significant increase in the mean of the concept test administered in each of the units. As a formative tool, the culture and language sensitive modules included activities that were initially designed to help the students in concept building and meaning making. These were rated using a rubric scoring guide which was a product of a consensus decision of the students, the teacher and the researcher. Presented in Table 5 was the frequency of scores of the students patterned using the K+12 proficiency levels (Appendix A).

Table 5. Proficiency Level of the Experimental Group using CS-CMIP's

Concept Test (CT)	No. of Activities	N	Proficiency Level				
			B	*D*	*AP*	*P*	*A*
			74 and below	*75-79*	*80-84*	*85-89*	*90 and above*
CS-CMIP (Energy in the Society)	6	39	0 (0%)	0 (0%)	3 (7.6%)	16 (41%)	20 (51.3%)
CS-CMIP (Energy in the Environment)	12	39	0 (0%)	1 (2.5%)	32 (82%)	6 (15%)	0 (0%)

B-Beginning D-Developing AP-Approaching Proficiency P-Proficient A - Advanced

Using the K+12 curriculum's proficiency level, most students can be categorized within the proficient and advanced level. Only few students of this group were tagged within the approaching proficiency level. Further, no one among these students belong to the beginning and developing level. Students belonging to *A-level* were able to exceed the core requirements in terms of knowledge, skills and understandings, and can transfer them automatically and flexibly through authentic performance tasks. While students within the *P-level* had developed the fundamental knowledge and skills and core understandings, and can transfer them independently through authentic performance tasks. These interpretations were set by the department of education as an inclusive assessment principle of K+12 curriculum implementation.

In unit 2, a clump on grade range 80-84 was observed. The students were tagged within the approaching proficiency level. At this level the students could be said to have developed the fundamental knowledge and skills and core understandings and, with little guidance from the teacher and/or with some assistance from peers. They could transfer these understandings through authentic performance tasks. It can be said that the students who used the culture and language sensitive curriculum materials displayed good performance during the course of the lesson. This resulted to significant difference in the pre-test and post-test performance.

Complementary to the results of the pre-test and post-test gain of the experimental group are their coded responses in the modules. Table 6 presents a summary of the coded responses highlighting the language preference and cultural connections appreciated by students.

Table 6. Summary of Journal Log Entries

Unit/ Module	Language preference (n=38)			Preferred Activities/Culture/Percentage students who prefer the activity
	English	Pangasinan	Shift in language preference	
1	24	12	2	• Pangasinan products, physics connections, & measurement (76.3%) • Mind map (5.3%) • Interview/Reporting/Brainstor ming (21%)
2	20	9	9	*Activities* • Act 1: Daluyon... (13.15%) • Act 3: SilewnaSumisigay (52.6%) • Act 4: KolornaSilew (89.5%) • Act. 5:Sayimahe.. (13.15%) • Act 6: Espijo tan Kirmat (47.4%) • Act 7: Ray diagramming (78.9%) • Act 8: Mirror Equation (36.8%) • Act 9: Refraction...(2.6%) • Act 10: LenteLente (2.6%) • Act 11: Ray tracing (28.94%) • Act 12:PinholeKamera (2.6%) *Insights* • Application is on buying fish we see diff color than the real one with a different light. • There are difficult terms but as a whole it is better than English. • What we learned are all useful in daily living.

	• Group collaboration in performing and answering activities. • It is in Act 3 where they recognized the hardships encountered by fisher folks • There are topics where learning them in the dialect is easy there are others however which appear difficult. • Difficulty encountered in dealing with mathematical equations using the dialect

In the first unit, more than half of the experimental group preferred to use English rather than the native language as medium of instruction. In the second unit, 52.6% of the students preferred English rather than the native language. There were several reasons mentioned by the students for this preference. The scientific or technical terms could not be translated. There were few words that could be used in the native language compared to English. Students had difficulty reading and writing native language words because they don't know the standard or acceptable spelling and other syntax. Different places were using different terms to mean the same event, thing or instance. These were the same difficulties identified by UNESCO (2002) in implementing mother-tongue instruction and mother tongue-based instruction.

On the other hand, there were about 31.6% of the students from the experimental group in the first unit and 23.7% in the second unit who preferred to use the native language rather than English language specifically in the oral discourse. These students claimed that they could easily express themselves without fear of being humiliated because of grammatical errors in oral discourse. They further mentioned that they were more active participants of the class as they were not focused on sentence construction during oral discourse but they gave all their attention to the details of the concepts and thus they easily understand the lesson. These were the same reasons marked by 5.2% of the students in the first unit and 23.7% of the students in second unit who shifted from the belief that they were better off in English language to an embrace of the native language as the medium of instruction in the next lesson.

The cultural views of the students were gathered from the journal log entries. This was done by including as part of the journal log sheet questions on the preferred activities of the particular module. In the first unit, most of the students (76.3%) appreciated the activities that included Pangasinan products, physics connections, & measurement. Twenty one percent like interviewing, reporting and brainstorming of non-tangible culture (beliefs, traditions, and practices) and tangible culture such as the products (Bagoong, Beaches, Bangus, Bucayo). Five percent of the class said they enjoy activities dealing with or designing mind maps. In the second unit, the most appreciated activities were SilewnaSumisigay; KolornaSilew; Espijo tan Kirmat; ray diagramming; mirror

equation; and ray tracing. They said that they were very interested in these activities because they were so practical and they were connected to their ways of life as natives. They were able to appreciate the concept of colors as applied to buying and selling fish. They were even empathetic with the ways of living of the fisher folks. They had a first-hand experience of knowing the science behind catching fish using different light intensities. From these experiences they were able to realize that the activities mentioned were very useful in everyday activities of the students. Though they mentioned difficulty in dealing with mathematical equations and some technical terms in the native language, the students still expressed that they were better off with the native language than English as the medium of instruction. These students also claimed that they learned best with collaboration with peers in performing all the activities. This matched with the diagnosed cultural background of the group with low individualism index which means that teachers deal with students as groups, students' individual initiatives were discouraged, and languages in which the word "I" is not pronounced rather self –concept is expressed in terms of group. Some connections were also identified with the epistemological beliefs of the students that matched with their insights. The interpretations were not far from the insights provided by the students where they specifically mentioned the usefulness of what they were learning and doing in daily living. Thus from these results and consequences, using the students' cultural profile or cultural preference to customize curriculum materials integrating culture and language resulted to significant gains in the students' attainment of concept. This was not far from the claim of several researches conducted by UNESCO (2008). Findings of the researches emphasized that the use of local languages as medium of instruction does not suffice to guarantee optimum effectiveness of teaching and learning. It was concluded that the use of the national languages in education could not be maximally successful without revising teaching methods and developing adequate teaching and learning materials.

Post implementation interview conducted with several students from the experimental group were used to verify all data collected from the concept tests as well as journal log entries. The teacher-participant and one of the evaluators of the module joined the post-implementation interview. Below are some excerpts of the transcribed interviews.

Students: *Amay diad English wala ray terms ya mairap ya ipaliwawa ta aralem. Amay diadPangasinan na-explain ya maong ta natalusan ni ta nen ugaw kami et aman lay gamit min salita.*
(In English there are terms that are very difficult to explain and cannot be easily understood. In Pangasinan it is better because we easily understand what is meant by the teacher because it is the language that we have been using since wewere kids.)

Students: *Ta mairap min talusan may libro ya blue madam katon amay module souusaren mi tan awit mi met ya lanang.*
(It is very hard to understand the concepts in the blue book for highschoolphysics so we always bring the modules instead because it is very easy to learnphysics with the modules.)

Teacher Nato: *Say sakey labat ya problema madam ta aramay araralem ya salita ag da la natalusan. Singa amay salming tan lente.*
(The only problem ma'am was the use of oldPangsinan terms that appears to bedifficult to the students).

Students: *Ag mi la balet natalusan iman. Marakep met balet ta dakel so naaral min aliwa labatya Physics no agta kultura tan amayamay ya salita ed Pangasinan.*
(We cannotunderstand old Pangasinan terms but we are still positive with theintegration ofculture and langauge because we are not only learning Physics butwe are also taught the culture and language of Pangasinan.)

From the excerpts, congruence in the following was observed. The use of the native language was really beneficial to the students specifically in meaning making. There were some difficulties with regards the use of the native language as the medium of instruction such as inadequate vocabulary to wholly translate the English counterpart of the concept being explained and non-standardization of native language terms thus making students encounter different terms that may mean the same phenomena. In-depth explanation of terms was achieved by the teacher and the student as they only focus on learning the concept and not understanding the language. An appreciation of learning Physics through learning the culture and language. Mother tongue based instruction was best accompanied by curriculum materials integrating culture and language to achieve optimum results.

To determine how effective are the culture and language sensitive curriculum materials in student concept attainment compared to the current curriculum materials, t-test for independent sample was computed for the post-test of the control and experimental group in the two modules. These are presented in Table 7.

Table 7. Comparing (t-test) Post-Test of Units 1 and 2 (CS-CMIP)

CS-CMIP Unit	*Grouping*	*N*	*Mean*	*Std. Deviation*	*T*	*p-value*
Unit 1	Control	85	4.37	1.11	-3.86	0.00*/0.01**
	Experimental	39	5.25	1.31	-3.74	
Unit 2	Control	82	14.85	3.8	-4.527	0.00*/0.00**
	Experimental	38	18.00	2.7	-4.601	

** equal variances assumed* *** equal variances not assumed*

The observed difference in the mean of the control and the experimental groups was significant at 95% level of confidence. In both modules, the experimental group to whom the culture and language sensitive curriculum materials were used as the intervention material significantly performed better as compared to their counterparts (control group) on which the current curriculum materials were used. Thus, in terms of post-test results, the culture and language sensitive materials displayed better efficacy in concept attainment of students than the

current curriculum materials. This was due to the following reasons. The culture and language sensitive modules were designed according to the cultural and language background and preferences of the students. The modules used culture and language as the major focus in the learning of physics concepts and principles. The modules were new to the students; and the modules made use of the native language as the medium of communication and instructions.

To validate the results in Table 7, the departmental test scores of the control and the experimental group were compared. The statistical comparison of the departmental scores is presented in Table 8.

Table 8. Comparing (t-test) the Departmental Test

Grouping	N	Mean	Std. Deviation	T	p-value
Control Group	86	32.78	6.13	-2.95	0.004*/0.000**
Experimental Group	39	35.79	3.09	-3.71	

** equal variances assumed* *** equal variances not assumed*

The observed difference in the mean of the two groups was statistically significant in favor of the experimental participants. This verified that the culture and language sensitive curriculum materials gave significantly better results in terms of physics concept attainment. To further explore the capability of the culture and language sensitive curriculum materials to attain concept attainment, percentages of students with correct responses in each of the items of the two concept/unit tests per module were determined. Comparison of the increase in the percentage of students with correct responses in both groups is presented in Table 9.

Table 9. Comparing the Percentage of Students with Correct Responses

CS-CMIP	Participants	Mean		S.D.		p-value
		Pre-Test	*Post-Test*	*Pre-Test*	*Post-Test*	
Unit 1	Control (89)	37.60	42.92	28.16	32.31	0.052
	Experimental (40)	36.00	55.50	27.08	36.49	*0.004
Unit 2	Control (89)	30.05	36.76	14.8	19.11	0.055/
	Experimental (40)	30.50	46.36	16.54	22.74	*0.001

**significant at p<0.05*

Higher mean percentages were observed in the post tests for both the control and experimental group as compared to their respective pre-tests. A significant increase was only attributed to the experimental group in both modules. Thus, more students from the experimental group were able get correct responses for the given items in the concept tests in both units. Graphs of correct responses are presented in Figures 1 and 2 for the first module.

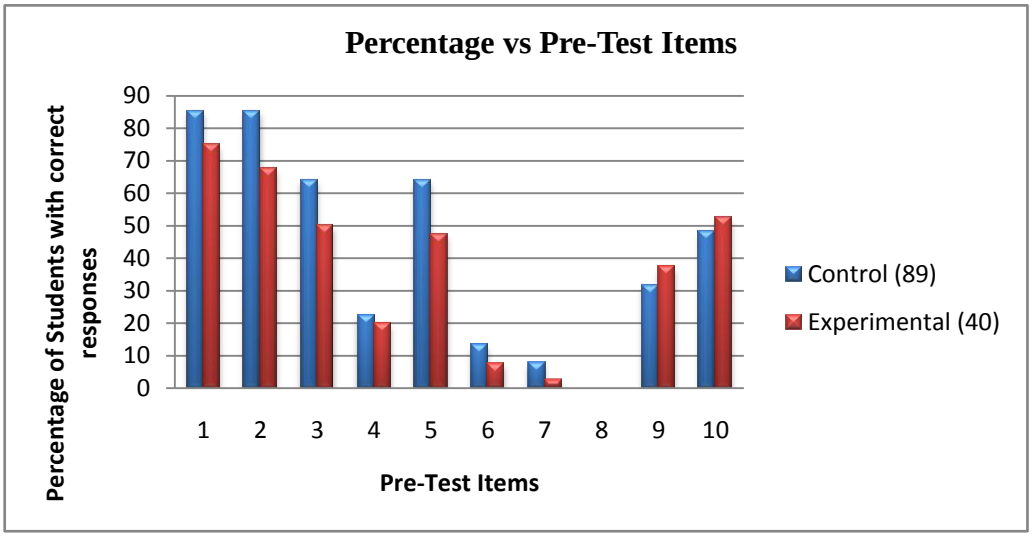

Figure 1: Percentage of Correct Responses vs. pre-Test Items of Unit 1

Greater percentage of students who obtained correct responses in the pre-tests belonged to the control group except in item nos. 9 and 10 on which no student obtained correct response. These items attributed to the control group were focused on the definition of the terms science, physics, technology, and hypothesis. Very low and zero percentage of student correct responses were observed in both groups in items 4, 6, 7 and 8 respectively which were focused on concepts on scientific theory, scientific laws, and other major parts of scientific method. Thus, both groups were already a-depth in terms of definition of terms related to the study of physics but were not knowledgeable enough to get correct responses in the concepts related to scientific method, scientific theories and laws. Although a greater percentage of student correct responses were observed in the control group, the trend in the concepts held by the student was the same with the experimental group.

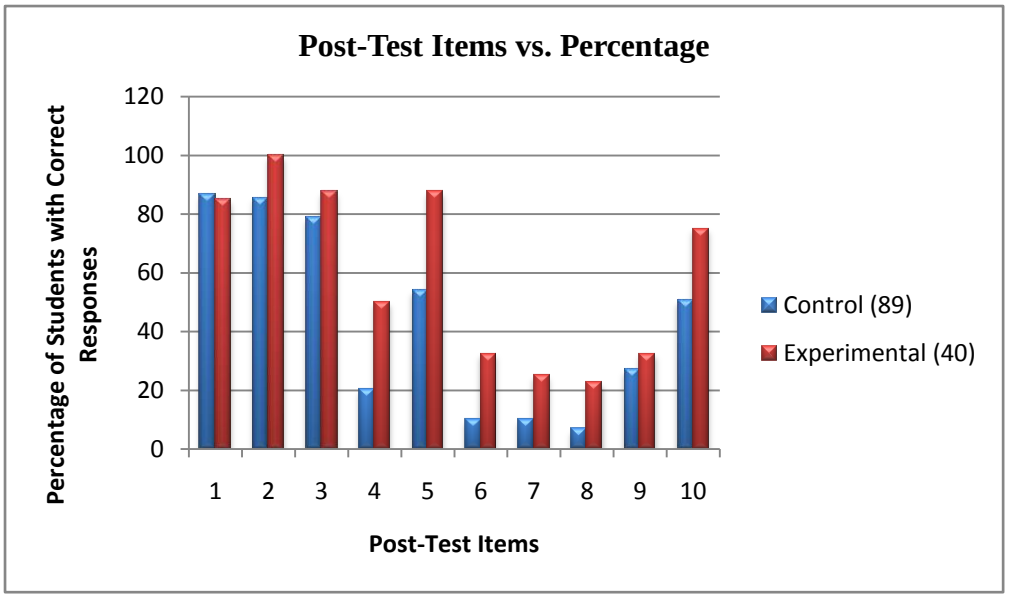

Figure 2: Percentage of Correct Responses vs. Post-Test Items of Unit 2

The increase observed in the experimental group was significant compared to the observed increase in the control group. A dramatic difference was monitored in all items except item no.1. This means that students' held concepts on the definitions of science, technology, physics and hypothesis were better enhanced in the control group. The experimental group did a lot better in the items (item nos. 4, 6, 7, 8, and 9) where both groups experienced difficulty getting the correct response in the pre-test. These items were primarily focused on the concepts of scientific method, scientific laws and theories. Thus, the cultural intervention (*use of the context of the Pangasinan 4B's: Bagoong, Beaches, Bucayo, and Bangus combining this with the context of San Roque Dam and Hydroelectric Power Plant in San Manuel Pangasinan*) made learning of definitions and concepts of science, physics, technology and hypothesis easily attained by the experimental group as compared to the control group. Further, a better concept attainment was observed in scientific method, scientific laws and theories using the context of *local beliefs, traditions, and artifacts* as cultural integration in the concept development.

The same observations were culled from the second module. Both the control and the experimental groups were at par in terms of the percentage of students with correct responses in item nos. 1, 6, 12, 16, 24, 32, and 33. These items were distributed to the three major topics of unit 2 which included light and spectroscopy, reflection and refraction. More pre-test items were observed to have marked a greater percentage of students with correct responses in favor of the control group. However, after the implementation of culture and language sensitive modules to the experimental group, greater percentage of students with correct responses were registered in all items as compared to the control group except in item nos. 1, 16, 20, 21, 22, 27, 30, and 32. Item nos. 1 and 27 were focused on speed of light, while item nos. 20, 21, and 22 were on refractive indices, and item nos. 30 and 31 were on index of refraction. These topics were discussed in the culture and language sensitive curriculum material using the

traditional and the usual presentation of the lesson except that the native language was used as medium of communication and instruction. On the other hand, a large difference was observed in the percentage of students with correct responses in all the other items in favor of the experimental group. It can be deduced that successful and enhanced concept attainment in the following topics: luminosity; image formation in plane and spherical mirrors; and refraction of light and lenses was achieved by the experimental group. This was through native language and culture integration (*use of* ***petromax****and use of superstitious beliefs and tangible culture such as wood and mirrors)*. These findings conform to the assumptions of instructional congruence framework and UNESCO (2008) findings that language integration in the teaching and learning process will only be successful with the proper materials on which culture was also integrated.

Conclusion and Recommendations

The use of culture and language sensitive curriculum materials attained higher degree of concept formation of the students. Deep meaning making of physics concepts was achieved by matching the lesson presentation, topic discussion, and medium of instruction to the cultural background or cultural preference of the learners. Students' post-implementation interviews verified the idea that utilizing students' cultural and epistemological background in the design of curriculum materials makes the curriculum material best fit for meaning making of physics concepts for the students. This allowed the students to concentrate on the deep understanding of the concepts while they are immersed in their own culture and language. This made learning of physics concepts more connected to them. They see physics as something that would enrich their knowledge of their roots and native language which boosts their motivation to learn. They view learning of physics concepts as something that has real-life significance.

On the details of learning, they are able to engage in deep processing of information and physics concepts using the same schema of thinking they often use as when they are engaging in their daily decision making. They are able to employ patterns of assimilation similar to how they assimilate daily and real-life concepts. Learning physics using culture and language sensitive materials made students experience concept attainment in physics in their natural learning setting. They did not experience what other physics students encounter. Others face the awkward feeling of nervousness and anxiety when entering a physics class as they anticipate a shift to a new world while entering their classroom. Instead, it still feels like "home" whenever students start engaging in physics taught in culture and native language perspective. This made learning of physics fun, more comfortable, relaxing, and satisfying on the part of both the students and the teacher.

Curriculum designers could peek into the process of integrating culture and language in the development of meaningful curriculum materials in science. Since only one ethnic group was used in this study, others could use the framework to extend the investigation to all other ethnic groups in the Philippines or to other countries of diverse cultural background. Curriculum

developers can design culture and language sensitive curriculum materials that make use of religious beliefs, practices and traditions such as celebration of fiesta and the like. It may also extend to utilize local games or those known as "laro-ng-lahi" (local games) in the lesson development or as part of the activities.

A longitudinal research may be adopted for better data gathering and analysis. This research may explore not only the learning aspect but the teaching aspect of science concepts as well. It would encompass a triangulation of the cognitive, affective and psychomotor aspects of teaching and learning process. Progress of the learners in all these domains of learning would be monitored and matched with the different stages of their psychological development. In the teaching aspect, series of in-service training programs on integration of culture and language in the teaching of science would be utilized for the experimental process on the teaching aspect.

The investigation may also be used in aligning the pre-service physics teacher curriculum and professional development programs of physics teachers. These efforts may be able to achieve the goals and recommendations of ASEAN 2015 (asean.org 2012) which is to build socio-cultural capital by linking culture to national development; harness indigenous knowledge system and practices, and promote the country's cultural strengths for ASEAN cooperation and participation and completion of information regarding cultural or social profiles of citizens of a country at the regional and provincial levels to distinctly characterize each ethnicity according to cultural and epistemological learning. This paradigm could include cognitive styles of the students per ethnic group for more characterization of the uniqueness of each ethnic group of learners.

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Appendix A
K+12 Curriculum Level of Proficiency

Level of Proficiency	Grade Equivalent	Interpretation
A – Advanced	90% and above	The student at this level exceeds the core requirements in terms of knowledge, skills and understandings, and can transfer them automatically and flexibly through authentic performance tasks.
P – Proficient	85% - 89%	The student at this level has developed the fundamental knowledge and skills and core understandings, and can transfer them independently through authentic performance tasks.
AP – Approaching Proficiency	80% - 84%	The student at this level has developed the fundamental knowledge and skills and core understandings and, with little guidance from the teacher and/or with some assistance from peers, can transfer these understandings through authentic performance tasks.
D–Developing	75% - 79%	The student at this level possesses the minimum knowledge and skills and core understandings, but needs help throughout the performance of authentic tasks.
B– Beginning	74% and below	The student at this level struggles with his/her understanding; prerequisite and fundamental knowledge and/or skills have not been acquired or developed adequately to aid understanding.

Source: Department of Education K+12 framework