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Unorthodox Process of Designing Culture and Language Sensitive Curriculum Materials in Physics (CLS-CMIP)

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I. Introduction

As most countries aspire for globalization, UNESCO envisages education to provide globally competitive citizenry. UNESCO (2014) asserts that education is a right that transforms lives when it is accessible to all, relevant and underpinned by core shared values. Quality education is the most influential force for alleviating poverty, improving health, and livelihoods, increasing prosperity and shaping more inclusive, sustainable and peaceful societies, it is in everyone's interest that it is at the center of the post – 2015 development agenda. In the position paper on post-2015 education agenda, UNESCO points out that the development agenda should be rights-based and should adopt an equity perspective, while reflecting the expanded vision of access to quality education at all levels, with a focus on learning. UNESCO recommends to its member states: **"Ensure equitable quality education and lifelong learning for ALL by 2030**"as a possible overarching education goal, aiming to achieve - just, inclusive, peaceful and sustainable societies. This overarching goal is translated into specific global **targets** to which countries would commit and could be held accountable, and for which corresponding **indicators** will be developed. Specific priority areas identified are basic education; post-basic & tertiary education; youth & adult literacy; skills for work & life; quality & relevant teaching & learning; and financing education. As proposed, UNESCO holds that ensuring quality and relevant teaching and learning in terms of inputs, content, processes and learning environments to support the holistic development of all children, youth and adults deserves the ***central*** place in post-2015 education agenda.

UNESCO (2014) qualified that good-quality education is the process of equipping people with the skills, knowledge and attitudes to: obtain decent work; live together as active citizens nationally and globally; understand and prepare for a world in which environmental degradation and climate change present a threat to sustainable living and livelihoods; and understand their rights. Thus highlights the teachers' central role in ensuring good-quality education and learning.

The need for a good quality education is vital if a country wants its citizens to able to make crucial choices in using the concepts and tools of science and technology. For instance, in local newspaper (Manila Bulletin 2001) news, the speculated outbreak of flu-like disease in October 2000 in at least five private schools in Metro Manila, Philippines spread through news and mass media. Accordingly, it was believed to be an epidemic caused by a biological weapon released by terrorists to strike fear in the heart of the city's elite district. This tale has caused school administrators,

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teachers, parents, and children unnecessary panic. In the long run, through investigations conducted by the Department of Health and Department of Education, it was found that the flu-like epidemic was caused by intermittent changes in weather. This incident concretized the need for Filipino children and adults to study science concepts, tools, instruments and equipment. They need to know the basic science concepts like outbreak, epidemic and diseases. They should also be knowledgeable about technology such as biological weapon, the massive destruction it can cause and be able to use these concepts and tools to make cognizant conclusions. They need to be scientifically and technologically literate to make informed decisions and judgment of their own environmental issues.

To reach scientific literacy for all remains to be a worldwide goal for science education and an important challenge to many countries (Tan 2004). It is therefore important for countries to know how to educate citizenry to be scientifically literate. In 2000, DeBoeber construes that scientific literacy is primarily the level of scientific understanding that exists in the adult population. Furthermore, he claimed that it is something that changes and grows over time. It is not about what the students know in school, though what they learn in school will certainly affect their attitude about science and their desire to continue to learn science in the future. But, it is the appeal to individuals to be able to read and understand science articles in the international and local newspapers, read and interpret graphs and other figures displaying scientific information, engage in scientifically informed discussion of a contemporary issue, apply scientific information in personal decision making and be able to locate valid scientific information and use all these in making sound judgment for personal, health benefits and safety purposes and precautions. However, an unusual scenario is observed in the Philippines which have encountered devastating natural disasters. The country is located along the Ring of Fire which makes it predisposed to earthquakes and eruptive volcanoes. Together with this, the country is annually visited by devastating typhoons that cause thousands of deaths and infrastructure damages. Decierdo (2011) recalled the wrath of typhoon Sendong in 2009 that brought about thousands of deathsin Cagayan de Oro and still thousands more are missing due to flash floods. Just recently, in a local newspaper (2014) typhoon Yolanda slewed hundreds of thousands Filipinos due to storm surges and floods. Most recent among these natural disasters is typhoon Ruby that made several landfalls and typhoon Glenda that hit the metropolis and brought about great damages. Every year, several people die and heaps of resources destroyed due to natural disasters. In a report by Decierdo (2011), government officials and the public did not mindfully note the advice and warnings of scientists such as preventing locals to live in river's flood plain, illegal logging and large-scale mining in Misamis Occidental. Disregarding simple science lessons such as river's flood plain is regularly a naturally flooded area and excessive logging is bad and more trees in the mountain is good has brought about large-scale reparations to lives and properties. These tragedies serve as agonizing reminder to all Filipinos that in this age, making decisions based on a high level of scientific literacy is a matter of life and death.

With this vital need to enhance scientific and technological literacy, the Philippine science education curriculum framework for the basic education pictures developing scientific literacy among students that will prepare them to be informed and participative citizens who are able to make judgments and decisions regarding applications of scientific knowledge that may have social, health, or environmental impacts. With this, the government foresees the Philippine science education as a turn towards achieving scientifically literate citizens who are able to demonstrate understanding of the basic science concepts, applications of science process skills and display of scientific attitudes and values to solve problems critically, innovate beneficial products, protect the environment, conserve resources, enhance integrity and wellness of people and make informed and unbiased decisions about social issues that involve science and technology. This understanding is understood as learners' manifestation of respect for life and the environment, bearing in mind that Earth is our only home which should be nurtured and protected.

With the understanding that scientific literacy is needed to function in a modern industrialized world (Miller, 2007), the new Philippine basic education curriculum, better known as the K + 12 Enhanced Basic Education conceptualized to address the dire need of the country to develop scientifically literate citizenry traces back to three global and regional movements to which the Philippines targeted participating. Tabora (2014) reported that one of these movements is the Bologna accord that intends to focus on best quality tertiary education but refining the 12-year basic education as well. Second, standard movement in the United States and other countries emphasizing established curricular standards. On the regional level, the Philippines efforts to participate as one among the Association of South East Asian Nations (ASEAN) to help enable ASEAN 2015 integration to achieve the goal of materializing one market and one basis of production. Hence, the earnestness to refurbish the Philippine's basic education system to suit into the global demands and regional movements and to nurture citizens of globally and regionally comparable skills.

a) Historical account of the Philippine Basic Education

A little background into the Philippine basic education curriculum shows that the first implementation of a national curriculum dates as far back as 1950. Several reforms were carried out as part of curricular growth and advances. The Revised Education Program implemented from 1974 to 1989 centered on seven core courses with Citizen Advancement Training and skewed to technology-related subjects. Evaluation of the program reveals that students performed poorly, especially in reading, writing and mathematics (Luis-Santos, 2009).As a result, advancing towards a research-based curriculum, the Philippines implemented the National Elementary School Curriculum in 1984 and the New Secondary Education Curriculum in 1991 with foci on addressing identified problems in the Revised Education Program and an emphasis on mastery learning. Evaluation of the program, however, showed that students used to correctly answer 50% of questions asked in the core subjects, they were still deficient in reading ability, and that science curriculum was congested and overcrowded. Luis-Santos (2009) also recounted that results of the Third International Mathematics and Science Study exposed that the Philippine ranked 39thout of the 42 participating countries in the study. With these outcomes of the evaluation, restructuring of the curriculum led to the 2002 Basic Education Curriculum (DepEd 2002) on which the accents were development of learning-to-learn skills, development of functional literacy, linguistic fluency, scientific-numerical competence, decongested curriculum, and indigenization or localization of the curriculum.

However, the previous curriculum (Basic Education Curriculum 2002) promotes learning science as discipline-based approach. It was taught rationally, logically, analytically, and largely inclined to western system supported by latter's concept-based and standards-based curriculum, the new curriculum, is taught in spiral progression approach which is believed to make students appreciate science concepts and applications in all subjects. Learning science is strongly linked to the development of scientific literacy among students towards application of scientific knowledge that will have social, health, and environmental impact. The new curriculum reinforces learning of science and technology, cum indigenous technologies to preserve the country's distinct culture. Science content and process skills are learned in Grades 1 and 2 integrated in English as well as in Mathematics, Health, *Araling Panlipunan* (Social Studies), Music, Arts, and Physical Education. Spiral progression is implemented in Grades 3 to 10, with content revolving around the four science disciplines. As compared to the old curriculum, science subjects, except in Year 1, were offered one in each year level (Biology in 2nd Year, Chemistry in 3rd Year, and Physics in 4th Year). With the full-swing operation of the new paradigm, the recent curriculum imagines to enable Filipinos to make judgments and decisions on applying scientific knowledge that may have social, health, or environmental impacts. It visualizes the development of scientifically, technologically, and environmentally literate and productive members of society who manifest skills as critical problem solvers, responsible stewards of nature, innovative and creative citizens, informed decision makers, and effective communicators. Designed around the three domains of learning science: a) understanding and applying scientific knowledge in local setting as well as global context whenever possible, b) performing scientific processes and skills, and c) developing and demonstrating scientific attitudes and values, the science curriculum aims to promote a strong link between science and technology, even indigenous technology, to keep the country's cultural uniqueness and peculiarities intact. With this, the curriculum is seen as a response to the needs of the Filipino community that would directly help communities such that an agricultural town may offer agricultural elective courses; a coastal area, fishery elective courses; and an urban area, industrial arts. It realizes the educational benefits of having a strong sense of ethical aspect of life, linkage of the curriculum to indigenous technology and preservation of the country's cultural uniqueness and peculiarities.

Moreover, the use of indigenous knowledge in education is seen as a way to better learning of life concepts and skills to enrich the cultural background of Filipinos thus, conserving and preserving the unique culture and tradition of the different ethnic groups in the country and adhering to assimilation of concepts by the learners in their natural setting. As an example, Abayoa (2003) in her study of the indigenous people of Ifugao province found that there is a wide cavity between what is taught in the formal schooling and the needed skills of the indigenous people. Shakespeare is taught and learned in school but the Ifugaos remain ignorant of their own epics such as the *Hudhud* and the *Alim*. They also study mathematics and the Egyptian pyramids but are unfamiliar with how their own ancestors built the spectacular mountains of *pajaw* (rice terraces).In history, the first formal education of the Ifugaos established by the Americans was the Kiangan school was received well by the Ifugaos but a notable decrease in interest occurred when pupils were presentedwith the American curriculum (Abayao 2003). Similar findings were identified in the study of Kroma (1995) and Jenista (1987).

b) Philippine Language and Learning

In the aspect of language, the first enactment of the Mother-Tongue-Based Multilingual Education was introduced as one of the national learning strategies complementing both the formal and non-formal education of the Filipino people.Consistent with the

directions of BESRA is the key plan of the new curriculum to integrate culture and language sensitivity. The use of the Mother Tongue-Based Multilingual Education and localization of senior high school (DepEd Discussion Paper 2010) are further envisioned processes of integrating language and culture in the curriculum. Mother tongue-based instruction accentuates on 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.

Language in the Philippines is highly influenced by their unique ethnicity. Though Filipinos are known to speak their national language called "Filipino," each ethnic group uses its own native language or mother tongue for communication. At present, there are about nine major ethnic groups in the Philippines with their own distinct native languages. Cebuanos who speak 'Bisaya' compose the highest percentage of population, while Pangasinenses whose mother tongue is 'Pangasinan' comprises the lowest percentage of the population. House Bill 3719 known as the Multilingual Education and Literacy Bill was promulgated after the success of the mother tongue-based instruction through the Lubuagan First Language Component Multilingual Education in 1998 (Castillo-Llaneta 2010). The Lubuagan project attained high student achievement in the core subjects such as mathematics and science when the subjects were taught in the native language of students. The bill aims to promote literacy and learning by making the native tongue as the medium of instruction during the formative years of basic education. In response to this progress, the DepEd mandated the use of the mother tongue in instruction 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. Part of the department's plan to fully implement mother tongue instruction as a separate subject from pre-school to grade three and one of the media of instruction in the whole stretch of formal education.

c) Learning in community context

Localization of senior high school covers a curriculum emphasizing the community's practices, traditions, and source of living and livelihood. Localization perspective of the K – 12 enhanced basic education curriculum is not solely observed in language and medium of instruction. As add on, senior high school is expanded to accommodate local and responsible curriculum. This means that the major components of the senior high school curriculum embrace learning through and enhancing the culture of a particular ethnic group in the Philippines. Learners from the Ilocos region, for example, would promote weaving, while those from Batangas would train for coffee making, and Ifugao for terracing. Other traditions of the other ethnic groups in the Philippines would form part of their respective senior high school curriculum. The use of culture, tradition, and mother tongue for curricular reform, according to the Department of Education, is very responsive to the unique needs and demands of the Filipino people as by percentage, about 21% of the whole Philippine population are Cebuanos who speak Bisaya, 14% are Tagalogs popularly speaking the national language known as Filipino, 10% belong to the Ilocano group, Hiligaynon comprise 8% of the populations, Bikolanos 7% and the Pangasinenses contribute 2% of the population. These were the identified major ethnic groups by the DepEd as the focus of responsiveness of the new curriculum. The remaining 38% makes up the minority ethnic groups of the Philippines.

With these inputs, the DepEd saw the rhyme and reason for preserving and conserving indigenous knowledge to better the conditions of the Filipinos and preserve the culture, tradition and environment of the people, while making them learn and be literate in varied aspects, including scientific and technological literacy. This theme "going global by being local," theme that conforms to those pursued by the basic education sector through its Basic Education Sector Reform Agenda (BESRA) (2006-2010). As defined BESRA is a set of policy actions that seek to create a basic education sector capable of realizing the country's Education for All (EFA) objectives by the year 2015. These comprise universal adult functional literacy; universal school participation and elimination of drop-outs; universal completion of the full cycle of basic education schooling with satisfactory achievement levels; and total community commitment to attainment of basic education competencies for all. In the program, it is strongly encouraged that every community mobilizes all its social, political, cultural and economic resources and capabilitiesto support universal attainment of basic education competencies such as basic literacies in language, numeracy, as well as functional, scientific and technological literacies. Adhering to the policy actions, the Department of Education created the National Learning Strategies to help achieve the identified goals which include Alternative Learning System (ALS) fixated on community-based informal learning approach where the learners benefit from learning in their own community meantat being literate and preserving the community's culture, tradition, and well-being. The agency marked that cultural and language preservation and conservation be achieved through the unique senior high school curriculum of the major ethnic groups together with the other minor ethnic groups in the Philippines. Also, Indigenous People (IP) program was established to develop an IP culture-sensitive core curriculum, learning materials and assessment tools/ instruments. The identified core learning areas for the

indigenous people core curriculum are family life; civic consciousness; environment; health; sanitation and nutrition; and economics and income which touch grounds not only on learning science for scientific and technological literacy but also addressing the socio-cultural aspect of the Filipino learners. This program is moored on a larger platform known as Alternative Learning System (ALS) intended to educate out-of-school youth so that the aim of developing scientifically and technologically literate Filipino citizens is not limited to in-school children. Other programs in partnership with the IP are basic literacy and informal education program which are vital in addressing the different needs of the Filipino learner to reach their maximum potential in the different core learning areas. It is in light that the study was conceptualize to help the Philippine government especially the education sector to bring in culture and language in the study of science.

d) Purposes of the Research Study

The study aimed to design culture and language sensitive curriculum materials in physics. Specifically, the study sought to realize the following objectives:

1. Develop using unconventional processes culture and language sensitive curriculum materials in physics (CLS-CMIP),
2. Establish the content validity and reliability of the culture and language sensitive curriculum materials in physics,
3. Determine the inter-class and inter-rater reliability of the culture and language sensitive curriculum materials in physics,
4. Develop design guide as protocol for the unconventional design of culture sensitive curriculum materials in physics

e) Framework of the Study

The first effort to develop the curriculum materials in Physics was guided by the principles of culture sensitivity which includes integration of culture and language, use of the mother tongue based-multi-lingual education, instructional congruence framework, and constructivism. Unorthodox or non-conventional process was used to come up with draft copies of culture and language sensitive student modules in physics. Pilot study included inputs of the elderly of the place of study, teachers' views, students' views and literature reviews. These were gathered through focus group discussions, interviews, panel discussions and intensive research of literatures. These were used to determine and identify specific culture, tradition or belief which can be used as the key feature of the culture and language sensitive curriculum material.

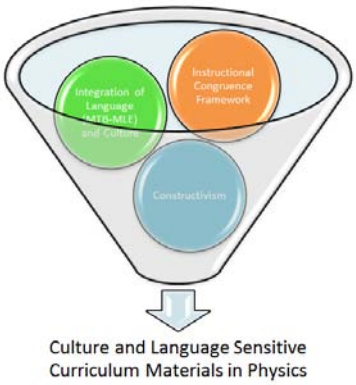


Figure 1 : Conceptual Framework

Language: Focus on Mother-Tongue Based Multi Lingual Education (MTB-MLE)

Defending the languages and language diversity was one of the major goals of UNESCO's education for all. The same objectives were revealed in several researches (Agnihotri, 2008; Collier & Thomas, 2004; Fafunwa, Macauley &Soyinka, 1989; and Benson, 2002) which gave confirmations that the longer a child is taught in his or her home language, the higher is his or her academic achievement in school. In the Philippines, the Lubuagan first language component multilingual education in 1998 revealed the same insights on the success of Mother-tongue instruction on academic achievement (Castillo-Llaneta, 2010).

Seeing the benefits of the native language in instruction, Philippine legislator promulgated House Bill 3719 known as the multilingual education and literacy bill which aimed to promote literacy and learning by making the native language as the medium of instruction during the formative years of basic education. In response to this action plan, the department of education mandated the use of the native language in instruction through DepEd Order No. 74 (s. 2009). The agency through such an order planned 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. It was part of strategy to fully implement DepEd Order No. 74 in the new curriculum where the native language of the learners 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.

f) Instructional Congruence Framework

Instructional congruence framework presents a process of mediating the nature of academic content with the students' language and cultural experience (Johnson,2005 and Lee & Lykx, 2007).Moreover, cultural experiences were the knowledge that students have obtained from their community. Whereas students' language experiences were the languages used in their

daily life. When the knowledge of science is integratedin the students' language and experiences, students would be more involved in the learning process and science would be easier, meaningful and relevant to students. Learning environment that puts weight 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.

Accordingly, the 4 main characteristics of instructional congruence framework (Johnson, 2005 and Lee & Fradd, 2001) were as follows:

- *Role of Teacher*. The teacher needs to identify what the students need, their culture and their daily language which are to be integrated in the instructional design.
- Instructional congruence is *subject-specific pedagogy of teaching model* based on particular cultural model where teachers need to give similar emphasis between scientific knowledge and the actual inquiry process with the students' language and cultural experience.
- *Learning Science and Learning Literacy* is believed to be able to improve students' mastery of writing skills, encourages more discussion and allows more sharing on cultural experience.
- Instructional congruence is *constructivist* in approach. Students develop knowledge by integrating their experiences with the environment which also promote academic achievement in science and literacy.

g) Integration of culture and language in curriculum materials

Several researches revealed that culture correlated highly with meaning making and knowledge construction of students (Samarov, & Porter, 2004; Banks, 1993; Lixin, 2006; Liu, 2010). In fact, Samarov (2004) mentioned that culture affects the way we perceive and process the world. Accordingly, the effects of culture could be identified in 4 cognitive styles: field independence which ignored context and treats subject directly (Western culture) versus field sensitivity which exhibits more awareness of broader contexts and social dimensions (Asian culture); cooperation versus competition; trial and error versus watch then do (Asian culture); and tolerance (Asian culture) versus intolerance of ambiguity (American culture).

The constructivists' perspective known as culturally sensitive meaning making model showed that teachers should make explicit effort to help students engage in meaning making which needs to be sensitive and relevant to the students' cultural values. As claimed by Darling-Hammond, et.al. (2007); the following efforts should be extended by the teachers to achieve a culturally-sensitive meaning making atmosphere:

- The teacher needed to model respect by using inclusive examples and inclusive language; welcoming alternative viewpoints; and asking students to produce projects describing particular cultural practice.
- The teacher needed to examine values by reflecting on the values implicit in the subject; reflecting on values that may be challenging to some cultures; respectfully exploring different value systems in relation to a topic.
- The teacher needed to celebrate difference by asking students to provide examples of teaching topics relevant to their culture and collecting culturally diverse materials for use in the classroom.

These identified needs were congruent with the observations and recommendations of UNESCO's priority theme cultural heritage, cultural perspective and indigenous knowledge of the cultural SD pillar. Specifically, the frameworks for ESD which jibed with the identified needs are as follows: (UNESCO, 2009)

- Measures were to be taken to conserve use and promote knowledge of indigenous people with respect to ESD. The conservation, use and promotion of indigenous knowledge are considered integral part of SD's strategies for preserving diversity – both cultural and natural.
- ESD aimed to promote teaching which highly respects indigenous and traditional knowledge and encourages the use of indigenous language in education.
- Indigenous worldview and perspective on sustainability should be integrated into education programs at all levels whenever relevant.
- Local knowledge and language were repositories of diversity and key resources in understanding the environment and in using it to the best advantage.
- Culture must be respected as the living and dynamic contexts which human beings find their values and identity.

One probable way to address these requirements of ESD was to take a close look at cultural integration models in education. May (2002) claim that teaching culturally relevant curriculum was not merely throwing a few good ethnic books, rather, the cultivation of culturally relevant ideas, conversation and critical thinking about the way they believe and experience culture. Bull (2010) clarifies that students will be able to understand sense of place and what was it to be a people through cultural integration. She added that by integrating culture, they are able to perform acts of decolonization by giving the students access to their tribal knowledge back rather than taking something away from the students leaving a vacant space in them. The study further showed that it is a part of the understanding that culture is a multilayered experience and that exploration of culture in a structured

educational environment is an imperfect and incomplete experience. Particularly, she identified 2 kinds of cultural integration as spontaneous integration and planned integration. She said that the most successful cultural integration in the classroom and in the field is when it is done spontaneously through students' prior knowledge and the connection that students make in their learning. The other way of integrating culture is known as planned cultural integration that can also happen both in the classroom and as field based experience. Accordingly, Bull (2010) suggested the following actives for planned integration of culture: mini-immersion, place-based field trips, and institutional programs.

The project, Rekindling Tradition spearheaded by Aikenhead (2001) emphasized cross-cultural science teaching for aboriginal students. Its major objectives are: to develop a prototype process for producing culturally sensitive instructional strategies and curriculum materials that support student learning within any particular community and produce teaching strategies and materials that exemplify culturally sensitive science teaching for aboriginal students of grades 6 – 11. Similarly, these objectives were also the identified major concerns and difficulty of DESD (Decade of Education for Sustainable Development) which were specified as the lack of relevant and culturally appropriate educational materials such as brochures, teaching materials, activities, scientific researches and studies.

Aikenhead (2001) was able to come up with 2 major results: process on how to develop culturally sensitive materials and strategy on how to integrate such developed materials:

- Prototype of Process
  - The selected teachers were given release periods for research writing and working with local experts in their units or topics.
  - A six 2-day planning meeting was conducted with consultants and researchers.
  - Piloted appropriate resources, activities and teaching methods to suit the units.
  - Edited and polished the lesson plans
  - Planned for professional development workshop for other teachers
  - Face to face critiquing
- To produce Some Teaching Strategies and Materials
  - The first strategy that made a world of difference was teaching out of doors. Students reacted very positively when immersed in nature away from the school building, even when it occurred for only one or two lessons in a unit.

The most effective way of integrating culturally sensitive materials in science teaching was through outdoor teaching. It was a strategy that involved students in gaining local aboriginal knowledge related to the unit where western content is taught in the context of the local community's aboriginal science. Conceptually, outdoor teaching promoted "context-based learning and teaching. Context-based learning and teaching of Physics in particular represented the use of events from the students' and teachers' life, social and cultural background as a platform to learning physics. They added that it is a good way to show the students the operation of physics in the real world and society, and thus giving a concrete and authentic picture for the learning of science. Similar effect was observed by Beckert (2001) in his study on Conversion and Context in Physics Education. He said that Physics could be placed in proper context by connecting the subject to everyday life by using technical applications or by describing the historical context of physics and its impact on society. This was implemented through the development of context-rich problems difficult enough to need a problem-solving strategy.

II. Methodology

Quantitative research design combined with qualitative approaches was used in the development of culture and language sensitive curriculum materials in physics. Survey research was used to determine the feasibility of the curriculum material in the area of development and design of culture and language sensitive learning packages in Physics. The study consisted of three major stages: Preparation and pilot; design and development; and validation and reliability determination.

a) Participants of the Study

Table 1: Participants of the Study

Stages of the Study	Participants/Sample	Sampling Process
Preparation and Pilot Study	2Pangasinan Elders 4High school students	Purposive sampling
Design and Development	3 Physics Experts who are Pangasinan speakers 1 Pangasinan Language expert	Purposive sampling
Pilot Testing and Data Analysis	21 Physics/Science Teachers of Pangasinan 4 Physics Experts	Purposive sampling based on native language of Pangasinan

In all the three stages, purposive sampling was done to identify the appropriate participant for each of the stages identified. In the preparation and pilot study, the identified participants were elderly of Pangasinan who are more or less capable of identifying traditions,

beliefs and practices of the place. Four high school students were also chosen to determine if all the accounted traditions, beliefs and practices of the elderly are still observed in this era. Focus-group discussion and interviews were conducted as preliminary processes to designing the culture and language sensitive curriculum materials in physics. The participants for the second stage were also purposively chosen on the bases of their being experts in physics and Pangasinan language. Finally, the rest of the participants in the last stage of the study were identified to evaluate developed curriculum material for Pangasinan learners. Since the curriculum materials were designed for Pangasinan learners using the culture and native language of Pangasinan, the chosen evaluators were also natives of Pangasinan who are fluent in the native language and are science teachers.

b) Stage 1: Preparation and Pilot Study

Document analysis and literature review revealed the cultural dimension, epistemological beliefs and views of Pangasinan learners on the integration of culture and language in learning Physics concepts. The distinct characteristics of Pangasinan learners identified by Morales (2014) enabled the customization of a culture and language sensitive curriculum material in Physics. Literature reviews focused on cultural perspective of learning, scientific literacy and instructional congruence also aided the preparation of CLS-CMIP. The format of the developed curriculum materials conformed to the K+12 curricular materials of the Department of Education.

Pilot study was conducted through interviews to determine the different practices, beliefs and tradition of Pangasinan. Two (2) elderly who are natives of Pangasinan, 4 high school students from different parts of Pangasinan were interviewed so as to have a wide range of cultural sources. Interview protocols translated in Pangasinan dialect were used. Throughout the interview process, the Pangasinan dialect was the medium so as to establish rapport with the participants who are natives of Pangasinan.

c) Stage 2: Design and Development of CLS-CMIP

Information derived from the cultural profile of Pangasinan students and pilot study contributed to the initial design and format of curriculum materials identified as version 1 of the culture and language sensitive- curriculum materials in physics (CLS-CMIP v.1). The curriculum materials were planned to be in 2 parts: student module and teacher's guide. The student module was packed with a pre-test and post-test, introduction of the module and several lessons depending on the coverage of the unit. Modules are thematically presented using combination of culture, tradition, practices, products and home language of the Pangsinan learners. In each of the lessons, introductory statement, discussion of concepts, presentation of activities and post discussion of activities were included. Worksheets were also provided as well as journal logs.

The journal logs were intended to extract students' insights on the lesson, on the language used, and on the process of culture integration in the learning progression. The activities provided in the student module made use of indigenous materials locally available in Pangasinan but may not be available in other provinces. Design of the activities conformed to the cultural and epistemological preferences of the Pangasinan learners (Morales, 2014) such as working collaboratively in groups, student-centered paradigm, that science is important in real-life. The choice of materials, activity and the lesson discussion in the module were highly customized to the Pangasinan learners' cultural and epistemological profile. Cultural integration was implemented using the provided traditions, beliefs, practices and artifacts by the Pangasinan folks in the pilot study. Though the language used in the student module was Pangasinan, the last activity in the student module comprised of parts where students were asked to translate their answers written in Pangasinan to English language. This was to account for the fact that all the participants of the study would eventually answer common concept test as post-test written in English language.

The teacher's guides were designed with three phases which resembled the stages of Understanding by Design (UBD) Framework. However, the researcher chose to rename the different phases while adapting most of the format and principles of UBD. These phases were termed as follows: (1) *Phase 1- Setting the Learning* which included goals of learning, skills that could be enhanced by the module, & key questions; (2) *Phase 2 – Assessing Learning* was a combination of paper-and-pencil test and performance tasks highlighting the GRASPS; and (3) *Phase 3-Facilitating Learning* consisted of activity listing and teaching tips. Together with these phases were introductory statements about the module; competency listing, and unit details.

d) Stage 3: Pilot Testing and Data Analysis

The draft version of the curriculum materials were subjected to two methods of content validation by the 4 experts: (i) descriptive and (ii) quantitative content validation. Only descriptive validation was done for face validation while descriptive validation stressed on the use of phrases or words to describe the assessment of the curriculum materials. These were presented as comments, remarks or suggestions of the experts. The experts were requested to look into, suggest and comment on the exactness and correctness of the content and concept, the format of the module, the appropriateness and viability of the activities, how suitable the language (Pangasinan dialect) and the terms used to the level of the students, and

appropriateness of the artifact, tradition, cultural beliefs and practices imbedded in the lesson as cultural integration. They were also asked to check the grammar and spelling of the Pangasinan terms since every one of them is well versed in the home language. The quantitative content validation was done by the 3 of the 4 experts using the culture and language sensitive – curriculum evaluation tool (CS-CMET) developed by Morales (2014). All comments, corrections and suggestions of the experts were written on the copies of student module and teacher's guide provided them. These were incorporated in the module resulting to version 2 of CLS-CMIP (*CLS-CMIP v.2*) of the 2 units in fourth year physics (Energy in Society and Energy in the Environment).

Second validation cycle was done by 4 experts. They were again requested to look into, suggest and comment on the exactness and correctness of the content and concept, the format of the module, the appropriateness and viability of the activities, how suitable the language (Pangasinan dialect), the terms used to the level of the students, and appropriateness of the artifact, tradition, cultural beliefs and practices imbedded in the lesson as cultural integration. They were also asked to check the grammar and spelling of the Pangasinan terms. They were also tasked to monitor if all their previous comments and suggestions in the first run of validation procedure were all incorporated in the 2nd run of the validation process. To quantify their evaluation,they were asked to use CS-CMET as an evaluation instrument for the CS-CMIP. All comments, corrections and suggestions of the experts were written on the copies of student module and teacher's guide provided them. These were incorporated in the module which led to version 3 of CLS-CMIP (*CLS-CMIP v.3*) of the 2 units in fourth year physics (Energy in Society and Energy in the Environment). All student modules in both units were printed in book form.

The third version which included all the revisions based on the comments and suggestions from the 2nd validation cycle was subjected to a qualitative evaluation on readability. Three high school students from Pangasinan were invited to read the student modules and identify the Pangasinan words which were not very clear to them. The researcher asked them if the alternative words were appropriate and were understandable. This step was done in both CLS-CMIP units to ensure that the content of the module would be understood by the intended users. After integrating all the corrections and suggestions, the final copies of the culture and language sensitive curriculum materials and teacher's guides were printed in book form and soft copies made available online at http://cliphysicsed.weebly.com.

III. Results and Eiscussion

a) Culture and Language Sensitive – Curriculum Materials in Physics

Accordingly, Morales (2014) summarized the learning characteristics of Pangsinan learners in culture and epistemological perspective with their beliefs on integrating culture and language in learning Physics.

These cultural dimensions and epistemological beliefs were the bases of the design of the curriculum materials in physics. All activities, lesson discussions, and examples were based on the traditions, practices and beliefs in Pangsinan gathered from the pilot study. Design of activities and lesson presentations were in accordance to the above presented cultural dimensions and epistemological beliefs of the Pangasinan learners.

The culture and language sensitive curriculum materials came in two sets for every unit: the student module and the teacher's guide. The former was designed to match the format of the existing modules of DepEd. With the student module are pretest and posttest; discussions of the topics in cultural perspective highlighting traditions, beliefs and practices of Pangasinan; use of the native language (Pangasinan); activities using indigenous materials of Pangasinan inclusive of worksheets; journal logs where students could write their insights and views; summary; and references. Figure 1 shows excerpts from the student module. Activity 4, though is about scientific method presented using the native language in the context of Lingayen Gulf. The other example discusses intensity of light using a lighting system (petromax) prevalent among the fisher folks in Pangasinan.

Journal log sheets were also embedded in the module after every major lesson of the unit. Questions in the journal log sheets were expressed in the native language (Pangasinan), which sample questions are translated thus:

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

The last journal log sheets required the students to shift language from the native language (Pangasinan) to English to ensure that they could easily shift to the standard language used in school (English) in preparation for the common assessment written in English given to all participants of the study.

The teacher's guide was designed using Wiggins' and McTighe's (2005) '*Understanding by Design*' framework. Covered in the teacher's guide were identified goals, enduring understanding, key questions, activity listing, assessment, key, summary, references, and teaching tips. The assessments combined paper-and-pencil test and performance tasks highlighting the

Goal-Role-Audience-Situation-Product-Standard model. Figure 3shows sample parts of the teacher's guide consisting *three major phases*: Phase 1- Setting the Learning: Identified Goals, Enduring Understanding, and Key Questions; Phase 2 - Assessing Learning: Assessment by way of paper-and-pencil test and performance tasks; and Phase 3-Facilitating Learning: Activity Listing and Teaching Tips. The answers were posted in the module as part of the teacher's guide with summary of concepts and some references used.

b) Validation of Culture and Language Sensitive – Curriculum Materials in Physics (CLS-CMIP)

Version 1 of the CLS-CMIP: Teacher's Guide and Student Module

Version 1 of CLS-CMIP was subjected to two methods of content validation by the experts: descriptive and quantitative content validation. Only descriptive validation was done for face validation descriptive validation featured the use of phrases or words to describe the assessment of the curriculum materials. These were presented as comments, remarks or suggestions of the experts written in the draft copy of the module. Quantitative content validation made use of the 31-item culture and language sensitive-curriculum material evaluation tool (CS-CMET) developed by Morales (2014). A summary of the averages per expert ratings in validating the CLS-CMIP v.1 for units 1 and 2 was presented in tables 26 and 27 respectively. Presented in Table 4 are experts' comments and suggestions which were part of the descriptive method of validation. Other comments and corrections on the CLS-CMIP's as portion of the descriptive method of validation were written in the draft copy of the CLS-CMIP. However, only the first 3 experts did the descriptive as well as the quantitative content validation. The fourth expert was asked to focus on checking the Pangasinan grammar and words used as he is the only invited expert who is well-versed in the home language because of formal vernacular schooling, a member of a language organization in Pangasinan and has taught Physics for almost 20 years.

Table 4 : Content and Face Validity of CS-CMIP (Unit 1: Energy in the Society) v.1

Experts	Mean
1	4.94
2	4.83
3	5.00
Over-all Mean	*4.93 out of 5*

The means of the individual experts were determined by getting the ratio of the sum of the ratings per expert and the total number of items in the CS-CMET. For a more reliable computation, Statistical Package for Social Sciences (SPSS) generated output was used instead of manual calculations. All evaluators rated the developed test 4.93 out of 5.0 suggesting that the raters evaluated the student modules and teacher's guide within the highest continuum of the Likert scale range. This suggested a good quality curriculum material (integrating culture and language) in construction and valid content wise. The 3rdcolumn provided the suggestion and comments of the experts. Some of these comments were written in the validation checklist while most were written in the draft copy of the student module and teacher's guide being validated. The fourth evaluator focused on checking the language used grammatically, syntactically, and technically. All corrections, comments and suggestions by the 4th expert were written on the draft copy of the CLS-CMIP. Table 5 presents the ratings, descriptive comments and suggestions for the student module and teacher's guide of CLS-CMIP for unit 2.

Table 5 : Content and Face Validity of CS-CMIP (Unit 2: Energy in the Environment) v.1

Experts	Mean
1	4.90
2	4.90
3	5.00
Over-all Mean	*4.92 out of 5*

All evaluators rated the developed test 4.92 out of 5.0 suggesting that the raters evaluated the student module and the teacher's guide within the highest continuum of the Likert scale. This acclaimed a good quality curriculum material (integrating culture and language) in construction and valid content wise. The 3rd column provided the suggestion and comments of the experts which were written in the validation checklist while most were written in the draft copy of the student module and teacher's guide being validated. The fourth evaluator focused on checking the language used grammatically, syntactically, and technically. All corrections, comments and suggestions by the 4th expert were written on the draft copy of the CS-CMIP.

Version 1 of the CLS-CMIP: Teacher's Guide and Student Module

After revising the student modules and teacher's guides, version 2 (*v.2*) was subjected to a second round of content and face validation. The rating improved with an over-all mean of 4.96 out of 5.00 by the four raters. This new overall rating was an improvement of the student module and the teacher's guide in the 1st validation cycle. Each of the raters evaluated the test as very close to 5.0 as presented in Table 6.

Table 6 : Content and Face Validity of CS-CMIP (Unit 1: Energy in the Society) v.2

Experts	Mean
1	5.00
2	4.97
3	4.94
4	4.94
Over-all Mean	*4.94 out of 5*

The fourth evaluator or expert was an end-user of the CLS-CMIP who rated the set for Unit 1 as very good with an average rating of 4.94 out of 5.00. Descriptive comments and suggestions were also provided by the fourth expert for the improvement of the student module and the teacher's guide. In addition, the same set of evaluators assessed the second module. The descriptive and quantitative evaluations of the experts were summarized in Table 7.

Table 7 : Content and Face Validity of CS-CMIP (Unit 1: Energy in the Environment) v.2

Experts	Mean
1	5.00
2	4.91
3	4.87
4	4.91
Over-all Mean	*4.92 out of 5*

The rating improved with an over-all mean of 4.92 out of 5.00 by the four raters. This new overall rating was an improvement of the student module and the teacher's guide as compared to the 1st validation cycle. Each of the raters evaluated the test as very close to 5.0 as presented in Table 7. An invited end-user -the fourth evaluator - assessed the developed module as very good with an average rating of 4.94 out of 5.00 who provided descriptive comments and suggestions for the improvement of the student module and the teacher's guide.

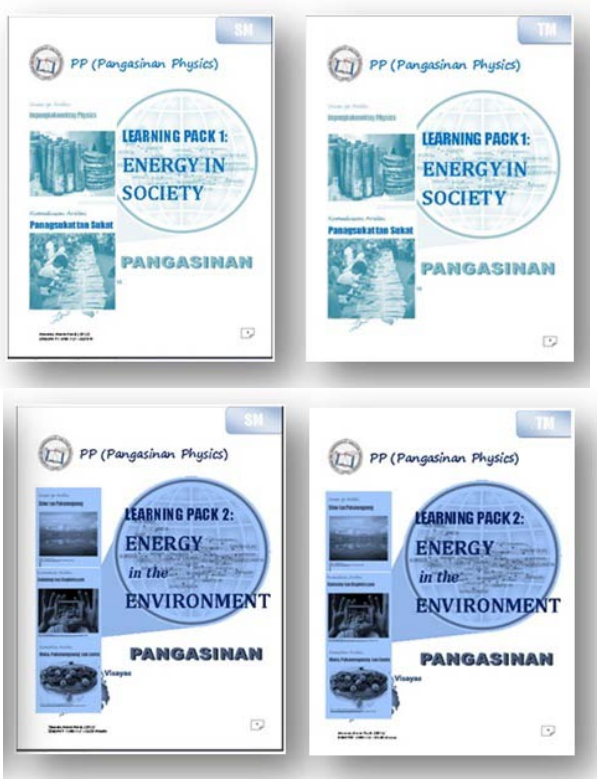
In addition to mean values of experts' evaluation, averages of content validity coefficient of the items are shown in Table 8. Content validity coefficients of the two versions of the CLS-CMIPs provide an information that the curriculum materials were actually rated as content wise and valid curriculum materials in Physics.

Table 8 : Content Validity Coefficient (VI_K) of CLS-CMIP's (v.1& V.2)

CLS-CMIP	Aiken'sVI_K (Content Validity Coefficient)	
	Version 1	*Version 2*
Unit 1	0.99	1.0
Unit 2	0.98	1.0

Accordingly, Aiken (1985) interpreted Aiken's content validity coefficient *(VI_K), as* closeness of the coefficient to 1 where an item is rated as content valid. The experts who rated the student module and the teacher's guide found these sets valid content wise as shown in the values of content validity coefficients ($VI_K \approx 1.0$). All the items in the CS-CMET pertaining to the characteristics of the CLS-CMIP were rated close to 1 suggestive of a high content validity coefficient. A second stage of content validity coefficient computation was done with the results presented in table 8. An improvement in the coefficient is shown in version 2 (v.2) where both modules were rated with an average content validity coefficient of 1.0 which shows that both modules are content valid as assessed by the same experts.

Interview with students regarding the readability and appropriateness of the Pangasinan words and terms used were able to identify difficult words and had also helped in changing these words or terms appropriate to the context. With the corrections, the final copies of the student modules and teacher's guide were printed in book form (*Attachment 2 to 5:*



CLS-CMIP Units 1 and 2) presented in Figure 4.

These were distributed to 21 Pangasinan High School Teachers who were currently teaching physics and general science. A total of 21 High school physics or general science teacher rated one of the modules and 5 Physics experts rated both modules. Table 9 shows the numeric equivalent of the average rating of high school teachers of CLS- CMIP.

Table 32 : Average Rating of CLS-CMIP using CS-CMETv.2

CS-CMET Components (n = 29)	Average Rating
Component 1: *Constructivism: Culture and Language-Based Principles*	4.62
Component 2: *Emphasis on Learning Science and Learning Culture, Language, and Literacy*	4.67
Over-All Rating	4.65

From Table 9, it can be gleaned that most of the evaluators rated the modules (CLS-CMIP) with high marks with an over-all rating of 4.65 out of 5.00. This was deduced by taking the average rating of all the raters in all the 31 items of the CS-CMET. For each of the component, averages over the number of inclusive items were also done whichled to high marks of 4.62 out of 5.0 for component 1 and 4.67 out of 5.00 for component 2. Thus, from these results, it is suggestive that the modules projected *constructivism*, *language-based principles, emphasis on learning science while learning culture*, and *language & literacy*. These descriptions of the CLS-CMIP may fit the intended integration of culture and language in curriculum materials and projected to bring about significant effect on the Physics learning process of the participants.

Table 6 presents the inter-rater agreement coefficient for the first run of validation. Inter-rater agreement coefficient ensures that experts' evaluation and validation are consistent.

Table 9 : Inter-Rater Coefficient of the Draft Version

Inter –Rater Coefficient	Expert 1-Expert 2	Expert 1-Expert 3	Expert 2-Expert 3
Kappa	0.88	0.50	0.38

Based from Table 9, an almost perfect agreement was observed between Experts 1 and 2. Moderate and fair agreement, on the other hand was exhibited by experts 2 & 3 and experts 1 & 3 respectively. Interpretations of the Kappa coefficients were based on the standards set by Landis (1977). Improved agreements of experts were shown in the second cycle of validation process for the revised version as presented in Table 10.

Table 10 : Inter-Rater Coefficient of the Revised Version

Inter – Rater Coefficient	E1-E2	E1-E3	E1-E4	E2-E3	E2-E4	E2-E4
Kappa	0.88	0.88	0.88	0.88	0.88	0.88

**E-Expert*

As shown in Table 10, all experts agree that the instrument they were validating and evaluating was within the standard excellent category as also presented in the mean values of their ratings (Tables 6 and 7), in the Aiken's validity coefficients for the two versions of the CS-CMIPs (Tables 8), and in the evaluation of the culture and language sensitive curriculum materials using CS-CMET (Table 9). The Intra-class coefficient, a descriptive statistics that provides the composite of intra-observer and inter-observer variability is provided in Table 11. It would refer to intra-observer variability which is the deviation of a particular rater's score.

Table 11 : Intra-Class Coefficient Revised Version

Kind of Measure	Intra-Class Correlation	p-value
Single	0.82	0.00*
Average	0.98	0.00*

** significant at 0.05*

From Table 11, the index of variability for one single rating is 0.82 classified as almost perfect. While the index for the reliability or agreement of different raters averaged together is 0.98, close to +1 (perfect) agreement. In both cases (single and average), difference of measures of scores is significant ($p < 0.05$) which means that there were variable scores but these scores are still in agreement with each other both within the same rater or among raters. It can be deduced that intra-rater agreement is high that supports the validity and reliability of the instrument.

c) Design Guide and Protocol

An inadvertent outcome of the development of the CLS-CMIP was the development of the overview and design template entitled "*Culture and Language Context – Physics*." It a document of how to come up with CLS-CMIP's for units 1 and 2. All process were documented in the protocol so as to impart the whole system to other Physics teachers who would want to replicate the same curriculum materials in the feature for their own consumption in the quest to enhance physics education starting at their very own locality. It featured some important details of how to come up with teacher's guide and student module integrating culture and language of a Physics teacher's locality. The following outline completed the protocol:

I. *Introduction*
   a. Terms and Definitions
   b. Physics in Cultural and Language Contexts
   c. Framework

II. *Phases (Teacher's Module)*
   a. Introductory Details
   b. Phase 1 – Setting the Learning
   c. Phase 2 – Assessing Learning
   d. Phase 3 – Facilitating Learning

III. *Guide to Preparation of Student Module*

IV. *Appendices*

a. VSM 08
b. CS-PLES
c. CS-CMET
d. Blank Template

Part 1 of the protocol consisted of the introductory concepts such as the framework; the rationale of the CS-CMIP development; some definitions of terms used in the CLS-CMIP development; and brief description of the different parts of the protocol. The flow of the protocol also included how to design the different phases of the teacher's guide: (1) Phase 1 – Setting the Learning; (2) Phase 2 – Facilitating Learning; and (3) Phase 3: Assessing Learning. Inclusive in this part was the preliminary details of the teacher's guide. Screenshots of the developed CLS-CMIP were included to make the design guide more appealing and user friendly. These screenshots were accompanied by detailed description of the part and a simple procedure on how to develop that part of the whole module. Sample assessment and worksheets were also provided in screenshots for the users to have a glimpse of how the activities and the assessment packages would be. Short discussions of important principle were included to give a sort of briefer to the user before designing the performance assessment. The third part of this protocol presents the procedure on how to design student modules. Just like the second section which described how to develop the teacher's guide, part 3 included screenshots of each of the stages of development of the student module. Finally, part 4 of the protocol shows the listing and appended instruments which would be needed by the teacher in the design and implementation of the student module and the teacher's guide. A blank template for teacher's guide and student template where the teacher-designer would key in all ideas on the design of the student module and teacher's guide were provided by the proponent on the later part of the 4th stage of the protocol. An account of how the teacher's guide and student module be implemented for optimum results were also included in the initial pages of the protocol.

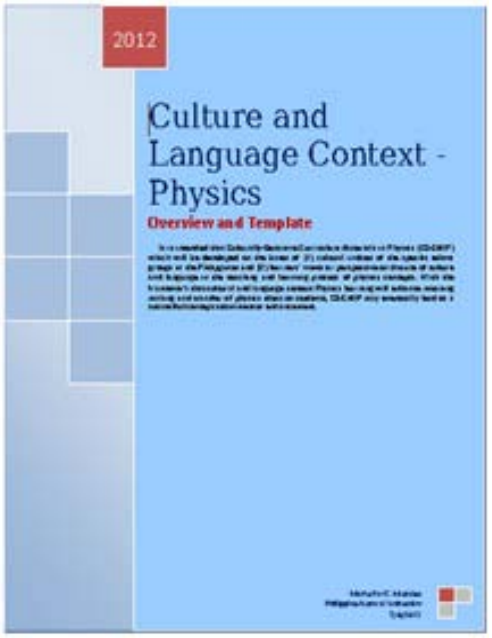


Figure 5 : CS-CMIP Design Guide

An initial attempt to test the efficacy of the protocol was done by asking a Physics alumnus from Aklan to design a simple lesson in Physics using the protocol. This alumnus represented the in-service sector. Following the design guide, the Physics alumnus was able to come up with a student module in Aklanon language integrating Aklanon culture

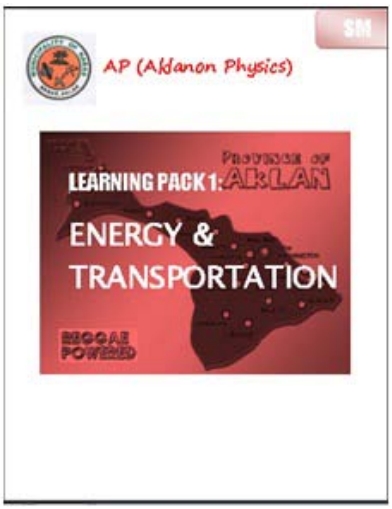


Figure 6 : Aklanon Physics

Accessibility of the said protocol with the design guide, framework, and instruments needed to profile the intended participants or ethnic group were made available through a website: http://cliphysicsed.weebly.com. With the cultural profile (*cultural dimensions, epistemological beliefs, and student views on culture and language integration*) of the participants, curriculum material designers would be able to develop a customized curriculum material in a specific subject.

Table 9 : Summary of statistical characteristics of the Culture and Language Sensitive- Curriculum Material in Physics (CLS-CMIP)

CLS-CMIP Unit 1	CLS-CMIP Unit 2
• *n (experts) = 4 • Content Validity o Over All Mean = 4.96 out of 5.00 o Aiken's Content Validity Coefficient (VI_k) = 1.0 • Rating using CS-CMET = 4.65 • Inter-rater reliability: 0.88 • Average Intra-Class Correlation: 0.98	• *n = 47 • Content Validity o Over All Mean = 4.92 out of 5.00 o Aiken's Content Validity Coefficient (VI_k) = 1.0 • Rating using CS-CMET = 4.65 • Inter-rater reliability: 0.88 • Average Intra-Class Correlation: 0.98

Quantitative measures of the CLS-CMIP's content validity, Inter-rater reliability and intra-class correlation suggests a valid and reliable curriculum materials in Physics which featurethe integration of culture and language of Pangasinan using as base data the cultural dimensions, epistemological beliefs and views on the use of local culture and language of the learners in the teaching and learning process. Practices, traditions, beliefs, values, local products and other unique features of Pangasinan included in the presentation of Physics concepts, lesson discussions and activities were empirically determined through pilot study. CLS-CMIPs also include worksheets, journal logs sheets where students can input their reflections, learning and insights, references, teacher's guide and design protocol as guide to development of the same kind in other ethnic groups, other science components likes Biology, Chemistry and Earth and Space, and other subjects which may be applicable.

IV. Conclusion

The study developed curriculum materials in Physics that feature integration of local cultures, traditions, beliefs, practices and products of the Pangasinan learners. Lesson discussions and activities used both culture and language of the participants to make science appealing, motivating and in the context of real-life as what the learners prefer based on the study of Morales (2014). Content and face validation by panel of experts was conducted to polish the materials. Afterwards, pilot testingof the instrument to in-service teachers was done to gather quantitative and qualitative data. The data collected was then subjected to Kappa statistics and intra-class coefficient to determine agreement among and within raters which. This yielded a value of 0.88 for Kappa and 0.82 and 0.98 for single and average intra-class coefficient respectively. Results of the validation process helps in the finalization of the curriculum materials. Finally, to further analyze the developed CLS-CMIP, CS-MET (Morales, 2014) was able to provide the idea that the developed materials exhibit constructs of the Instructional Congruence Framework. Very evident of the constructs are culture and language-based principles and emphasis on learning science and learning culture, language and literacy. These features of the CLS-CMIP may be able to address concerns of UNESCO (2008) with regards development of learning materials in the mother tongue stated as "*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.*"Thus, the use of the national languages in education could not be maximally successful without revising teaching methods and developing adequate teaching and learning materials. Though the developed CLS-CMIP includes a design guide for replication, further standardization of the design guide is recommended.

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