

Cultural and Epistemological Profile of Filipino Learners

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Abstract

Several researches identified that many students find physics the most difficult science subject. The quest to find ways to make learning physics more meaningful and interesting has lasted for decades. Even with all the new strategies and pedagogies being used, many students still find the subject formidable. This study critically explored the learning characteristics of Filipino physics students which will serve as baseline data for curriculum design. Value Survey Module 2008 (VSM 08) and Epistemological Beliefs Assessment for Physical Sciences (EBAPS) were used to determine the cultural dimension indices and the epistemological beliefs of 385 participants grouped according to ethnicity. Percentage contributions of the three identified ethnic groups (Tagalog, Bicol and Pangasinan) were determined by taking the population ratio of each ethnic group with the total population of the three ethnic groups. Hofstede's cultural interpretation and education perspective interpretation of cultural values and beliefs were used to deduce the significance of the cultural dimension indices of the sample ethnic groups. EBAPS axes interpretation was also deduced per ethnic group to establish the distinct epistemology of all three ethnic groups. In comparing the ethnic groups per cultural dimension index and per EBAPS axes the study noted the similarities and differences of the learning characteristics of the different learners in cultural perspective. Each ethnic group showed unique and distinct cultural dimensions and epistemology. The Pangasinan learners were culturally tagged as student-centered, while Bicol and Tagalog learners as teacher-centered. All ethnic groups, however, believed that science is composed of bit and pieces of concepts and knowledge. Pangasinan and Bicol learners emerged to move towards higher order thinking skills lessons when compared with the Tagalogs' epistemology. Correlation of the cultural dimension indices with the epistemological beliefs axes established the learning characteristics unique to each ethnic group of learner.

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Introduction

Learning has been extensively described based on researches in psychology and sociology and has provided significant insight about how learning occurs. However, a complete picture of learning may be deduced with an understanding of anthropology which highlights culture as a means to learn (Hammond & Brandt, 2004). Cultural context of education and cultural background provide an understanding of how and why students react in a particular manner to learning material

or learning environment (Mankutty, Anuradha & Hansen, 2007). Nieto (2000) expressed that culture consists of values, traditions, and social and political relationships. She further identified culture with the worldview that is created, shared and transformed by a group of people bound together by a common history, geographic location, language, social class, or religion. Culture does not only include the tangibles such as foods, holidays, dress, and artistic expressions; but also the less tangible manifestations such communication styles, attitudes, values and family relationships. Admittedly, the less tangible evidences of culture are often more difficult to identify, but using them in the context of learning and education may be necessary to understand how the learning process of students may be affected.

Correlating the cultural aspect of the learner and learning epistemology is a relatively new area of science education investigation. Research has established a relationship of cultural aspect to learning and epistemology to learning separately. However, establishing a unique attribute of the learner using the learner's cultural background and epistemology provides a new perspective of cultural aspect in the learning process in that it can bring significant contributions in instructional planning and curricular designs. This view is in consonance with the claim of Jordan, Carlile, & Stack (2008) that formal education reproduces culture. They further implied that students' cultural perspectives influence how they construct knowledge. Similarly, cultural background influences cognitive style and motivation. Aikenhead (2001) argued 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. The strategies adhere to "autonomous acculturation" that emphasizes learning western science content but still embracing one's culture and tradition.

In the Philippines, the vision of the basic education curriculum is geared towards the theme "going global by being local", an idea that conforms to those pursued by the basic education sector through the Basic Education Reform Agenda (BESRA, 2006-2010). BESRA contains a set of policy actions that focus on addressing the country's Education for All (EFA) objectives by the year 2015. As inclusions, the objectives focus on 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 attain basic education competencies for all. It is strongly encouraged that every community mobilizes all its social, political, cultural and economic resources and capabilities to support universal attainment of basic education competencies such as achieving basic literacies. The Department of Education created the National Learning System to address the identified goals in support of the policy. The agency's strategies include Alternative Learning System (ALS) centered on community-based informal learning approach where the learners benefit from instruction in their own community aimed at being literate and preserving the community's culture, tradition, and well-being. To this end, the Mother-Tongue-Based Multilingual Education was implemented as one of the national learning strategies to complement both the formal and non-formal education of the Filipino people. Congruent with the directions of BESRA is the major 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. While the former 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 latter is a curriculum that upholds the community's practices, traditions, and source of living and livelihood as central to learning. Specifically, the Philippine education sector recognizes culture as highly identified with languages

and language diversity. After all, the unique ethnicity of the Filipino people highly influences their cultural background.

In the new curriculum, learning science is strongly linked to the development of scientific literacy. Curriculum developers believe increased scientific literacy will help students apply scientific knowledge that will have an impact on their lives-social, health, and environmental. Furthermore, the new curriculum aims to strengthen learning science and technology, including indigenous technologies to preserve the country's varied culture and ethnic groups' distinct traditions. Capitalizing, therefore, on the unique cultural and epistemological beliefs of the learners may instill in them the interest and desire to learn or to develop their unique practices for cultural preservation and conservation. More so, science in the new curriculum is highly integrative and interdisciplinary. The four areas of science separately taught in the different year levels in the old curriculum are now integrated in all year levels in the new curriculum. In the old curriculum, grade 7 students learned the general sciences which included topics from different areas of science, grade 8 students learned biology, grade 9 students learned chemistry, and grade 10 students learned physics. Expectedly, in the new curriculum, the learner should assimilate all four disciplines and view them as complementary and interrelated, not compartmentalized. This requires the learners to have a good grasp of physics to help them fully grasp all the other disciplines integrated in the learning of science in each year level. It is also vital that the learners have a high interest in the subject for them to be enthusiastically involved in absorbing all other science concepts.

Learning science in the old curriculum highlighted a discipline-based approach. Science education is largely influenced by the western system's concept-based and standards-based curriculum. In such a framework, science is commonly taught rationally, logically and analytically. It is assumed that learners may grasp the concepts and skills in science by utilizing standard and new pedagogies advocated by the westerners (e.g. learner-centered paradigm, hands-on and minds-on experiences as well as authentic and alternative assessments). However, Abayao (2003) thought that these western efforts and systems may not fully extract students' interest, much less wholly bring about meaningful learning. In her study of the indigenous people of Ifugao province, she found that there is a gap between what is taught in formal schooling and the needed skills of the indigenous people. They might learn about Shakespeare in school but were ignorant of their own epics such as *Hudhud* and *Alim*. They also study mathematics and even the Egyptian pyramids, but do not know how their ancestors built the spectacular mountains of *pajaw* (rice terraces). History accounts that the 1st formal education of the Ifugaos established by the Americans was the Kaingan school, a system of learning fully received and welcomed by the natives. However, Abayoa pointed a marked decrease in interest to learn occurred, when pupils were subjected to the American curriculum. The same results were found by Korma (1995) and Jenista (1987). Thus, the Philippine's DepEd saw the importance of preservation and conservation of indigenous knowledge to enhance the conditions and lives of the Filipinos.

Filipino learners are categorized based on their respective ethnicity. By percentage, about 21% of the whole Philippine population are Cebuanos who speak Bisaya, 14% are Tagalog and are popularly speaking the national language known as Filipino, 10% belong to the Ilocano group, Hiligaynon comprise 8% of the populations, Bicolanos 7% and the Pangasinenses contribute 2% of the population. These were the identified major ethnic groups by the Department of Education as the focus of responsiveness of the new curriculum. The rest of the population (38%) include the minority groups of the Philippines. It is aimed by the agency that culture and language preservation and conservation be achieved through the unique senior high school curriculum of the major and

minor ethnic groups in the Philippines. Moreover, 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 IP core curriculum cover family life, civic consciousness, environment, health, sanitation and nutrition and economics and income which connect to learning science for scientific and technological literacy and addressing the socio-cultural aspect of the Filipino learners. Among the several ethnic groups, the next largest are the combined population of Bicolanos and Tagalogs. The major condition for their inclusion in the study is their language constancy and standardization. “Bisaya”, the language spoken by Cebuanos is used or spoken in varied ways and styles in different areas. “Bisaya” spoken by the people Cebu differly in many ways and words from those spoken by the people of Bohol. Compared to “Bisaya” of Cebu, “Bicol and Tagalog (Filipino)” spoken by Bicolanos and Tagalogs present and use their language consistently with better constancy and standardization.

Pangasinan is the most difficult to assimilate if not a dying language. Gordon (2005) claimed that Pangasinan as a province, houses several dialects or mother-tongue such as Ilokano and Bolinao. This means that only a few towns in Pangasinan speak “Pangasinan dialect”. With inter and mixed marriages, Pangasinan speakers need to assimilate other languages for the marriage enough to dilute the number of native speakers of the dialect. Communicative status also dictates that a Pangasinan speaker cannot just speak the dialect in front of any one. In fact, the Pangasinan speaker has to shift to the national languages Filipino and English. Out migration aggravated the status of the language and more so Pangasinan as part of the Ilocos region was dominated by the rise of the Ilokano population and language as well leaving less percentage of Pangasinan speakers. Thus, these reasons prompted the research of the cultural dimensions and epistemological beliefs of these specific groups of Filipino learners: Bicolanos, Tagalogs and the people of Pangasinan.

The present study seeks to establish the cultural dimension and epistemological perspectives of Filipino physics students. It is limited to identifying the cultural indices of three ethnic groups of learners and to relate these indices to students’ epistemological beliefs as a way to characterize the unique cultural and epistemological attributes of each ethnic group. Specifically, it attempts to shed light on two questions:

1. What are the similarities and differences of the three different ethnic groups of physics students in terms of cultural dimension and epistemological beliefs?
2. What relationship exists between cultural dimension and epistemological belief per ethnic group?

Literature

On Cultural Dimension

Several studies on indexing the culture of countries identify the dominant culture of the country particularized in different occasions and in varied fields (Ahmad & Majid, 2010; Mankutty, Anuradha & Hansen, 2007; Spector, Cooper & Sparks, 2001). A case in point is the prominent model of Hofstede’s (1994) known as Value Survey Module 1994 (VSM 94). VSM 94 distinguished cultures according to five dimensions: power distance, uncertainty avoidance, individualism/collectivism, masculinity/femininity, and long-term orientation. The model provided scales from 0 to 100 in each dimension for about 76 countries. Each country has a specific position on each scale or index relative to other countries. As Hofstede and Mooij (2010) claimed, even if country scores were originally produced in the early 1970s, many replications of Hofstede’s study on different samples have provided evidence that the country ranking in his data is still valid.

Cultural indexing made its way to the education field, however, through the study conducted by Cronje (2006). He used the improved version of VSM 94 and found out that Hofstede's dimension of power distance explained students' lack of self-confidence and initiative. Students preferred to let the apparently more powerful professor take the responsibility. Furthermore, he explained that the high level of avoidance explained why students required much guidance from the teacher as regards completing the requirements and understanding assessment rubric. A similar study conducted by Baron (2008) named the key differences of the cultural indices from an education perspective to culturally describe the students' learning characteristics.

The Value Survey Module 2008 (VSM 08), a 34-item paper-and-pencil questionnaire, was developed 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 of the respondents. Six were demographic. In addition to nationality, answers to the 28 content questions were foreseen to reflect other characteristics of the respondents such as gender, age, level of education, occupation, kind of work and the point in time when they answered the questions. Thus, comparison of countries should be based on samples of respondents matched on all criteria other than the nationality that could systematically affect the answer. Notably, VSM 08 was aimed at country-level correlation that will produce dimensions of national culture.

Hofstede (2008) described the five cultural dimensions as Power Distance Index (PDI), Individualism (IDV), Masculinity (MAS), Uncertainty Avoidance (UAI), and Long-Term Orientation (LTO).

- *Power Distance Index (PDI)* measures the extent to which the less powerful members of organizations and institutions (like the family) accept and expect that power is distributed unequally. This represents inequality (more versus less), but defines from below, not from above.
- *Individualism (IDV)* -versus its opposite, collectivism - identifies the degree to which individuals are integrated into groups. On the individualist side one finds societies in which the ties between individuals are loose: everyone is expected to look after him/herself and his/her immediate family. On the collectivist side, one finds societies in which people from birth onwards are integrated into strong, cohesive in-groups, often extended families (with uncles, aunts and grandparents) that continuously protect them in exchange for unquestioning loyalty.
- *Masculinity (MAS)* - versus its opposite, femininity - refers to the distribution of roles between the genders which is another fundamental issue for any society to which a range of solutions are found. Studies reveal that (a) women's values differ less among societies than their men's counterparts; while (b) men's values from one country to another contain a dimension from very assertive and competitive and maximally different from women's values on the one side, to modest and caring and similar to women's values on the other.
- *Uncertainty Avoidance Index (UAI)* deals with a society's tolerance for uncertainty and ambiguity; it ultimately refers to man's search for *truth*. It indicates the extent a culture programs its members to feel either uncomfortable or comfortable in unstructured situations. Unstructured situations are novel, unknown, surprising, and different from usual. Uncertainty avoiding cultures tries to minimize the possibility of such situations by strict laws and rules, safety and security measures, and on the philosophical and religious level by a belief in absolute Truth; 'there can only be one Truth and we have it. People in uncertainty avoiding countries tend to be more emotional, and are motivated by inner nervous energy.

The opposite type, uncertainty accepting cultures, proves more tolerant of opinions different from what they are used to; they try to have as few rules as possible, and on the philosophical and religious level they are relativists so as to allow many currents to flow side by side. People within these cultures tend to be more phlegmatic and contemplative, and are unexpected by their environment to express emotions.

- *Long-Term Orientation (LTO)* - versus short-term orientation which deals with Virtue regardless of Truth. Values associated with Long Term Orientation are thrift and perseverance; values associated with Short Term Orientation are respect for tradition, fulfilling social obligations, and protecting one's 'face'.

On Epistemological Beliefs

May and Etkina (2002) claimed that when it comes to learning physics concepts, students' epistemology matters. The forms of epistemological beliefs in learning and academic development originated from the work of Perry (1970). During the past 15 years, epistemological beliefs had emerged as an active research topic (Muis, 2004; Scrhaw & Sinatra, 2004) in the works cited by Phan (2006).

Elby (1999) claimed that Epistemological Beliefs Assessment for Physical Sciences probes students' views along five non-orthogonal dimensions:

- *Structure of scientific knowledge.* Is physics and chemistry knowledge a bunch of weakly connected pieces without much structure and consisting mainly of facts and formulas? Or is it coherent, conceptual, highly-structured, unified whole?
- *Nature of knowing and learning.* Does learning science consist mainly of absorbing information? Or, does it rely crucially on constructing one's own understanding by working through the material actively, by relating new material to prior experiences, intuitions, and knowledge, and by reflecting upon and monitoring one's understanding?
- *Real-life applicability.* Are scientific knowledge and scientific ways of thinking applicable only in restricted spheres, such as a classroom or laboratory? Or, does science apply more generally to real life?
- *Evolving knowledge.* This dimension probes the extent to which students navigate between the twin perils of absolutism (thinking all scientific knowledge is set in stone) and extreme relativism (making no distinctions between evidence-based reasoning and mere opinion).
- *Source of ability to learn.* Is being good at science mostly a matter of fixed natural ability? Or, can most people become better at learning (and doing) science? As much as possible, these items probe students' epistemological views about the efficacy of hard work and good study strategies, *as distinct from* their self-confidence and other beliefs about themselves.

Magno (2011) maintained that beliefs about knowledge and learning had a great deal of influence on the learners' approach in dealing with and constructing information. Further, a close look at the study 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 (Muis, 2004; Schommer, 1990; Schrommer, Crouse & Rhodes, 1994). Categorically, beliefs about structures and certainty of knowledge predicted comprehension and interpretation of information.

Several researchers (Bernardo, 2008; Chan & Elliot, 2004; You, Yang & Choi, 2001) explored epistemological beliefs 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. In the Philippine setting, Bernardo and Calleja (2005) found out that epistemology of learning was basically guided by how educators teach subjects in schools. They further claimed that Filipino instructors created “simple” lesson plans and taught with “minimal effort” by employing simple and light forms of classroom discussion and activities. Bernardo (2008) showed 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”. Further, Filipino pre-service teachers, in the findings of Bernardo (2008) took into consideration their beliefs, values, and feelings as they evaluate which options will bring about optimal teaching-learning outcome. This characteristic may also be evident in Filipino learners. Epistemology and cultural background define the learning pattern and attributes of Filipinos.

Methodology

The study adopted the descriptive design summarized and presented below. Descriptive research design was used to determine the cultural dimensions, epistemological beliefs, and students’ views on culture and language integration in the learning of physics concept.

Table 1: Summary

Focus of the Study	Dimensions	Data Collection/Instruments	Acronym	Data Analysis
Cultural Profiling	Cultural Dimensions <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • 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

Participants

The study involved 385 Filipino physics students identified through purposive sampling procedure. Purposive sampling also known as judgmental sampling is a selection of participants based on the knowledge of the population and the purpose of the study. The selected participants have in them unique cultural characteristic traits that may lead to determining the data needed for the study. From nine ethnic groups, three sample groups were intentionally chosen from which schools were identified, Bicol, Tagalog and Pangasinan. Bicol and Tagalog were singled out on the bases of their language constancy and being standardized, while Pangasinan was made part of the sample group as the dialect is known to be on the verge of extinction, as well as being last (9th) in rank of population. Percentage contributions of the population of the three ethnic groups were determined by taking the population ratio of the identified ethnic group and the total population of the three ethnic groups. From this process, Pangasinan with 13%, Bicol contributed 19.5%, and Tagalog with 68%. Based on these percentages, 50 students formed ethnic group 1 (Pangasinan), 75 students from ethnic group 2 (Bicol) and 260 students from ethnic group 3 (Tagalog). These sets completed the participants of the study.

Several sampling techniques were used to complete the 385 sample respondents for the survey research. From 20 Philippine ethnic groups, three ethnic groups were purposively selected. From a random identification of province, a random choice of public high school (government-owned high school) was done. From the sampling procedure, 50 students (IV-A) from Pangasinan National High School were identified for ethnic group 1: Pangasinan. The same sampling technique resulted in 75 students (IV-A and IV-B) from Bicol Regional Science High School identified for ethnic group 2: Bicol. Finally, 260 students (IV-1, IV-2, IV-3, IV-SS2, IV-6, and IV-8) from Arellano High School for the Tagalog group.

Instruments

Epistemological Belief Assessment for Physical Science (EBAPS). EBAPS is a forced-choice instrument designed to explore students' *epistemologies*, their views about the nature of knowledge and learning in the physical sciences. It is a thirty-item questionnaire on a five-point Likert scale (1-strongly disagree, to 5-strongly agree) developed to measure the epistemological beliefs of students. EBAPS is aimed at high school and college students taking introductory physics, chemistry or physical science. Optimized for algebra-based courses, it adapts very well to the Filipino physics students.

Value Survey Module 2008 (VSM 08). The Value Survey Module 2008 (VSM 08) comprises 34-item paper-and-pencil questionnaire developed for comparing culturally influenced values and sentiments of similar respondents from two or more countries or regions within countries.

Data Collection and Analysis

The survey was conducted in all three groups of learners clustered according to ethnicity. The two instruments (VSM 08 and EBAPS) were administered to the identified 385 Filipino physics students within a specified period. Data were extracted and analyzed as prescribed by each of the identified questionnaires' module or administration manual. Correlation of the VSM 08 indices with the constructs of EBAPS helped deduce major considerations of students regarding knowledge and the cultural correspondence of their beliefs. The correlation was utilized to determine the learning processes and preferences of Filipino physics students in cultural and epistemological perspectives.

Results

The two major goals of the study were to establish similarities and differences of the three ethnic groups of learners in terms of their respective cultural dimensions and epistemological beliefs as well as correlate per ethnicity their respective cultural dimension with their epistemological beliefs. Implications of the results were focused on how these characteristics will affect how students learn science content and concepts in the future.

Cultural Dimension

Cultural dimension of every ethnicity was generated using the VSM 08. The data provided by each ethnic group were interpreted using Hofstede's (2008) cultural index analysis. Presented in Table 2, each of the three ethnic groups was distinctly categorized.

Table 2. Cultural Dimension Indices per Ethnicity

Cultural Dimension	Ethnic 1 (Pangasinan)	Ethnic 2 (Bicol)	Ethnic 3 (Tagalog)
Power Distance Index (PDI)	29.70 (Low)	42.10 (Moderate)	61.66 (High)
Individualism Index (IDV)	31.01 (Low)	41.42 (Moderate)	60.27 (High)
Masculinity Index (MAS)	23.40 (Low)	40.07 (Moderate)	52.83 (Moderate)
Uncertainty Avoidance Index (UAI)	61.36 (High)	45.00 (Moderate)	28.69 (Low)
Long Term Orientation (LTO)	96.20 (High)	91.69 (High)	76.50 (High)

Stewart (2008) provided an interpretation of VSM scores as follows: VSM score > 60 is represented as High (H), 40 > VSM score < 60 are represented as Moderate (M), and VSM score < 40 Low (L). Ethnic group 1 (Pangasinan) had a "Low" PDI, "Low" IDV, and "Low" MAS. On the other hand, UAI and LTO got "High" indices. Ethnic group 2 (Bicol) as "Moderate" in PDI, IDV, MAS, and UAI while "High" in LTO. Finally, ethnic group 3 (Tagalog) rated "High" in PDI, IDV and LTO; "Moderate" in MAS; and "Low" in UAI. Among all the cultural dimension indices, only long term orientation index was rated "High" in all the three ethnic groups.

Corresponding descriptions of high, moderate, and low qualities of cultural indices were also provided by Hofstede (2008). Based from these descriptions, the ethnic groups were described in Tables 3, 4, and 5 according to cultural indices provided by the groups.

Table 3. Ethnic Group 1 (Pangasinan) Hofstede's Interpretation

Cultural Dimension	Hofstede's Interpretation
LOW PDI: (Power Distance Index)	<ul style="list-style-type: none"> de-emphasizes the differences between citizen's power and wealth stresses equality and opportunity for everyone

LOW IDV: (Individualism Index)	<ul style="list-style-type: none"> • more collectivist nature with close ties between individuals • reinforces extended families and collectives where everyone takes responsibility for fellow members of their group
LOW MAS: (Masculinity Index)	<ul style="list-style-type: none"> • demonstrates low level of differentiation and discrimination between genders • females are treated equally to males in all aspects of the society
HIGH UAI: (Uncertainty Avoidance Index)	<ul style="list-style-type: none"> • shows low tolerance for uncertainty and ambiguity • rule-oriented society that institutes laws, rules, regulations, and controls in order to reduce the amount of uncertainty
HIGH LTO: (Long Term Orientation Index)	<ul style="list-style-type: none"> • prescribes to the values of long-term commitments and respect for tradition • supports a strong work ethic where long-term rewards are expected as a result of today's hard work

Ethnic group 1 (Pangasinan) exemplified a culture that believes that equality and opportunity for everyone should be stressed. The low individualism index described the group as collectivist in nature and low masculinity defined these people as promoting gender equality. On the other hand, people of Pangasinan had low tolerance for uncertainty and ambiguity. This finding matches exhibiting rule-orientedness which defines the people of Pangasinan as capable of mobilizing and working best when they are governed by rules and regulations. The idea of being controlled by conventional rules provides certain amount of certainty on their part which allows them to act confidently over things and occurrences. Finally, these learners, prescribed to values of long-term commitment and respect for tradition, support the idea of strong work ethic that when they work hard today, long-term rewards await them.

Table 4. Ethnic Group 2 (Bicol) Hofstede's Interpretation

Cultural Dimension	Hofstede's Interpretation
Moderate PDI: (Power Distance Index)	<ul style="list-style-type: none"> • not very decisive if they are for equality of power or not
Moderate IDV (Individualism Index)	<ul style="list-style-type: none"> • neither collectivist nor individualist
Moderate MAS (Masculinity Index)	<ul style="list-style-type: none"> • not critical about gender equality • are not agreeable either on the concept that male should be the dominant sex
Moderate UAI (Uncertainty Avoidance Index)	<ul style="list-style-type: none"> • neither tolerant nor intolerant about uncertainties and ambiguities
HIGH LTO	<ul style="list-style-type: none"> • prescribes to the values of long-term commitments and respect for

(Long Term Orientation Index)	<ul style="list-style-type: none"> tradition supports a strong work ethic where long-term rewards are expected as a result of today's hard work
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Ethnic group 2 (Bicol) typified a culture that neither believed that equality and opportunity for everyone should be stressed or not. The moderate individualism index proved that the group was neither collectivist nor individualist, while moderate masculinity means non-critical on gender issues. However, Bicolanos do not accept either that male is the dominant sex. They have moderate tolerance for uncertainty and ambiguity which means that they may resort to case- to - case basis of rule-orientedness. Bicolanos are typically described by their cultural dimension as people who cater to the belief that everything that happens is brought about by the current occurrences. This means that they may not want rules and regulations governing them all the time. But when there exist cases that would need such, they may want to re-establish these rules for regularity and smoothness of their work. Finally, these learners prescribe to values of long-term commitment and respect for tradition. Just like the people of Pangasinan, they support the idea of strong work ethic that when they work hard today, long-term rewards awaits them.

Table 5. Ethnic Group 3 (Tagalog) Hofstede's Interpretation

Cultural Dimension	Hofstede's Interpretation
High PDI: (Power Distance Index)	<ul style="list-style-type: none"> are more likely to follow a caste system that does not allow significant upward mobility of its citizens
High IDV: (Individualism Index)	<ul style="list-style-type: none"> high individualism may tend to form a larger number of looser relationships
Moderate MAS: (Masculinity Index)	<ul style="list-style-type: none"> are not agreeable on the concept that male should be the dominant sex
Low UAI: (Uncertainty Avoidance Index)	<ul style="list-style-type: none"> high tolerance for variety of opinions less rule-oriented, more readily accepts change, and takes more and greater risks
HIGH LTO: (Long Term Orientation Index)	<ul style="list-style-type: none"> prescribes to the values of long-term commitments and respect for tradition supports a strong work ethic where long-term rewards are expected as results of today's hard work

Ethnic group 3's (Tagalogs') high power distance index described their adherence to a caste system where significant upward movement of a citizen is disallowed. High individualism index promoted more individualism rather than collectivism. Thus, less extended family was supposedly observed in this group. Married family members would live with their new families separate from their parents and siblings. Moderate masculinity index showed being non-critical on gender issues, but just like the Bicolanos, the Tagalogs do not accept either that male is the dominant sex. Low uncertainty avoidance index promoted high tolerance for variety of opinions. Unlike the people of Pangasinan who exhibited high uncertainty avoidance index which described them as people who

are intolerant of varied opinions, the Tagalogs, however, can exist in a society of multi-opinionated people who may interpret rules and regulations from different perspectives allowing them to still act according to the rules and regulations, but with different motivations and on a unique and diverse perspectives and views. As learners, the Tagalogs appeared as more risk takers in exploring diversity in the society. Finally, these learners prescribed to values of long-term commitment and respect for tradition just like the Bicolanos and the people of Pangasinan.

Hofstede’s (2008) interpretations of the cultural indices were focused on the general cultural attribute of the ethnic group as presented in the previous tables. Using Baron’s (2008) research outputs, the indices were interpreted per ethnic group, as construed in educational perspective shown in Tables 6, 7, and 8.

Table 6. Ethnic Group 1 (Pangasinan) Educational Perspective of Cultural Values and Beliefs

Cultural Dimension	Educational Perspective of Cultural Values and Beliefs
LOW PDI: (Power Distance Index)	<ul style="list-style-type: none"> • Teachers treat students as equals and vice versa • Student-centered education • Students initiate some communication in class • Teachers are experts who transfer impersonal truths • Quality of learning depends on two-way communication and excellence of student • Lower educational levels maintain more authoritarian relations • Educational system focuses on middle levels • More modest expectations on benefits of technology
LOW IDV: (Individualism Index)	<ul style="list-style-type: none"> • Languages in which the word ‘I’ is not pronounced and Self-concept in terms of group • Students’ gender and religion are important for their identity • Teachers deal with pupils as a group • Pupils’ individual initiatives are discouraged • Schoolchildren report ethnocentric, traditional views • Students associate according to pre-existing in-group ties • Students will not speak up in class or large groups • Students’ aggressive behavior is bad for academic performance • Purpose of education is learning how to do
LOW MAS: (Masculinity Index)	<ul style="list-style-type: none"> • Friendliness of teachers is appreciated • Students’ social adaptation is important • Failing in school is a minor accident • Public praise to encourage weak students • Average student is the norm • Curriculum choices are guided by intrinsic interest • Students take own problems less seriously • Teachers give equal attention to girls and boys • Boys and girls study same subjects • Small gender difference in perceptual abilities
HIGH UAI: (Uncertainty)	<ul style="list-style-type: none"> • Teacher as well as students are the sources of knowledge • Students are active

Avoidance Index)	<ul style="list-style-type: none"> • Classroom is guided by rules and regulations
HIGH LTO: (Long Term Orientation Index)	<ul style="list-style-type: none"> • Persistence and perseverance • Relationships ordered by status and this order observed • Nice people are thrifty, sparing with resources • Face considerations common, but considered a weakness • Adaptation of traditions to new circumstances • Reciprocation considerations are problematic, risk of overspending • Leisure time not so important • Most important events in life will occur in future • Large share of additional income saved

Table 6 presented the cultural values and beliefs in educational perspective of ethnic group 1 (Pangasinan). The educational characteristics of Pangasinan learners can be presented in four sections. Gender equity is very pronounced in this group of learners with low masculinity index. As described, boys and girls study the same subjects, small marked differences in perceptual abilities are observed, and their gender together with their religion are important for their identity. On the area of teacher traits that would match the cultural background of the learners, it includes equal treatment of students whether advanced students or not, teachers as experts, equal treatment for male and female students, and focus on group rather than individual students. As learners, Pangasinan students can initiate communication in class as well as they like to be associated with groups to characterize their need for social adaptation. In the aspect of pedagogy, curriculum and class environment, Pangasinan learners are characterized as adapted to a student-centered class. Friendliness of teacher is appreciated where two-way communication and excellence of students are deemed necessary for quality learning. The purpose of education that matched the student-centered paradigm is learning how to do. Pangasinan learners tend to be successful in attaining meaningful learning when the curriculum choices are guided by the learners intrinsic interests which include acknowledgement of rules and regulations, authoritarian relation for the lower educational levels, and appreciation of what the teacher as well as what the students can contribute as knowledge. These traits are deemed necessary in preparation for the future events, the most important events in life. Thus, Pangasinan learners tend to view learning as something that will prepare them for bigger events in their future lives.

Table 7. Ethnic Group 2 (Bicol) Educational Perspective of Cultural Values and Beliefs

Cultural Dimension	Educational Perspective of Cultural Values and Beliefs
HIGH LTO: (Long Term Orientation Index)	<ul style="list-style-type: none"> • Persistence and perseverance • Relationships are ordered by status and this order observed • Nice people are thrifty, sparing with resources • A sense of shame is common • Face considerations common but considered a weakness • Adaptation of traditions to new circumstances • Reciprocal considerations are problematic, risk of overspending • Leisure time is not so important • Most important events in life will occur in the future • Large share of additional income saved

Research such as those of Baron (2008) and Hofstede (2008) have not described cultural values and beliefs in educational perspectives for moderate rating. Ethnic group 2 can best be described by long term orientation index only. Accordingly, high long term orientation index suggested that Bicolanos were persistent, persevering and thrifty. From the education perspective, they were very much concerned with “face” value and the concept of “shame” worked best for them to plan for a good future.

Table 8. Ethnic Group 3 (Tagalog) Educational Perspective of Cultural Values and Beliefs

Cultural Dimension	Educational Perspective of Cultural Values and Beliefs
High PDI: (Power Distance Index)	<ul style="list-style-type: none"> • Students are dependent on teachers • Students treat teachers with respect, even outside class • Teacher-centered education • Teachers initiate all communication in class • Teachers are gurus who transfer personal wisdom • Quality of learning depends on excellence of teachers • Authoritarian values are independent of education levels • Educational system focuses on top level • Fewer Nobel Prizes in sciences per capita • High expectations on benefits of technology
High IDV, (Individualism Index)	<ul style="list-style-type: none"> • Languages in which the word ‘I’ is indispensable for understanding • Students’ gender and religion are less important for their identity • Self-concept idiocentricity • Teachers deal with individual pupil • Pupils’ individual initiatives are encouraged • Schoolchildren report ‘modern’ views • Students associate according to tasks and current needs • Students expected to speak up in class or large groups • Students’ self-esteem is good for academic performance • Purpose of education is learning how to learn
Low UAI: (Uncertainty Avoidance Index)	<ul style="list-style-type: none"> • Students’ overarching fear of the unknown led them to work together • Teacher as the source of knowledge • Students are passive learners •
HIGH LTO: (Long Term Orientation Index)	<ul style="list-style-type: none"> • Persistence and perseverance • Relationships ordered by status and this order observed • Nice people are thrifty, sparing with resources • A sense of shame is common • Face considerations common, but considered a weakness • Adaptation of traditions to new circumstances • Reciprocal considerations are problematic, risk of overspending • Leisure time is not so important

- Most important events in life will occur in the future
- Large share of additional income saved

Table 8 presents the cultural values and beliefs in educational perspective of ethnic group 3 (Tagalog). The educational characteristics of Tagalog learners are shown in four sections. Gender equity is not that pronounced in this group of learners with a moderate masculinity index unlike the Pangasinan learners. As described, Tagalog learners are not very critical about gender, but they still do not agree that male is the dominant sex. They consider their gender and religion not that important for their identity. Teachers for Tagalog learners are expected to initiate communications in class since they are looked up to by these learners as the “guru” from whom they are able to get wisdom. They also hold that quality learning does not depend on them as learners but is dependent on the teacher’s excellence. Thus, in a school setting with a strong teaching force, Tagalog students are expected to excel. Teachers are also presumed to deal with individual students and not as groups of learners. These teacher traits are paired with students’ characteristics as teacher dependent and passive learners. The students treat teachers with respect even outside classes. They associate to task and current needs and are often indulged to report modern views. They do not advocate their old practices and have high expectation on the benefits of technology. They are consistently encouraged as individuals but sometimes they tend to cling to groups due to the fear of the unknown. On the pedagogical and curricular aspect, the Tagalog learners adhere to a teacher-centered education where the major purpose of education for them is learning how to learn. Unlike the Pangasinan learners, they focused on learning how to learn and advocate student-centered education. Meanwhile, Tagalog learners would best benefit from an educational system centered on the top level. Leisure time is not so important for them and just like the Pangasinan learners, they view education as a preparatory stage for more important life events in the future. The cultural dimensions of the ethnic groups were summarized and compared as shown in Figure 1.

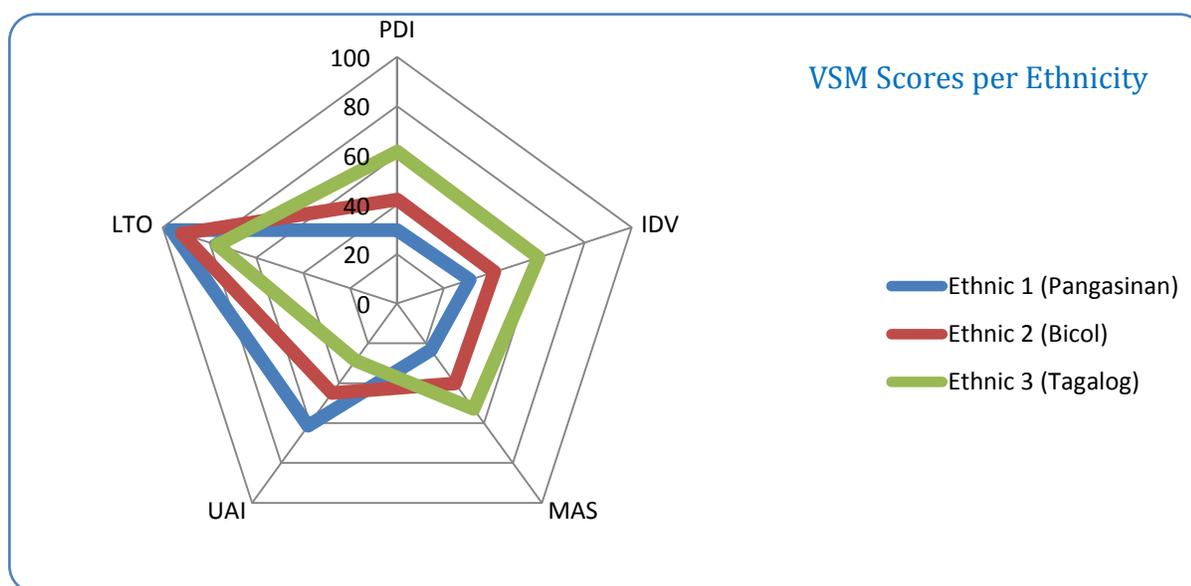


Figure 1: VSM Scores per Ethnic Group

In sum, a radar type chart was presented as an appropriate visual for categories identified as not directly comparable. The data were presented as relative to a focus point. Ethnic group 3 had the

highest PDI, IDV, MAS and LTO. Ethnic groups 1 and 2 had low UAI. Also ethnic group 1 was rated lowest in PDI, IDV, and MAS, as viewed in relation to the focal point, and had the largest deviation from the center as compared with the other groups. Finally, it can be gleaned from the chart that each ethnic group had a distinct set of cultural indices which made them unique as persons and as learners.

Epistemological Beliefs

Epistemological beliefs of every ethnicity were generated using the EBAPS data provided by each ethnic group. (See the scores per construct of the epistemological beliefs of each ethnic group in Appendix A). As relative to the 5-point Likert scale, most scores in each construct of the ethnic groups fell within the range of 1.6 to 3. With the scoring range and the corresponding qualitative description per range provided in Appendix B, each ethnic group distinctively represented unique epistemology in relation to Physical Science.

Table 9. Epistemological Beliefs Assessment for Physical Sciences Scale per Ethnicity

Epistemological Belief Axis	Ethnic Group 1 (Pangasinan)	Ethnic Group 2 (Bicol)	Ethnic Group 3 (Tagalog)
Structure of Knowledge	Poorly Sophisticated	Poorly Sophisticated	Poorly Sophisticated
Nature of Learning	Moderately Sophisticated	Moderately Sophisticated	Poorly Sophisticated
Real Life Applicability	Moderately Sophisticated	Poorly Sophisticated	Moderately Sophisticated
Evolving Knowledge	Moderately Sophisticated	Poorly Sophisticated	Poorly Sophisticated
Source of Ability	Highly Sophisticated	Highly Sophisticated	Moderately Sophisticated

From table 9, one sees that Ethnic group 1 (Pangasinan) showed a poorly sophisticated structure of knowledge, perceiving physical science knowledge (Physics and Chemistry) as bits and pieces sans connections and structures. They also viewed this (physical science) knowledge as merely facts and formulas. By contrast, this group was rated as moderately sophisticated in nature of learning, real life applicability, and evolving knowledge. Hereon, it is expected that these students have better notion than naïve beliefs in the identified constructs. If these learners believed that learning is not just absorbing facts, they can be classified as those who are adapted to higher order thinking skills lessons. In perceiving science as vital in both the classroom and in real life, they hold that knowledge in physics is not wholly absorbing facts, but taken with a mixture of relativism based on opinions and evidence-based reasoning. Source of ability was rated high for ethnic group 1 which meant that these learners believed that being good in Physics was not solely determined by the learner's natural ability, but to a great extent how they extended effort to provide good and better learning.

Ethnic group 2 (Bicol), on the contrary, had shown poor sophistication in structure of knowledge, real life applicability, and evolving knowledge while moderate sophistication in real life applicability and source of ability. Overall, the Bicolanos' epistemological beliefs fell within the score range for poor sophistication. The Bicolanos perceived physical science knowledge (Physics and Chemistry) as bits and pieces sans connections and structures. Equally, they viewed this (physical science) knowledge as mere isolated facts and formulas, a belief that went with how

poorly they see real-life applicability of science much less science concepts, particularly physics concepts, are only valuable in the classroom. Justifying this belief of importance of science was how they viewed the evolution of physics concepts as set of facts, rules and laws. However, the moderately sophisticated sense on the nature of learning suggested that these learners held that learning is far from absorbing facts, hence they can be categorized as those who are adapted to higher order thinking skills lessons. The same rating was observed in the source of ability to learn, which showed that for them learning and doing good in science blended natural ability and considerable amount of effort.

Finally, ethnic group 3 (Tagalog) has shown naïve belief or poor sophistication in the following axes: Structure of Knowledge, Nature of Knowing and Learning, and Evolving Knowledge. Just like the two other ethnic groups (Pangasinan and Bicol); the Tagalogs recognized physical science knowledge (Physics and Chemistry) as bits and pieces sans connections and structures, as further verified by their naïve beliefs in the nature of knowing and learning and evolving knowledge. Learning science, particularly physics, was learning bits and pieces of facts which were set as concrete and fixed. However, the same was rated as moderately sophisticated in real-life applicability and source of ability. The Tagalogs viewed learning science as important in daily life. Being good in science, specifically physics, fused natural ability and good sweat. The epistemological beliefs of the ethnic groups were combined and compared as shown in Fig. 2.

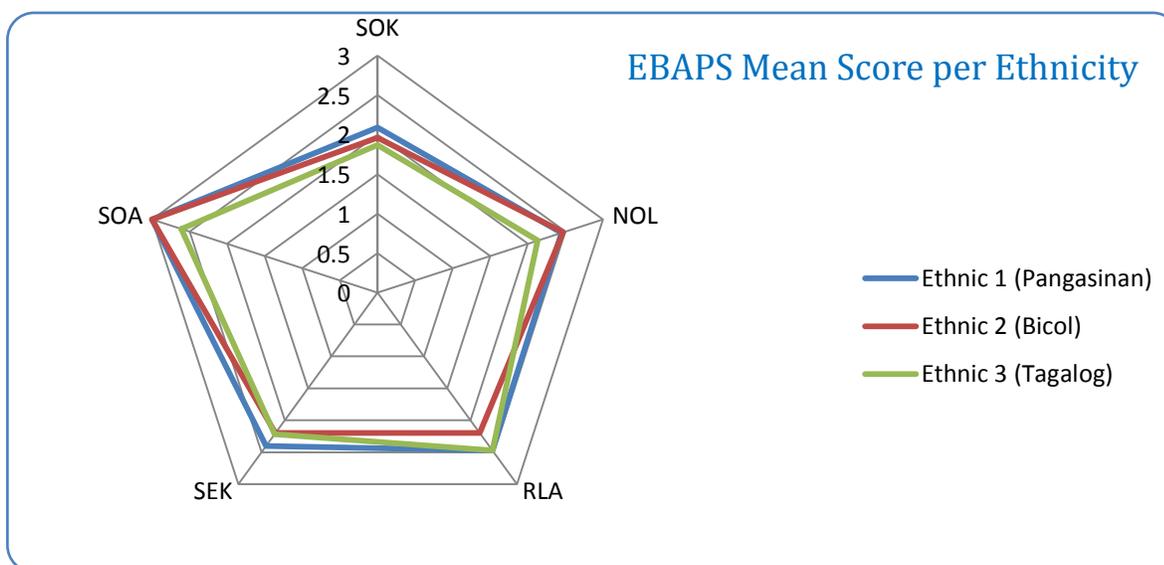


Figure 2: EBAPS Scores per Ethnicity

To sum up, Figure 2 showed the radar chart of the epistemological beliefs constructs or axes per ethnic group. Ethnic group 3 scored lower than the two other ethnic groups in all axes implying that these learners possessed naïve beliefs that hinder good cognition in physics. Ethnic group 1 scored highest when compared with the two other ethnic groups in all axes. Their beliefs were geared towards expert-like category and had a good chance of attaining physics achievement.

Correlating Cultural Indices with Epistemology beliefs axes

Correlation of cultural indices with epistemological belief axes was done using statistical software (SPSS) correlation application. Each index was paired with each axis; each EBAPS axis correlated with the other axes and each cultural index related with the other indices.

Table 10. VSM-EBAPS Construct Paired Correlation

VSM-EBAPS Paired Constructs		Ethnic 1- Pangasinan (N=50)	Ethnic 2- Bicol (N=74)	Ethnic 3- Tagalog (N=50)
Value Survey Module	Power Distance – Individualism			**0.195
	Power Distance –Long Term Orientation			*-0.128
	Masculinity – Power Distance			**0.195
	Uncertainty Avoidance-Individualism			*-0.132
VSM-EBAPS	Source of Knowledge – Individualism	*0.285	*0.230	
	Nature of Knowledge and Learning –Uncertainty Avoidance		*0.259	
	Real-Life Applicability – Individualism			** -0.161
	Real-Life Applicability – Masculinity	** -0.380		
	Source of Ability to Learn – Individualism			*-0.149
EBAPS	Source of Knowledge-Source of Ability to Learn			**0.166
	Source of Knowledge-Evolving Knowledge	*0.343		
	Source of Knowledge-Source of Ability to Learn	*-0.334	*0.278	*-0.248

**Correlation is significant at the 0.01 level
level

*Correlation is significant at the 0.05 level

Table 10 showed the correlation of cultural dimension indices with epistemological axes. Source of knowledge is positively correlated with individualistic index and evolving knowledge. Students' perception of physical science as bits and pieces sans connections and structure and that knowledge in physical science are mere facts and formulas are positively related to belief in group work, ethnocentric and traditional views, and focus of education as learning to do. Their perception of knowledge as facts and formulas positively relates to their views on the knowledge in physics as not wholly facts, but with a mixture of relativism based on opinion and evidence-based reasoning. However, the Pangasinan learners' perception of physical science as bits and pieces sans connection and structure negatively correlates to their belief on source ability where they adhere to the idea that being good in physics is not solely determined by the learner's natural ability. Negative relation exists between masculinity and real-life applicability. Low gender discrimination is negatively associated with classroom and real life importance of science as well as adaptation of these learners to higher order thinking skills.

Bicolanos (ethnic group 2) showed negative correlation between source of knowledge and individualism index, exactly opposite to that exhibited by the Pangasinan learners. Student perception of physical science as bits and pieces without connections and structure is negatively related to their belief in case to case basis of association. Source ability and uncertainty avoidance showed positive correlation. Learners' belief that being good in physics is not solely determined by the natural ability of the learner and learners' extended effort would provide good and better learning matched positively with their moderate uncertainty avoidance index that portray neither being tolerant nor intolerant about uncertainties and ambiguities. Finally, the study yielded a positive match between the learners' source of knowledge and source of ability to learn. Their

perception of physical science as bits and pieces positively related to their belief that being good in physics is not solely determined by the learner's natural ability.

Among the three ethnic groups, Tagalog learners manifested the most number of correlations. Positive correlation was observed in power distance index and individualism as well as in the cultural dimension of these learners registering high power distance index and high individualism index. Teacher-centered education, quality learning appears as teacher-dependent, educational system focused on top levels and high expectations of the learners on the benefits of technology positively matched learners' preference for self-concept ideocentricity, modern views, self-esteem as good for academic performance and learning how to learn perspective of education. Contrastingly, negative correlation was observed with power distance index and long term orientation index. While teacher-centered framework is advocated by these learners, masculinity positively matched with power distance index.

Tagalog learners view gender equity as equality of power. Negative correlation exists between power distance and uncertainty avoidance and so did in high power distance index and low uncertainty avoidance index. In a teacher-centered education, the teacher is the source of knowledge where students are passive learners. Positive correlation between individualism and real-life applicability also exists to imply that while Tagalog learners exhibit high concept of individualism, they also perceive that learning is not just absorbing facts. Adapted to higher order thinking skills, they extend the importance of classroom science in real life. Source of knowledge is positively matched with evolving knowledge. Their perception of physical science as bits and pieces, facts and formula sans connections and structure matched with their idea that physics does not consist wholly of facts, but with a mixture of relativism based on opinion and evidence-based reasoning. Positive correlation of source of ability and individualism exists and as students tend to be individualistic, they also view that being good in physics is not solely determined by the learner's natural ability, but extended effort is needed to promote good and better learning. Finally, negative correlation was observed between source of knowledge and source of ability. Just like Pangasinan learners, their view on physical science as bits and pieces or facts and formulas with no connections and structure is intensified when learners believe that being good in physics is naturally brought about by the learner's ability.

Discussions

Primarily, the research distinguished the similarities and differences of three ethnic groups of Filipino physics students as regards cultural dimension and epistemological beliefs so as to establish correlations, if any, between cultural dimension indices and epistemological beliefs axes. Table 11 presents the learners characteristics in cultural and epistemological perspectives.

Table 11. Summary of ethnic group learning characteristics based on cultural dimension indices and Epistemological beliefs

Ethnic Groups	Cultural Inclination	Epistemological Beliefs
Ethnic Group 1 (Pangasinan)	<ul style="list-style-type: none"> • Student-centered • Collectivist • Gender equality • Rule-oriented classroom • Persistence, perseverance 	<ul style="list-style-type: none"> • Perceive science as bits of knowledge, fact and formulas • Movement towards Higher Order Thinking Skills (HOTS) • Science is important in real-life. • Physics knowledge is evidence-

	and thriftiness	based
Ethnic Group 2 (Bicolanos)	<ul style="list-style-type: none"> • Neither student-centered nor teacher-centered • Moderate inclination to both collectivism and individualism • Persistence, perseverance and thriftiness 	<ul style="list-style-type: none"> • Good work and practice promote learning • Perceive science as bits of knowledge, fact and formulas • Science is only for the classroom and not important to everyday life • Natural ability determines learning • Good work and practice help promote learning
	<ul style="list-style-type: none"> • Teacher-centered • Individualist • Rule-oriented classroom • Moderate inclination to gender equality • Persistence, perseverance and thriftiness 	<ul style="list-style-type: none"> • Perceive science as bits of knowledge, fact and formulas • Science is important in real-life. • Good work and practice promote learning

The above list was culled from the results of ethnic groups of learners' individual cultural dimension indices and epistemological beliefs. Each group of learners had a distinct blending of cultural inclination and epistemological beliefs that made them unique groups from the other ethnic groups. This finding agreed with the claim of Ogden (2004) that culture has been observed to vary within Chinese areas, that is, equally held true in Philippine ethnic groups.

Culturally, learners from Pangasinan adhered to learner-centered paradigm and collectivist nature. However, as these learners progress to being individualistic, their views about physical science move towards being conceptual, coherent, and structured to connote that this set of learners may succeed in attaining meaningful learning through differentiated learning approach. The implication is that activities may be provided in groups as their cultural indices suggested, however, the teacher must be aware of the different attributes of the varied groups, if not the uniqueness of the individual students within the groups. Also they practiced gender equality and were adapted to a rule-oriented classroom. In fact, in a classroom where gender equity is practiced, students' interest in science also increases for these set of learners. Collaborative work may still work with them, but it should be emphasized that groupings should be gender free.

Pangasinan also support strong learning ethics where long-term rewards were expected as results of today's hard work. These learning characteristics partially matched the Eastern learning traits found by Lin, Liu, Lee, & Magjuka (2010). Accordingly, Eastern learners reflected collectivism and femininity attribute of their culture, a feature highly correlated with how they viewed learning as a product of good work and good amount of practice. Although they see science concepts as bits of knowledge, facts and formulas, Pangasinan learners can also move towards higher order thinking skills, found also evident in their belief that learning science was not limited in the classroom, but held equally vital in real-life. From these characteristics, a teacher may design physics and chemistry lessons adhering to learner-centered paradigm. Activities should focus on students doing the tasks to acquire knowledge and teacher facilitating the tasks assigned to students.

Students in this group are hard-working, hence difficult activities and problem-based learning scenarios may be given to them to boost their concept of science as something useful and applicable both in the classroom and in real-life situations. Though they adhere to collaborative work, the teacher must be aware of the differences of the group. Differentiated instruction may also come into play to address the needs of the respective groups while maintaining gender bias free atmosphere in the classroom.

On the other hand, Bicolanos tended to be neither learner-centered nor teacher-centered. Most probably they adopted each paradigm on different cases of learning scientific knowledge to match their moderate inclination to gender equality as well as collectivism and individualism. Probably, they learned science knowledge in different combinations of cultural traditions and beliefs; however, they still upheld the tradition of perseverance, persistence and thrift. Just like their Pangasinan counterparts, Bicolanos viewed science knowledge as bits of information, facts and formulas, affirming that they would acquire good science, particularly physics knowledge by merely memorizing them. In the school setting, inquiry-based instruction may not work well with these set of learners, since they are better adapted to the traditional lecture-discussion, individual recitation, exercise or drill, and seat work, as evidenced by the negative correlation of individualism and source of knowledge. There were indications, though, that these learners can shift towards a higher order thinking skills learning environment, as compared to their counterparts. They even believed that science is only for classroom use, but just like the other groups, they believed that practice, good work and natural ability would promote learning.

Contrary to the learning culture of Pangasinan learners, the Tagalogs preferred a teacher-centered paradigm and individualistic mode of learning. A positive match of power distance index and individualism index indicates that as the classroom setting becomes more individualistic, teacher-dependence is also heightened. Collaborative strategies may not work well with these students. By extension, lecture-discussions of science concepts, teacher-centeredness of the classroom setting, individualized set-ups and differentiated learning may be appropriate with these learners. These findings matched the observations of Lin, Liu, Lee, & Magjuka, (2010) that in Eastern education, teachers have the absolute authority such that students are not encouraged to question or challenge a teacher's knowledge. However, just like the learners of Pangasinan, they practiced rule-oriented classroom with persistence, perseverance and thriftiness. Gender equality for this ethnic group is not an issue in learning. As a common belief among the three ethnic groups, science is composed of bits and pieces of information, facts and formulas, but unlike the first two ethnic groups, the Tagalogs showed no indication of movement towards a higher order thinking skills (HOTS) classroom environment, although they perceived science as important in daily life. Finally, the Tagalogs shared common belief that good work and continuous practice fused with natural ability help promote science, specifically physics learning.

The uniqueness exhibited by each ethnic group was further verified by the distinctly correlated cultural dimension index and epistemological belief pairs in each ethnic group that strengthened and verified the ethnic groups' cultural inclination vis-à-vis their respective epistemological beliefs. More pointedly, however, relationships of culture and beliefs established in each of the ethnic groups were not meant to pass judgment on an ethnic group, but could serve as bases to effectively plan the curriculum and contribute to a more meaningful instructional design to help preserve the culture, tradition and indigenous knowledge of the ethnic groups. Admittedly, this conforms to the vision of UNESCO that we preserve our very own culture for sustainability through sustainable education.

As culture is observed to distinguish one ethnic group from another in terms of educational preference and perspective, the study can be extended to other ethnicity to completely determine the Filipino learners' unique learning characteristics. This paradigm can also be extended to include cognitive styles of the students per ethnic group in characterizing the uniqueness of each distinct ethnic group of learners in the Philippines.

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Appendices

Appendix A: Epistemological Beliefs Assessment for Physical Sciences Scale

Epistemological Belief Axis	Ethnic Group 1 (Pangasinan)	Ethnic Group 2 (Bicol)	Ethnic Group 3 (Tagalog)
Structure of Knowledge	2.09	1.96	1.87
Nature of Learning	2.45	2.47	2.13
Real Life Applicability	2.47	2.20	2.47
Evolving Knowledge	2.40	2.20	2.22
Source of Ability	3.00	3.00	2.61
OVER ALL	2.41	2.38	2.20

Appendix B. Epistemological Beliefs Assessment for Physical Sciences Scale

Sophistication Level	Score Range	Scaled Score Range
Extremely Sophisticated	3.5 – 4.0	87 – 100
Highly Sophisticated	3.4 – 3.0	86 – 75
Moderately Sophisticated	2.9 – 2.4	74 – 60
Poorly Sophisticated	2.3 – 1.6	59 – 40
Unsophisticated	1.5 - 0	39 – 0