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Ethno-Scientific Teaching Approach, Student Proficiency, and Attitude Toward Science and Ethnic Culture

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Abstract

This study aimed to determine the effect of ethno-scientific teaching approach on first year high school students' learning in science. Such approach was applied to a class of 40 students while the conventional teaching approach was used in another class of 40 students. The results indicated that students from ethno-scientific and conventional teaching groups did not differ in their performance in science proficiency test. It was found that the students' attitude towards science, ethnic culture, and their proficiency in science were significantly and positively correlated. This study is intended to make teaching in multicultural communities more effective and meaningful. Aside from getting the students to develop a positive attitude toward science and ethnic culture, the infusion of aspects of the practices, beliefs, and artifacts of various cultures in teaching science concepts is expected to help improve students' proficiency in the subject.

Keywords: science attitudes, proficiency in science, ethnic culture

Ethnic diversity is a social reality here and abroad (Hettne, 1993). "Ethnicity" has been used in various contexts to mean culture, economic and political strategy, or social relation. For Abuso (1981), one of the common conceptions of ethnicity is that it is an identity phenomenon. As an identity, ethnicity is tied to distinctive traditions or cultural heritage such as language, regional/geographical location, and religion (Abuso, 1981). He emphasized that the purpose of identity definition is to structure interaction.

For a country with plural societies and no particular ethnicity like the Philippines, ethnicity is also known as a form of collectivism (Reyes-Boquiren, 2003). To have mutual

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respect for other group identities and to celebrate diversity are believed to be noble ends. Reyes-Boquiren (2003) said that the common aspect of a group's ethnicity may be based on their cultural heritage such as language and geographical location—not biological or physical differences. It may thus be said that a positive attitude toward one's own ethnic culture and respect for other peoples' cultural identities form the real concept of ethnicity. This is the same notion celebrated by *e pluribus unum*, which promotes a society of diverse people bound by common democratic values (Carreon, 2003).

Research shows that ethnicity is among the most powerful predictors of proficiency in learning (McDougall, 2003). To tell whether students are becoming more and more proficient in school, one must know whether they can successfully accomplish class tasks, if given all the instructional demands (Tikunoff, 1985). With regard to achieving science proficiency, UNESCO (1991) encouraged that demands in instruction be geared toward understanding other peoples' cultures. Science instruction should also focus on global concerns and in helping students increase their concept understanding and science process skills. This may be manifested in their habits of cooperation and teamwork.

Concerning ethnicity and student proficiency, several researchers found that the former affects the latter (IAEP, 1992; NAEP, 1994; IAEEA, 2000; and APA, 2005). In an international study on science proficiency, the highest-performing 13-year-old pupils came from Taiwan, Korea, and Switzerland (IAEP, 1992). Studies conducted by NAEP (1994), IAEEA (2000), and APA (2005) reported that white students performed better than Asian/Pacific Islanders, Hispanic, and black students. On the other hand, Neathery (1997) said that ethnicity might not be a predictor of proficiency in science; even minorities performed with as much success as non-minorities in the science subtests of the Science Research Associates standardized achievement test for grades four to 11.

In the Philippines, the results of the study conducted by Carreon (2003) showed that students from a private school in Isabela who were exposed to Multicultural Physics Teaching Approach (MPTA) and Non-Multicultural Physics Teaching Approach (NMTA) have comparable mean scores in the concept understanding test after the treatment. Peralta (2000) suggested that recent times saw structural changes that influenced gradual gravitation toward cultural convergence; this may be a possible explanation for the findings of Carreon's study. Thus, Carreon (2003) and Neathery (1997) had similar findings about the relationship between ethnicity and science proficiency.

In 2006, Sabo-O emphasized that attitude towards learning is greatly influenced by sound methodology, procedures, and techniques that reflect one's personal experiences and interests. These factors make learning more meaningful and relevant to students. The National Science Education Standards of the Unites States likewise supports this view on motivation and learning (NSES, 1999). Locally, the Culture-Responsive Curriculum for Indigenous People (CCIP) responded by developing and implementing the Third Elementary Education Project (TEEO). This project emphasized that curriculum should be indigenized; learning should relate to the comprehension of the local environment and culture (CCIP, 2002).

Neathery (1997) reported that, using multiple correlations, science proficiency correlates with attitude toward science. On the other hand, Penwell (2004), Neathery (1997), and Carreon (1993) concluded that ethnicity is not an indicator of attitudes toward science since their studies showed that minorities and non-minorities had comparable ratings. It is therefore implied that the students had neither positive attitude change, which was associated with motivated behavior, nor negative attitude change which was linked to less motivation as stated by Berg (2005).

The consolidation of the perspectives mentioned about ethnicity and science proficiency and ethnicity and attitudes toward science led to the conceptualization of this study. This work sought to test whether science proficiency, attitude toward science, and attitude toward ethnic culture are correlated, since no studies have mentioned the correlations that might exist among these variables.

Research locale

Iba, the capital of Zambales, has a total land area of 15,338 hectares. It is bounded by the town of Botolan in the South, Palauig in the North, mountain ranges in the East, and the China Sea in the West (Fig. 1).

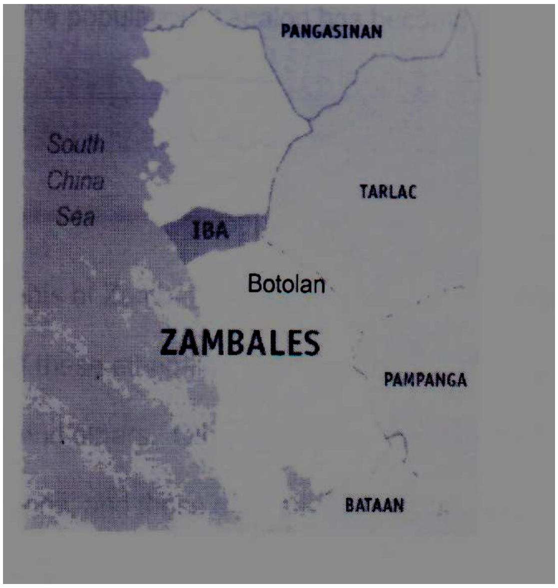

Figure 1. A map showing the municipality of Iba, Zambales.

For the past two decades, Iba's population has been a mixture of different ethno-linguistic groups from Pampanga, Pangasinan, Bataan, and Batangas. Accessibility to employment and business was a major reason for the influx of different ethno-linguistic groups from the provinces mentioned. While Ilocano and Sambal are spoken by many in the population, Tagalog has become the common language spoken in Iba.

Participants

Two freshmen classes from the Zambales National, both composed of 40 students, were involved in this study. The students, predominantly female in both classes, were between 11 and 13 years old. One class was randomly selected and exposed to ethno-scientific teaching approach; the other was taught using the conventional way of teaching science or the non-ethno-scientific teaching approach. Both classes had the same science teacher. Students from the ethno-scientific class were organized into groups based on their ethno-linguistic background (Fig. 2).

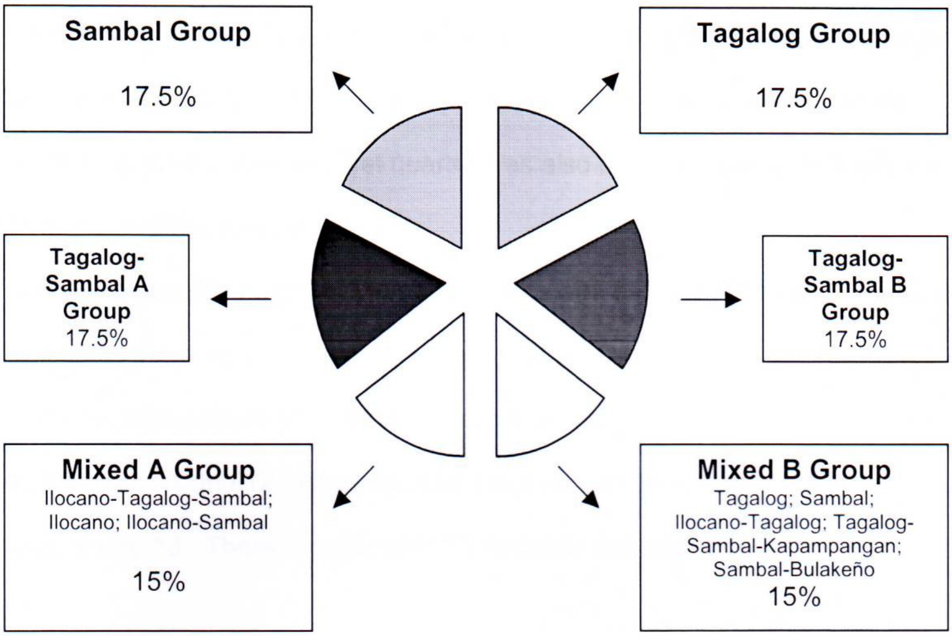

Figure 2. Percentage composition of the ethno-scientific class.

Figure 2 shows that students were more or less distributed equally to the following ethno-linguistic groups: Sambal, Tagalog, Tagalog-Sambal A, Tagalog-Sambal B, Mixed A, and Mixed B. Seven Sambal students were classified as the Sambal group; seven were named as the Tagalog group. Those who identified themselves as Tagalog-Sambals were divided into two groups. Three Ilocano-Tagalog-Sambal students were assigned to Mixed A together with an Ilocano-Sambal, and two Ilocano students. Two Tagalog students, together with two Sambals, an Ilocano-Tagalog, a Tagalaog-Sambal-Kapampangan, and a Sambal-Bulakeño were assigned to Mixed B.

The average grade of the students in science during the first quarter was also considered when assigning student groupings for both the ethno-scientific class and the conventional class. The latter was composed of 40 students, 26 females and 14 males. The ethno-scientific class also had 23 females and 17 males. The conventional class or the control group, with 40 students, 26 females and 14 males, was also divided into their respective groups according to their average in science in the previous quarter. The conventional class had 5 males and 16 males under the age 13. On the other hand, in the ethno-scientific class, there were more females than males in the age-group between 11 and 12. However, there was an equal distribution of males and females at age 13.

Instruments

Four instruments were used in the study: (1) ethnicity survey-inventory; (2) science proficiency test; (3) attitude scale toward science; and (4) attitude scale toward ethnic culture. All of these researcher-made instruments were examined and validated by a panel of experts. The instruments underwent revisions based on the panel members' suggestions. Prior to the experimentation phase, the instruments were pilot-tested on 41 freshmen from the special science section of a school in the same locality. The students were also from various ethno-linguistic groups. The internal reliability of the science proficiency test and the attitudinal scales were calculated using Cronbach alpha. After establishing a relatively high reliability, the instruments were used as the pretests and posttests in the study.

Ethnicity survey-inventory. This researcher-made survey-inventory has two parts. The first part of the instrument consisted of three items and was used to determine the ethno-linguistic group of the students and their parents. The second part of the instrument, which included a sample answer after the pilot-test, surveyed the ethnic practices and beliefs of the students in terms of preparation and cooking of food, planting, fishing, celebrating festivals, health care and personal hygiene, care for the environment, animal reproduction, and pest-control. The responses of the students were arranged according to their ethno-linguistic groups and were used as database of ethnic culture.

Science proficiency test. The purpose of this test is to assess student proficiency in terms of understanding and applying concepts as well as the processing skills required in general science. The distracters in the test items are the common misconceptions of general science students. The test consisted of 30 multiple-choice items and covered the following topics: Natural Phenomenon (1 item); Properties, Classification, and Composition of Matter (3 items); Physical and Chemical Changes (3 items); Energy in Changes (2 items); Highly Organized Structure of Living Things (9 items); Interactions Between Living Things and Their Environment (5 items); Cycling of Matter (4 items); and Balance of an Ecosystem (3 items). The Cronbach alpha reliability of the test was 0.736.

Attitude scale toward science. A Likert-type instrument consisting of 20 items was a 40-item test prior to validation. The items in this instrument considered the factors that affect learning as compiled by Pintrich and as mentioned in the study of Berg (2005). Each item was rated based on this five-point scale: 5 for strongly agree (SA); 4 for agree (A); 3 for undecided (U); 2 for disagree (D); and 1 for strongly disagree (SD). However, scoring was reversed for negatively constructed statements. The obtained reliability coefficient (Cronbach alpha) of the test was 0.814.

Attitude scale toward ethnic culture. A Likert-type instrument consisting of 20 items originally drawn from a 40-item test was used to measure the attitude of students toward their ethnic culture. The test was deemed appropriate by the researcher to represent ethnicity, as described by Reyes-Boquiren (2003). Reyes-Boquiren (2003) mentioned that ethnicity is ultimately the sense of having mutual respect for other identities or communalism, living, and celebrating diversity organically.

The questionnaire covered the common features of attitude toward ethnic culture such as sense of belonging, sense of achievement, appreciation of ethnic practices, beliefs, and artifacts. Each item was rated based on this five-point scale: 5 for strongly agree (SA); 4 for agree (A); 3 for undecided (U); 2 for disagree (D); and 1 for strongly disagree (SD). However, scoring was reversed for negatively constructed statements. The obtained reliability coefficient (Cronbach alpha) of the test was 0.805, which means that the instrument accurately measured the attitude of the students toward their ethnic culture.

Teaching approaches

The ethno-scientific class and the conventional class were taught the same topics for the second quarter. The content of evaluation materials was parallel in both classes. The medium of instruction was English. Both classes were taught consecutively for 75 minutes, five times each week, for eight weeks. The time spent in each class, which was 16 % of each school day, was the time allotted for a special science class in one grading period of a regular academic year. The treatment, which was conducted in each class for 40 meetings, was implemented in the presence of the cooperating science teacher.

Each class was divided into six groups. The ethno-scientific class was divided based on two factors: the students' ethno-linguistic groups and their average grade in science from the previous quarter. The latter was the sole basis for the groupings in the conventional class. Each group was asked to create its own name and to elect a leader, an assistant leader, a secretary, a runner or keeper of materials, a timer, and a monitor. Each was also given points for every trivia question answered correctly, for complete materials brought for activities/experiments, and for tasks accomplished correctly.

A. Ethno-scientific teaching approach

The implementation of the ethno-scientific teaching approach was based on the recommendations for teaching science of the CCIP (2002) and the Science for All movement (UNESCO, 1991) which are: (1) the content, language, symbols, designs, and purpose of the curriculum should be linked to day-to-day experiences and goals of the children; (2) theory should be linked to practice, human purpose, the quality of life, and in-school experience to out-of-school experience; and (3) teaching and learning should begin from the beliefs, interests, and learning skills that students bring to the classroom and should help each of them extend and revise their ability and understanding.

The approach included strategies gathered by the researcher through survey, observation, and interview to implement cooperation among ethno-linguistic groups, relevance to ethnic culture, and sensitivity to the learning needs of each ethno-linguistic group. To foster cooperation within an ethno-linguistic group, respect toward contributions of each member was encouraged. It lessened the problem of low student motivation under usual classroom situations. Experience showed that more adept members of the group often become motivated to tutor the less able students. For instance, during one weekend, each group was asked to observe an organism in any of the following areas near their chosen locality: bay, river, pond, grassland, rice field, and/or forest. This is for an activity about the characteristics of living things. The data obtained were checked by the leader and the assistant leader. The secretary wrote the report on Manila paper, and the runner and monitor reported the output to the class. To develop respect to other ethno-linguistic groups, other members of the class were encouraged to ask questions and share relevant information regarding the output of the reporter. To ensure the relevance of the lessons to the ethnic culture of the students, aspects like beliefs, practices, and artifacts/objects were integrated. For example, the sample output below (Table 1) included the organism's local names, the delicacies their ethno-linguistic groups made out of it, and some other beliefs. The topic was about the characteristics of living things.

Table 1
Sample output from the ethno-scientific lass (Activity: It's Alive!)

	**Seahorse** **Tagalog:** ***Kabayong-dagat*** **Sambal:** ***Kabayong-ambay***
Characteristics	***How it happens?***
Growth	Usually, it grows up to 5 inches
Development	Egg > baby seahorse > mature seahorse (adult)
Adaptation	It is well adapted to marine environment
Response to stimuli	It is naturally afraid of crabs, which are its predators. Storms can tear it from its holding place and cast it ashore until it dies of exhaustion
Reproduction	A female seahorse lays her eggs in a pouch on the belly of a male seahorse. The male seahorse carries the eggs until they hatch and are ready to leave his pouch.
*Trivia	There are some Sambals who include dried seahorses in their native delicacy *Sinigang*.

The ethno-scientific teaching approach also practiced sensitivity to the learning needs of the ethno-linguistic groups, which were collected through the survey given to the class. In school, more members of each ethno-linguistic group preferred group activities to individual ones, written to oral tests, games to making written report of experiments, and laboratory activities to lectures.

B. Conventional teaching approach

The conventional class was different from the ethno-scientific class because the aspects of ethnic culture were never integrated in the lessons and activities. Conventional strategies such as lectures, discussions, take-home worksheets, and science activities used by the school in teaching science to first-year students were applied to the class. Table 2 shows the comparison between the ethno-scientific and conventional activities. Highlighted are the activities that involved aspects of the students' ethnic culture.

Table 2
Comparison of ethno-scientific and conventional activities

Topics	Ethno-scientific activities	Conventional activities
Natural phenomena	concept mapping on *lanum/danum*; learning stations; creative output related to ethnic practices; discussion; quiz	concept mapping on water; learning stations; creative output; discussion; quiz
Substances and mixtures	inside our ethnic kitchen (listing 5 artifacts and 5 delicacies of each ethno-linguistic group); kitch-ethno-mics (preparing ethnic substances and mixtures); discussion; quiz	inside our kitchen; food party; discussion; quiz
Physical and chemical changes	magic tricks; learning station 1: Rosel leaves (alas-dose plant as used by the mixed group) and dried Kamias fruit (Sambal group); 2: wooden displays; 3: bagoong isda (Tagalog-Sambal group); 4: window blinds made by aetas (Mixed group); charades of ethnic practices; discussion; quiz	magic tricks; learning stations on everyday changes; charades on everyday changes; discussion; quiz
Energy involved in changes	discussion using tables that summarize ethnic practices; duiz	discussion; quiz
Characteristics of living things	*Biag ni Lam-ang* (Life of Lam-ang); It's Alive! (observation of an organism in their community); drawing of characteristics of ethnic plant and/or animal; discussion; quiz	concept mapping; table completion; reporting a plant/and or an animal and its characteristics; drawing characteristics of a living thing; discussion; quiz
Cells	analogy about the parts of a cell using the people and establishments in Zambales; plates of animal and plant cells; discussion; quiz	identification of parts; research work; plates of animal and plant cells; discussion; quiz
Ecological systems	ethno-*henyo* (ethno-genius; memory game which included ethnic species discussed in the lesson on characteristics of living things); bio-ethno-rama (diaroma depicting ecosystems, food chains, and food webs in Zambales); discussion; quiz	diorama; identifying food chains and food webs in each diaroma; discussion; quiz
Maintaining balance in an ecosystem (follow-up lesson of ecological systems)	making a newspaper showcasing the diverse ethnic culture of their ethno-linguistic group and how their practices and beliefs contribute to the balance in the different ecological systems in their province; discussion; quiz	slogan making; discussion; quiz

Results and discussion

Science proficiency

Prior to the treatment, the mean pretest scores obtained by both classes were comparable. Before instruction, the ethno-scientific class had higher proficiency in science, as indicated by the mean pretest score of 61% in the science proficiency test. The conventional class obtained a lower mean pretest score of 59%.

The mean posttest score obtained (p=0.123) by the ethno-scientific class in the science proficiency test was higher at 77% than that of the conventional class (74%). This implies that the results of the science proficiency test of both classes were comparable after the treatment (Table 3).

Table 3
Comparison of mean posttest scores in the science proficiency test

Class	Number of cases	Mean*	SD	t-value	Significance level (one-tailed)
Ethno-scientific	40	23.00 (77%)	3.623	1.167	.123
Conventional	40	22.10 (74%)	3.264		

Note. Perfect score = 30; percent mean score in parentheses

An important factor that would explain the results would be the nature of classes involved in the study. Both classes belonged to the special sciences classes. The students were asked to study well and to strive to have good grades in science regardless of the approaches implemented in their classes.

A comparison of both classes' performance per item (Table 4) indicates that the ethno-scientific class and the conventional class significantly differed in terms of their proficiency in the science posttest in four out of six items. The highlighted items show where the ethno-scientific class had a higher mean score than the conventional class.

Table 4

Items in the science proficiency posttest where the means of the ethno-scientific class and the conventional class significantly differ

Item number	Topic/Concept	Ethno-scientific class mean score	Conventional class mean score	Significance level (one-tailed)
5	Physical and chemical changes (identifying the type of change taking place in the situation)	.75	.93	.017
10	**Characteristics of living things (inferring the characteristics of living things exemplified in the situation/diagram)**	**.68**	**.10**	**.0000**
16	Parts of a cell (identifying which parts of a cell perform the function)	.53	.73	.033
20	**Ecological systems (inferring the environment where the species can be found)**	**1.0**	**.88**	**.0105**
22	**Ecological systems (inferring the role/type of organism shown in the diagram)**	**.83**	**.55**	**.004**
24	**Cycling of matter (inferring the fate of carbon compounds)**	**.98**	**.88**	**.046**

Students in the ethno-scientific scored higher than the conventional class in an item on living things. The class learned the characteristics of living things by reporting to the class about an ethnic plant or animal near their vicinity and by making illustrations that show how their selected plant or animal species grows, develops, responds to stimuli, reproduces, and adapts to its environment. The report included: (1) picture of actual species; (2) ethno-linguistic name for selected species; (3) information on species' growth, development, response to stimuli, reproduce, and adaptation to their environment; and (4) importance of species to certain ethno-linguistic groups.

Another topic where the ethno-scientific class scored higher than the conventional class was on ecological systems (2 items). During the instructional phase, each group in the ethno-scientific class was asked to identify the organisms found in the area assigned to them. Afterwards, they were asked to take pictures of an ecosystem which may be a pond, river, grassland, rice field, beach, or forest.

After this, each group constructed a bio-ethno-rama (a diorama) showing the ecosystem. The students were also asked to put arrows using yarns or construction paper to show interspecific relationships in terms of food chains and food webs. According to the students, although the activity was hard, they were able to see more closely how organisms were intricately related. This might give an insight why the ethno-scientific class scored higher than the conventional class in an item on ecological interactions.

The ethno-scientific class also scored higher than the conventional class in an item on cycling of matter. The information on the bio-ethno-rama was used in their reporting and discussion.

In this regard, it can be stated that, on a general note, the ethno-scientific teaching approach had no positive effect on the science proficiency of students from both classes. However, it had succeeded in improving the proficiency of the ethno-scientific class about the characteristics of living things, how organisms interact with abiotic factors in ecological systems, and how some abiotic factors are used again in the cycling of matter.

Being able to observe actual objects and/or artifacts of their culture in their actual settings and using them in their activities could have significantly improved the concepts of students on ecology.

The conventional class had higher significant mean posttest scores on items where they were asked to identify the type of change being exemplified in the situation and the part of the cell being described. It was revealed in the survey of learning needs, as well as in the interview that there were students who were unable to adjust to the strategies implemented in their class, like infusing ethnic practices to physical and chemical changes and using the "Zambales' analogy" to discuss the parts and functions of a cell. This is because they prefer to use the methods that are already common to them (e.g. take home written activities that would require the students to derive answers from the reference book).

Attitude toward science

The mean pretest ratings of both classes were comparable prior to the treatment. Before instruction, both classes had a very positive attitude toward science as indicated by mean attitude rating of 75.95 (76%) for the ethno-scientific class and 75.80 (76%) for the conventional class.

After the treatment, the ethno-scientific class had a significantly (p=0.031) higher positive mean rating in their attitude toward science (83.35 or 83%) than the conventional class (79.55 or 80%). This is shown in Table 5.

Table 5
Comparison of mean posttest scores in the attitude scale toward science

Class	Number of cases	Mean	SD	t-value	Significance level (one-tailed)
Ethno-scientific	40	83.35 (83%)	8.347	1.894	.031
Conventional	40	79.55 (80%)	9.559		

Note. Perfect score = 20; percent mean score in parentheses

A comparison of the ratings of both classes per item (Table 6) revealed that there were items where the ethno-scientific class and the conventional class significantly differ in terms of their mean posttest attitude ratings in the attitude scale toward science.

Table 6
Items in the attitude scale toward science posttest in which the means of the ethno-scientific class and the conventional class significantly differ

Item number	Item	Ethno-scientific class mean score	Conventional class mean score	Significance level (one-tailed)
2	I am not the type of student who can be good in science.	3.40	2.93	.02
4	I always think that I will fail in my science tests.	4.05	3.65	.047
13	My teacher believes that I cannot get a high score in science.	4.05	3.55	.018
14	I have not been good in science.	4.18	3.83	.036
16	I will not be able to use any of the concepts I learn in science in order to find a better job in the future.	4.65	4.15	.0015
17	I always do leisure activities before I do science tasks at home.	4.18	3.80	.0385

The table shows that the ethno-scientific class had higher mean posttest ratings in all six items. Since the statements were negatively stated, the scoring for each item was reversed.

The ethno-scientific teaching approach significantly affected the attitude of students toward science. It also succeeded in helping the students in the ethno-scientific class realize that: 1) They can be good in science; 2) They can pass science tests; 3) Their teacher believes they are highly capable of getting high scores in science; 4) Science is relevant to their future job-related undertakings; and, more importantly 5) Prioritizing science-related tasks at home is an important indicator of being highly and positively inclined to science.

It can be stated that the ethno-scientific students were motivated in terms of internal factors (expectancy, affective, and value components) of motivation as summarized by the Pintrich model in the study of Berg (2005). Internal factors refer to beliefs and emotions that are assumed to mediate between the nature (the reward system of the tasks) and the behavior of the student. Furthermore, the expectancy component under the internal factors of motivation is about attributions (item 13). The affective component refers to self worth or confidence (item 2 and 4) and test anxiety (item 14) that a student feels during a learning task.

Item 16, which indicates being able to see that there are science concepts relevant to future job-related undertakings, falls under the value component of the internal factors of motivation where interests or intrinsic and extrinsic goals of students lie. In addition, evidence in motivated behavior of students in the ethno-scientific class is also presented in item 17. This is the choice-behavior factor, one of the three indicators in motivated behavior of students (Berg, 2005).

Attitude toward ethnic culture

The mean attitude ratings of both classes toward ethnic culture were not comparable prior to the treatment. A One-way Analysis of Variance (ANOVA), with pretest as a covariate, showed no significant difference in the mean posttest ratings of the two classes.

Before instruction, both classes had a very positive attitude toward their ethnic culture, as indicated by the mean attitude rating of 74.48 (78%) for the conventional class and 83.05 (83%) for the ethno-scientific class.

The mean posttest attitude ratings toward ethnic culture (Table 7) indicate that the ethno-scientific class (84.55 or 85%) had a significantly (p=0.033) more positive attitude toward their ethnic culture than the conventional class (81.15 03 81%).

Table 7

Comparison of mean posttest scores in the attitude scale toward ethnic culture

Class	**Number of cases**	**Mean**	**SD**	**t-value**	**Significance level (one-tailed)**
Ethno-scientific	40	84.55 (85%)	7.394	1.866	.033
Conventional	40	81.15 (81%)	8.836		

Note. Perfect score = 20; percent mean score in parentheses

A comparison of the both classes' ratings per item (Table 8) revealed that there were six items in which the ethno-scientific class and the conventional class significantly differed in terms of their posttest attitude ratings in the attitude scale toward ethnic culture.

Table 8

Items in the attitude scale toward ethnic culture posttest in which the means of the ethno-scientific class and the conventional class significantly differ

Item number	Item	Ethno-scientific class mean score	Conventional class mean score	Significance level (one-tailed)
1	I cannot learn anything about the beliefs of other ethno-linguistic groups through listening.	3.68	3.23	.025
4	Aetas/Ilocanos/Sambals/others give up easily in their studies.	4.65	4.30	.0135
5	Aetas/Ilocanos/Sambals/others are impatient learners.	4.63	4.23	.0145
9	This school does not give importance to our ethno-linguistic group's culture.	4.45	4.05	.017
10	I cannot learn about the feelings of other ethno-linguistic groups through observing their actions.	3.73	3.30	.017
15	I do not feel happy whenever the traditions, beliefs, and practices of my group are mentioned in the things we study.	4.48	4.23	.0495

The ethno-scientific teaching approach significantly affected the attitude of students toward their ethnic culture. It also succeeded in helping the students in the ethno-scientific class realize that: 1) Their ethno-linguistic group is patient when it comes to studying and learning new things; 2) Their school gives importance to their ethno-linguistic group's traditions; 3) They are capable of learning about the beliefs of other groups by listening; and 4) They are capable of learning the deep feelings of other groups by observing their actions. More importantly, they feel happy whenever insights into their group's culture are mentioned in their studies.

Since the students in the ethno-scientific class believed that the school is giving importance to their traditions (item 9), the expectancy component of the internal factor of motivation has improved. The students' ratings in the contextual factors, which normally influence students' motivation, also improved. Even though the task would give them opportunities to listen or observe other group's traditions and deep feelings, they strongly believed that they could still cope with the challenge of the activity (items 1 and 10). Judging from the result of the significance of item 15, which assessed the affective component of the internal factor of motivation, it can be noted that the students in the ethno-scientific class felt happy and proud whenever their ethnic culture became part of the learning process.

Most importantly, it can be stated that the students in the ethno-scientific class were highly motivated in terms of their level of activity and involvement (motivated behavior factor in student motivation) as mentioned by Berg (2005), because they opted to participate and to be patient while learning (items 4 and 5).

Correlation between variables

Table 9 indicates positive and significant relationships between attitude toward ethnic culture and attitude toward science, and between attitude toward science and science proficiency. Highlighted items show relationships between variables that were found to be significant.

Table 9

Summary of correlations of the posttest proficiency scores and attitude ratings toward science and ethnic culture

Correlations	Pearson	Significance (one-tailed)*
Attitude toward ethnic culture and science proficiency	-.029	.401
Attitude toward ethnic culture and attitude toward science	**.415**	**.000**
Attitude toward science and science proficiency	**.364**	**.000**

Note. Correlation is significant at 0.01 level.

The result of the study was similar to that of Neathery (1997), which stated that ethnicity did not affect the proficiency of students in the science test.

Several factors could give insights into the result mentioned above. One factor could be that the subject (science) itself is inherently neutral in terms of cultural differences (Kitano and Morey, 1997 and Carreon, 2003). Another factor could be that the municipality where most students reside is already highly urbanized. The effects of the structural changes are apparent. These changes, as Peralta (2000) mentioned, indicated gravitation toward cultural convergence. For instance, the types of architecture and clothing that were distinct to their ethnic culture were no longer distinguishable. It could also be a factor that the language used in class discussions was mostly English while Tagalog was the most common language spoken by students after classes. Thus, keen ethnic competition was not observed. Last factor could be that both classes were special science sections and, therefore, students were expected to be proficient in science.

The study of Neathery (1997) and Penwell (2004) on ethnicity and attitude toward science revealed non-significance between these variables. The results of the study indicate a significantly positive correlation between these variables. Their sense of respect toward other ethnic cultures, as well as their sense of communalism, or ethnicity (Reyes-Boquiren, 2003), would improve as their ethno-linguistic group's beliefs, practices, and artifacts are integrated to science concepts, or vice versa.

Perhaps, the activities implemented, which infused the ethnic culture of students were effective in helping the students develop positive attitude toward science. However, during the experimentation phase, there were some students who were not highly aware of their own ethnic practices and beliefs; others could not appreciate the ethnic culture of their classmates. Thus, reactions of students in class discussions varied from amazement to ridicule. In addition, majority of the students in both classes were 12 year olds. This age is the critical stage in the formation of stereotyped information and biased views regarding ethnicity and ethno-linguistic groups (Chinen and Tucker, 2005). A Tagalog student, who obtained the lowest rating in the attitude scale toward science and the attitude scale toward ethnic culture said that, "*Ayoko 'yun 'pag tumatawa 'yung mga kaklase ko sa ibang shini-share (ibinabahagi) ng mga kaklase ko tungkol sa ethnic culture ng iba* (I do not find it amusing how my classmates would laugh about some aspects of the ethnic cultures being shared to the class)."

Like the recent researches of NSES (1999), the results of the study also showed that science proficiency significantly and positively correlated with attitude toward science. According to Eagly and Chaiken (1993), thoughts are stored when positive attitudes are developed toward a stimulus. In addition, they mentioned that these thoughts are then regarded as cognitive structures, which as a result, organize prior knowledge and facilitate higher order thinking skills and information processing. These statements may help elucidate why the ethno-scientific class became proficient in science as well.

Conclusions and recommendations

The following findings were established after the treatment. (1) There is no significance difference between the mean posttest scores in the science proficiency test of the ethno-scientific class and the conventional class. (2) There were four out of six items in which the ethno-scientific class and the conventional class significantly differed in terms of their proficiency in the science posttest. (3) The ethno-scientific class had higher mean ratings in the attitude scales toward science than the conventional class. (4) The ethno-scientific class scored higher than the conventional class on all six items where the two classes significantly differ in their attitude toward science. (5) The ethno-scientific class had higher mean ratings in the attitude scale toward ethnic culture than the conventional class. (6) The ethno-scientific class scored higher than the conventional class on all six items where the two classes significantly differ in their attitude toward science. (7) The relationship between attitude toward science and attitude toward ethnic culture are significantly and positively correlated. And (8) the relationship between attitude toward science and science proficiency were also found to be significantly and positively correlated.

The following conclusions were drawn from the findings of the study. First, the ethno-scientific class and the conventional class were comparable in the science proficiency test since their mean scores did not significantly differ from that of the conventional class. Second, the ethno-scientific class' mean scores on topics about the characteristics of living things, how organisms interact with abiotic factors in ecological systems, and how some abiotic factors are used again in the cycling of matter had significantly improved. Third, the ethno-scientific class developed a higher positive attitude toward science than the conventional class after the treatment. Fourth, the ethno-scientific teaching approach had succeeded in helping the students in the ethno-scientific class realize that they can be good in science, they can pass science tests, their teacher believes that they are highly capable of getting high scores in science, and science is relevant to their future job-related undertakings. More importantly, prioritizing science-related tasks at home, which is an important indicator of being highly and positively inclined in science, was also realized by most students in the ethno-scientific class. Fifth, the ethno-scientific teaching approach had significantly and positively affected the attitude of students toward their ethnic culture. Sixth, it also had succeeded in helping the students in the ethno-scientific class realize that: their ethno-linguistic group has a virtue on being patient when it comes to studying and learning new things, their school gives importance to their ethno-linguistic group's traditions, they are capable of learning about the beliefs of other groups by listening, they are capable of learning the deep feelings of other groups by observing their actions. More importantly, the ethno-scientific teaching approach made them feel happy whenever insights about group's culture are mentioned in their studies. Seventh, the positive and significant correlation between attitude toward ethnic culture and attitude toward science reveals that the students felt positively inclined toward science as they realize that their ethnic culture can be relevant in learning concepts. Eight, the positive and significant correlation between attitude toward science and science proficiency of students show that positive inclination toward science helped improved their proficiency in science. Because the students became motivated in learning science after the treatment, their scores in the science proficiency test got better.

Based on the findings and conclusions of the study, the following recommendations are given:

1. Conduct the study in a regular class, which may not be as science-proficient as the samples in the study. The nature of the class was considered as an important factor why students in both classes were comparable in the science proficiency test. Since the ethno-scientific class and the conventional class belonged to special science classes, they were intrinsically motivated to do well in the subject.

2. Increase the extent of students' observation of aspects of ethnic culture in their actual settings. For instance, being able to observe actual objects and/or artifacts of culture in their actual settings and including them in science activities and discussions could significantly improve the concepts of students on ecology. Not only does the strategy make the students see the relevance of their culture in learning, it could also help the students develop a positive inclination in science and their ethnic culture.

3. Encourage the teachers to promote cultural sensitivity among students, especially for unique ethnic practices, beliefs, and artifacts. In addition, age may pose as an

underlying factor for the development of biased views regarding ethnic culture. Thus, teachers should set good examples and help students realize the essence of ethnicity, which is being able to celebrate and live diversity by promoting positive interactions among different ethno-linguistic groups.

4. Explore other variables like students' participative competency and interactional competency that may correlate with science proficiency, attitude toward science, and/or attitude toward ethnic culture. The study of Tikunoff (1985) in teaching English as a second language revealed that participative competency and interactional competency are correlated. However, no studies are available in science. In addition, the said competencies may also be correlated to science proficiency, attitude toward science, and attitude toward ethnic culture.

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