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ANALYSIS OF INDIGENOUS INFORMAL SCIENCE CAMP ON STUDENTS' LEARNING

Abstract:

The research aims to explore students' learning interest and learning efficacy through a Informal Science Camp. The Informal Science Camp is a science camp designed for elementary school student with a culturally oriented focus. The Informal Science Camp intends to develop a culture-based link between indigenous culture and scientific knowledge, including mathematics, life science and technology, and also incorporate Indigenous culture and life.

The research team had previously developed culture-based teaching curriculum for five different indigenous tribes, including Paiwan, Rukai, Amis, Bunun, and Yami (Tao). The team rewrote the teaching curriculums to incorporate them to become the content of the Informal Science Camp. Unlike one-way learning methods, students were able to explore their own ethnic culture, pass down indigenous wisdom, and discover science knowledge. In the process, researcher used assessments to understand students' learning process and situational interest.

The study is a 4-year project (2014-2017). The project aimed to implement 20 Informal Science at different elementary schools each year. The third year of the Indigenous Informal Science camp were carried out from August 2015 to April 2016. We had implemented the camp in 16 elementary schools, totaling 601 students (306 boys and 295 girls), 75 elementary school teachers, and 36 tribal elders. Among the 75 elementary school teachers, 69 are indigenous (23 Amis teachers, 18 Bunun teachers, 21 Paiwan teachers, 5 Rukai teachers, 1 Yami (Tao) teachers, and 1 Puyuma teachers).

Paired t-tests were used to compare the situational interest, the exploration of science and learning efficacy of students both before and after the camp. We found significant difference in students' situational interest, the exploration of science, and learning efficacy after participating in the Indigenous Informal Science camp. The favorite subjects were "Ocean and I" for Amis curriculum; "Paiwan Traditional Food" for Paiwan curriculum; "Super Hunter" for Bunun curriculum; and "the Cultue of Wood Carving Boats" for the Yami (Tao) curriculum.

Keywords:

Informal education, Assessment model, Indigenous, Science education

Introduction

During the 1980s, the international community set off a wave of "multicultural education" which advocated for education that enabled students to understand their own cultures and respect other diverse culture (Banks, 1993). Indigenous culture contributes as one of the important elements in the diversity background in Taiwan. In 1993, the Ministry of Education in the Republic of China (Taiwan) announced the 5 Year Indigenous Education Improvement and Development Goal to meet the international trend of multicultural education. In 1998, the Education Act for Indigenous Peoples was promulgated to give Indigenous Peoples a legal basis to protect their rights for education. The goal of this act is to develop and promote indigenous education. The initial development for indigenous education focused on indigenous cultures and Indigenous languages, but little attention was placed on indigenous scientific education and research.

In July of 2008, the Ministry of Science announced the Indigenous Science Education Plan (2009-2012) and established the Indigenous Science Education Action Plan. The goal of the plan was to promote indigenous scientific education, to improve the competiveness of indigenous peoples, and to encourage more indigenous scholars and science educators. The plan aims to integrate indigenous communities with more central resources and to develop indigenous scientific learning curriculums and learning activities.

Research on scientific education started to focus on the learning disparity seen among ethnic minorities. Many relevant organizations were established to promote indigenous scientific education. In 1991, the National Science Teachers Association (NSTA) announced the Position Statement on Multicultural Science Education, and then in 1993, used “science for all cultures” as the main theme for its annual meeting. NSTA reiterated that the social context and cultural environments should be considered in the cognitive learning model when investigating scientific education (Fu, 1999).

Even with a late start, Taiwan followed the international trend to promote multicultural education. The Indigenous Science Education Plan is entering its sixth year in 2015. From 2009 to 2013, a series of indigenous science educational curriculum was designed and tested. Small experimental courses began in 2013 to improve curriculum and to adjust the teaching module to best fit the needs of indigenous students. In addition, the Indigenous Non-Conventional Science Camp (INC Science Camp) was developed to promote indigenous scientific education.

Statement of Objectives/Problems

The objectives of the study were to promote scientific curriculum blended with “indigenous culture and life,” and to design and promote the framework of Indigenous scientific education. Additionally, the objectives sought to the implement Indigenous Non-Conventional Science Camp (INC Science Camp).

Study aims

1. Utilize a culturally responsive method to enhance the interest of students in learning.
2. Use INC Science Camp to improve the learning efficacy of indigenous students.
3. Increase participation of teachers and people from the indigenous community in the INC Science Camp in order to benefit everyone in the community

Study questions

1. Did students’ learning interests increase with the culturally responsive method?
2. Did the INC Science Camp significantly improve the learning efficacy of students?
3. What is the benefit for teachers and people from the indigenous community from the INC Science Camp?

Literature Review

Indigenous peoples in Taiwan and Scientific Theories

Indigenous peoples are the earliest residents living in the land of Taiwan, who coexisted with the natural surrounding and utilized the geographical environment to make their lives more convenient. Therefore, Indigenous peoples developed a special scientific wisdom with their worldview.

There is a wealth of scientific knowledge in indigenous traditional culture, and many examples can be found. Mathematic theory of geometry and multiplication are applied on the weaving of Alpinia mats, furthermore, the biological structure of the Alpinia weaving mat is among the important scientific concept taught in the current science curriculum. The famous canoe from the Yami tribe is made with mulberry wood which expands in water, enabling the canoe to be more tightly sealed. The theory behind the floating of the Yami canoe is another important theory in physics. Fu (2004) investigated the making of dry Taiwan shovelijaw carp by the Atayal tribe and analysed the related scientific concepts in each step. In her study, it was found that the traditional life for the Atayal tribe was harsh and it was difficult to obtain fish and meat, therefore, it was critical to preserve the uneaten meat. Drying was the easiest way for food preservation. Elders from the Atayal use salt and cooled cooked rice to make the dry Taiwan shovel-jaw carp. The salt can prevent bad microbes from growing but also allow the good microbe to grow and help the fermentation process. A layer of rice was laid between the carp to make a stack. Under the natural fermentation process, acetic acid was produce giving the salted carp a lightly sour taste which prevent from rotting. Chen's (2009) field study investigated farming and hunting practices, as well as the taro drying process of the Paiwan tribe. The study indicated that indigenous people truly have an objective worldview culturally oriented scientific concepts through the unique their life experiences.

Indigenous peoples utilize the surrounding resources and ingredients to make their lives more convenient. This is another example of how indigenous peoples live in harmony with the natural environment and how a culturally-base science concept was developed. The most important thing is that the traditional knowledge of indigenous peoples in Taiwan is not diverged from the mainstream science knowledge. Indigenous peoples' long term interaction with the surrounding environment enables them to efficiently apply resource to expedite the daily practices in their lives, which also exemplified the advancement of technology. The science concept of indigenous people also evolves with time and forms an important science and culture asset.

Informal Education

The concept of Informal Education was first started in 1960 by British education scholars. In 1970, American education scholars began to advocate the so call Open Education. The core ideas of Informal Education and Open Education are similar; comparing to general learning, Informal Education and Open Education broke the frame of in-class teaching and encouraged active learning, flexible and well-rounded development from both the teachers and students.

Information Education is more often used in science education, Huang (2000) pointed out that science education can be implemented through formal and informal education system to achieve the goal of science education. The in-class learning can encourage students to learn systematic science concepts while informal learning can help students learn outside classrooms. A designed thematic approach can use scientific education resource in the society or in students' daily life to allow students to learn materials of their interests. The key issue for science education at present is how to integrate formal and informal education resources and methods.

Many studies on science education had indicated that informal and formal science education had complementing effect to each other; information science education stresses learning as an active, continuous, comprehensive and personal process. In a informal learning environment, through finding problems, critical thinking, practical hand-on experience, observation, oral and writing records, students develop the essence and attitude toward scientific learning while at the same time, strengthen the idea and actions of active learning (Kelly, 2000, Falk, Storksdieck & Dierking, 2007; Stocklmayer, Rennie, Leonie &Gilbert, 2010). Overall, informal science education focuses on the building of an active and interactive learning environment to develop students' practical experience, which is different from the "learning about learning" and "learning while doing" focuses of formal science education system. As a result, formal and informal education can compensate for the overall learning process (Chuang and Shin, 2008). At the same time, the application of both the formal and informal education can help achieve the ultimate goal of lifetime learning.

Research done by Lo and Chuang (2011) on 6th graders Indigenous students in Hualien County shared similar findings. They used the Legend of White Deer of the Tsao tribe as a preamble to teach about math and science concept, and then famous cartoon characters were used as samples in the problem sets to sparks students' interests in solving math and science problems in group activities. The study found students had high interests in indigenous traditional story which pushed them to learn science concept through informal teaching method. In this teaching module, students also exhibited high learning interests which confirmed the complementary effect of informal and formal education.

Science Camp

This study use the design of a science camp to implement the teaching modules from the Paiwan, Bunun, Rukai, Amis and Yami tribe with new activity designs. The design of the activities of the science camp was made to be active and lively, applying informal teaching method in order to encourage students' active learning initiatives. Science camp provides interesting activities for students to learn about science and develop scientific thinking. In summary, formal education is not the only way to instruct scientific knowledge, activities from informal education can help students understand the concept, theory, and development process behind scientific knowledge.

The science camp implement in this study is an example of situated learning where a design environment was applied to encourage participants' learning efficacy. Situated learning was originated by Scribner (1984) and Suchman (1987). Their research found that human could only obtained limited knowledge in school settings and the knowledge was sometimes significantly different from cognitive learning developed from daily life. This finding suggested that human cognitive activities are limited to the social environment and that the meaning of knowledge is determined by social activities. Suchman pointed out that situated action is the direct action and participation of the social environment of which one develop knowledge. This process of knowledge learning is also a form of social activity; as participants constantly engaged in a real situation during the activity; they kept searching for the meaning of knowledge. However, during the search of the knowledge, the constraint of activity design would limit the knowledge expression and formation.

Informal education and formal education can significantly improve student's short-term and long-term learning when properly integrated. As pointed by research, the learning results of informal education were diversity and had many potential influenced toward attitude, emotion, faith, and value (Hooper-Greenhill, 2007). Student gained educational experiences from informal education which helped cultured interests toward science learning and played an important role for their decision in future career in scientific research (Stocklmayer et al., 2010)

Methodology

Research framework

Indigenous students have unique culture backgrounds. There was wealth of indigenous knowledge in their everyday life and their coexistence with the nature. Indigenous peoples integrated ecology, hydrology and other scientific knowledge into everyday life, however, comparing to the mainstream Chinese society, the main education system seldom applied these culture knowledge in the teaching of Chinese, English, mathematics, social science, and life technology. The lack of indigenous culture in the education curriculum resulted in the lack of interests in schools and science subjects; it also created barriers for indigenous students, especially on long mathematic calculation and scientific formula.

The study recruited five collaborating elementary schools from the Indigenous Focus Schools, which were identified from the Indigenous Education Statistics and Census Report This report is published annually by the Council of Indigenous Peoples in Taiwan. The five schools represented the Paiwan, Rukai, Amis, Bunun, and Yami tribes.

The main theme of the study was the INC Science Camp. The research team developed teaching activities suitable for each of the five tribes. The teaching activities each had four units, and the activities were designed to reflect the characteristics of each tribe, thus linking culture with scientific knowledge. The INC Science Camp was carried out in a format of games and activities. (Figure 1)

The study participants were selected from grades 3-6 (both indigenous and non-indigenous students were eligible). Four teachers from each of the elementary school were responsible for the teaching of the class, with assistance by community elders who served as the cultural teachers. The research team provided course curriculum and activities, guides for teachers, posters, and other teaching materials needed. The participating schools provided the classroom, students, lists for teachers, and other types of hardware, equipment, and administrative supports.

The study then analyzed the learning efficacy of students. This included their interest in science before and after participating in the INC Science Camp and the benefits for the participating staff.

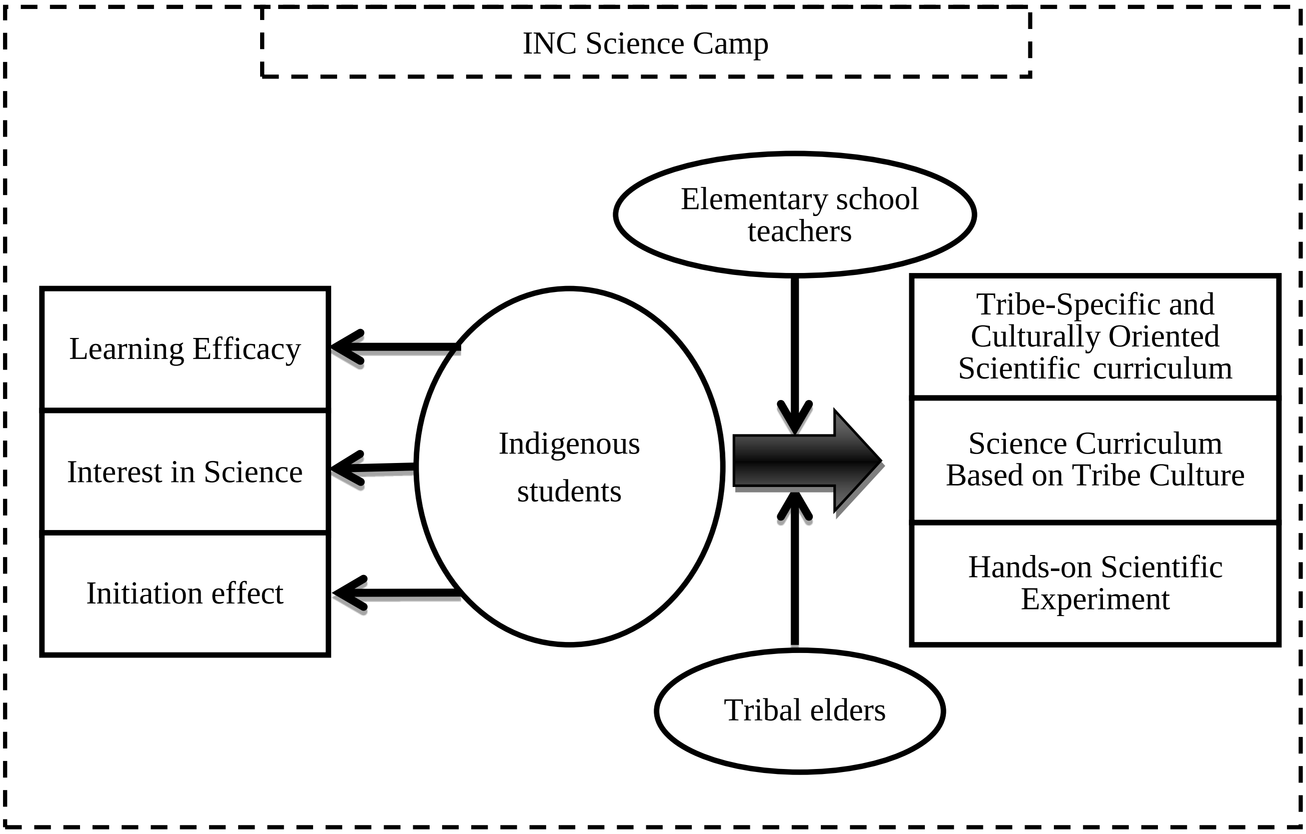

Figure 1 Research Framework (Figure developed by this study).

Research subjects

The research subjects included grades 3-6 who participated in the INC Science Camp in Taiwan, in addition to the teachers and tribal elders who also participated in the camp. Sixteen sessions of the INC Science camp were carried out from August 1st, 2015 to April 30th, 2016 in 5 Amis schools, 7 Bunun schools, 3 Paiwan schools, and 1 Yami school, totaling 601 students, 75 elementary school teachers, and 36 tribal elders.

Research Flowchart

The research project had two stages, totaling 8 years. The first stage (2009-2013) followed curriculum development. The research team explored scientific knowledge in indigenous culture and studied the characteristics of indigenous students in order to develop a culturally oriented scientific curriculum.

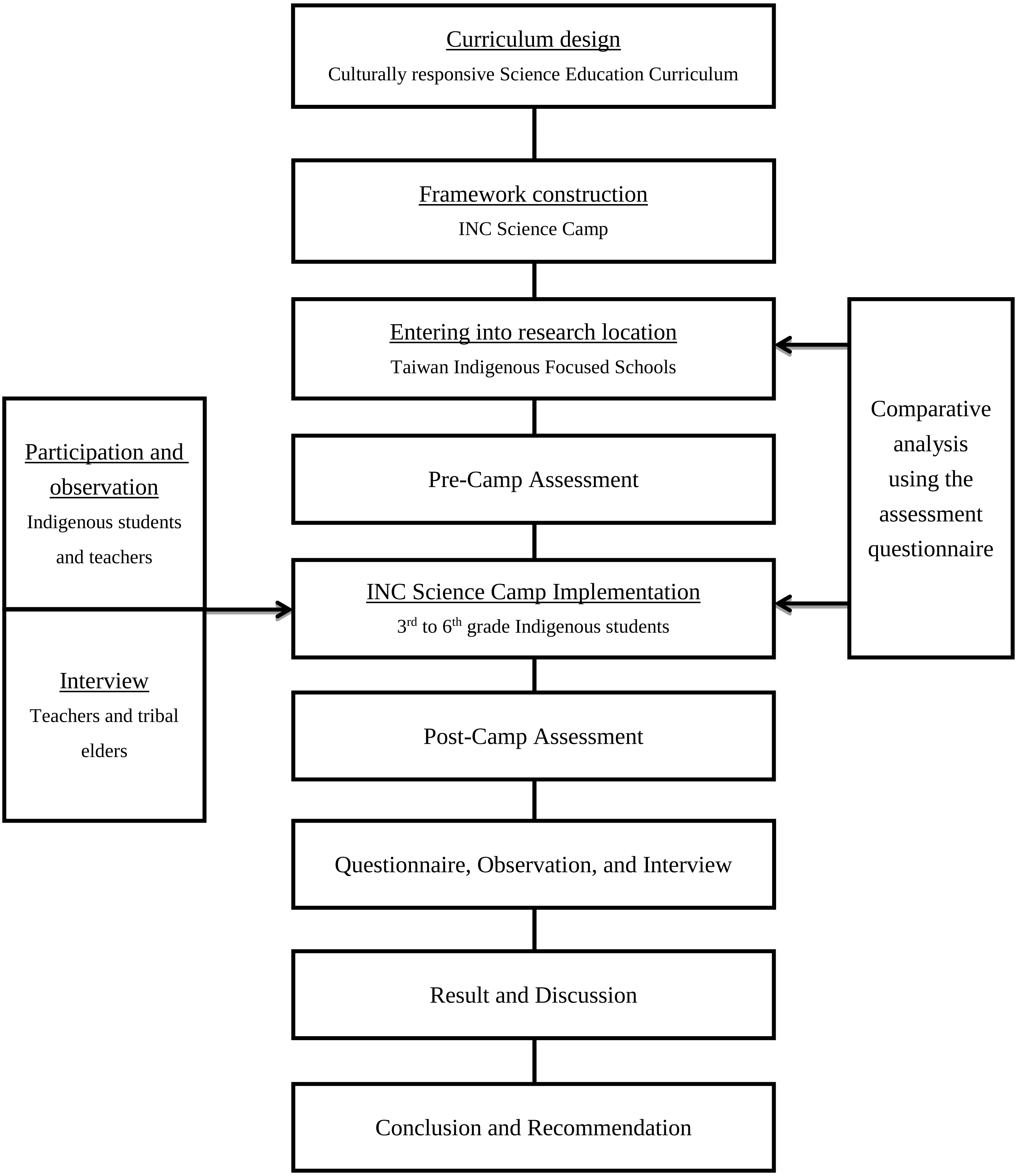

Figure 2. Research flowchart (Reference: figure developed by this study)

The curriculum design utilized indigenous cultural heritage and natural resources, and the curriculum was designed to bridge with the science and life technology curriculum of elementary schools. The second stage (2013-2017) focused on the promotion of indigenous scientific education. The scientific curriculum developed from the first stage of the project was transformed into a science camp with students at the center of the process. The curriculum was carried out by teachers and community elders from each of the schools. The response of both students and teachers was observed and recorded, and unstructured interviews were conducted. Questionnaires were also used to assess the outcome before and after the camp. The research chart (Figure 2) is as follows:

Research Tools and Data Analysis

This study utilized the observation, interviews, and questionnaires for data collection and verification. The results of the study were used as the references to make recommendation for the project.

1. Participant Observation
   Students were passively observed during the INC Science camp by trained researchers. The learning behavior of the indigenous students and the teaching process and methods were recorded to evaluate the application of indigenous culture in scientific education.
2. Interview Survey
   Unstructured interviews were conducted on the instructors teaching the INC Science Camps, including the elementary school teachers and tribal elders. Subjects were randomly selected to evaluate the design of the curriculum and outcome of the camp. The interview process was recorded in writing.
3. Assessment Questionnaires
   The assessment questionnaires used in the study was adopted using the "Learning Interest Scale" from Linnenbrink-Garcia, et al. (2010). The assessment questionnaires were given to the students before and after the camp anonymously (Table 1, Table 2). The Likert Scale was used with the following variables: "I know it very well," "I know it," "okay," "I don't know it," "I don't know it at all."

Table 1 Interest in Science Before and After the Camp

Question Number	Pre-camp question	Post-camp question
1	I think biology class is interesting and catches my attention.	I think the science camp is interesting and catches my attention.
2	I think biology class is fun.	I think the science camp is fun.
3	I like what I learn in biology class.	I like what I learned in the science camp.
4	I think what we do in biology class is interesting.	I think what we do in the science camp is interesting.
5	What I learn in biology class helps me understand other things.	What I learned in the science camp helps me understand other things.
6	Taking biology class helps me understand science.	Participating in the science camp helps me understand science.
7	Taking biology class helps me discover many new things.	Participating in the science camp helps me discover many new things.
8	Taking biology class helps me apply it in daily life.	Participating in the science camp helps me apply it in daily life.
9	Taking biology class makes me like science more.	Participating in the science camp makes me like science more.
10	Taking biology class allows me to know the relationship between indigenous culture and science.	Participating in the science camp allows me to know the relationship between indigenous culture and science.

Source: developed by this study

The section on learning efficacy is specific to the curriculum content, thus, different questions were used (shown in Table 2)

Table 2 Learning Efficacy Section of the Assessment Questionnaire

Question Number	Tribe by	Title

11	Amis	I know what the wild vegetables commonly used by Amis People are.
12	Amis	I know that at the same length, a circle makes the largest area.
13	Amis	I know the Amis dance hand movements.
14	Amis	I understand the scientific principle behind turning hakhak into toron.
15	Amis	I know that iodine can be used to test whether the food contains starch or vitamin C.
11	Bunun	I understand the scientific principles behind making bows.
12	Bunun	I can name the three elements of sound.
13	Bunun	I know the scientific principles of a rotating gyro.
14	Bunun	I could estimate the lunar calendar by observing the changes of the moon .
15	Bunun	I know the speed of the transmission of a medium is the fastest in solid, then liquid, then gas.
11	Paiwan	I understand the scientific principles for making a trap.
12	Paiwan	I know the types of leisure activities for Paiwan people.
13	Paiwan	I know the principle of a symmetry cross stitch.
14	Paiwan	I can know the food commonly eaten by the Paiwan tribe.
15	Paiwan	I know the species of trees that are used by Paiwan people to make the elastic trap.
11	Yami	I can know the food commonly eaten by the Yami tribe.
12	Yami	I can name the three elements of sound.
13	Yami	I know the scientific principles behind making wood carving boats.
14	Yami	I can know the drainage system of lanyu vahay by scientific experiments
15	Yami	I know the speed of the transmission of a medium is the fastest in solid, then liquid, then gas.

Source: This study organized our own questionnaire

The data was presented in quantitative format and was analyzed using SPSS 17.0. The statistical analysis used included both descriptive and regression analysis, which provided the main source to quantify the outcome of the INC Science Camp.

3-1 Descriptive Statistics

Descriptive statistics were used to show the background of student demographics. This included participant numbers from each school, indigenous tribes that students belonged to, gender, grade, favorite subject and favorite activities.

3-2 Paired t-test

Paired t-tests were used to test for significant difference in students' interest in science and students' learning efficacy before and after participating in the INC Science camp.

Result and Discussion

We will first analyze the participation of the camp, show the result from the assessment questionnaire, and conclude using the observation from the unstructured interview.

Teachers and students' performance during the INC Science Camp

This study broke the conventional classroom teaching model and moved the classroom outdoors. Locations included the track and field, under a big tree, in a corridor, and in a kitchen. Three teams were formed from mixed ages and genders to compete with each other. A trained research assistant served as the activity directors and facilitated the flow of activities for the students. There were a total of four activities and each lasted 40 minutes. The activity directors served as the instructors and were teachers from the participating elementary schools. The activities were broken down into 15 minutes of explanation on cultural background, 15 minutes of hand-on practice of experiment for scientific knowledge, and 10 minutes of assessment and review. Each instructor could adjust the teaching pace accordingly to promote differentiated learning. At the end of the 40 minutes session, an alarm went off to signal the students to change to another activity station.

From the above description, we can see that the INC Science Camp tried to build a very active, fun, and dynamic learning environment. The camp encouraged hands-on practice and team work. Indigenous students worked with each other to earn honor for their team, and we found this to be an important factor for students' active participation. Activities with hands-on practice and experiments particularly motivated students' interest in learning. The INC Science camp does not have the restriction of a classroom setting and it did not rely too heavily on media or technology aides. The camp focused on the interaction between teachers and students. Teachers were instructed to encourage students to solve problems, and they gave students instant feedback and praise. More importantly, the teachers incorporate everyday experiences into the curriculum in order to resonate with the interests of students and facilitate the learning process.

Students' outcome from participating in the INC Science Camp

1. Students' basic demographic

   From August 1st, 2015 to April 30th, 2016, a total of 16 sessions were conducted in 5 Amis elementary schools, 7 Bunun elementary schools, 3 Paiwan elementary schools and 1 Yami school, with a total of 601 students from Grades 3 to 6 participating.

Table 3 Numbers of students from each tribe and grade

Tribe	3rd graders	4th graders	5th graders	6th graders	7th graders	8th graders	9th graders	Total students
Amis	21	42	57	57	24	4	10	215
Bunun	19	74	64	102	0	0	0	259
Paiwan	3	26	40	31	0	0	0	100
Yami	0	10	7	10	0	0	0	27
Total	43	152	168	200	24	4	10	601

2. Analysis of students' exploration of science

   Paired t-tests were used to compare the exploration of science of students before and after the camp (Table 4). The average score of students in exploration of science was 3.37 before participating in the INC Science Camp and was 3.81 after the camp. The overall increases in exploration of science were statistically significant.

Table 4 Exploration of science before and after the INC Science Camp

Variable	N	Pre-Camp		Post-Camp		t-value	Significance
		Mean	Standard Deviation	Mean	Standard Deviation		
Exploration of science	601	3.37	0.81	3.81	0.83	13.33	***

***p<0.001

3. Analysis of the interest of students in science

   Paired t-tests were used to compare the interest of students in science both before and after the camp (Table 5). The average score of students in science was 3.42 before participating in the INC Science Camp compared to 3.85 after the camp. The overall increases in interests in science were statistically significant and demonstrate the efficacy of the camp.

Table 5 Interest in Science before and after the INC Science Camp

Variable	N	Pre-Camp		Post-Camp		t-value	Significance
		Mean	Standard Deviation	Mean	Standard Deviation		
Situational Interest	601	3.42	0.81	3.85	0.7680	13.20	***

***p<0.001

4. Analysis of students' learning efficacy
   Paired t-tests were used to compare the learning efficacy of students before and after the camp (Table 6). The average score of students in in learning efficacy was 2.69 before participating in the INC Science Camp and was 3.86 after the camp. The overall increases in learning efficacy were statistically significant.

Table 6 Learning efficacy before and after the INC Science Camp

Variable	N	Pre-Camp		Post-Camp		t-value	Significance
		Mean	Standard Deviation	Mean	Standard Deviation		
Learning efficacy	601	2.69	0.81	3.86	0.76	32.80	***

***p<0.001

5. Analysis of post-camp outcome for each school
   Both the interest of students in science and learning efficacy increased after the INC Science camp. The average scores were all above 3 (Table 7). This showed that the utilization of nonconventional teaching can significantly improve the interest of students in science and learning efficacy.

Table 7 The interest of students in science and learning efficacy for each school after the INC Science Camp

Tribe	School Name	Average Post-Camp Score in Exploration of science	Average Post-Camp Score in Interests in Science	Average Post-Camp Score in Learning Efficacy
Amis	Amis Cilangason tribal school	3.89	3.95	4.01
	Taitung San-Min	3.70	4.56	3.65
	Hualien Shou-Feng	3.72	3.76	3.69
	Hualien Wu-He	3.68	3.87	3.86
	Taitung Tung-He	3.53	3.55	3.60
Bunun	Taitung Chu-Lai	3.89	3.92	4.01
	Nantou Tung-Fu	3.81	3.86	3.78
	Taitung Kuang-Yuan	4.11	4.11	4.06
	Hualien Fu-Hsing	3.99	4.12	3.96
	Nantou Chiu-Mei	4.00	4.01	4.09
	Taitung Luan-San	3.71	3.71	3.92
	Taitung Chin-Ping	3.67	3.92	3.91
Paiwan	Pingtung Ku-Lou	3.50	3.45	3.93
	Pingtung Tsou-Pu	3.89	3.92	4.08
	Pingtung Dimur	3.95	3.94	3.97
Yami	Taitung Yayo	3.71	3.71	3.76

Other benefits for the teachers and people from the community

The unstructured interview targeted questions to investigate the motivation of subjects motivation to participate, the objective they wanted to achieve during the camp, which part of the camp they liked the most, the format of the camp, as well as the benefits from the camp. Most teachers expressed that the motivation to participate in the camp was to “improve understanding for indigenous cultures and to strength indigenous cultural identity for themselves and for the students, in addition to passing on the culture heritage and wisdoms from their ancestors to the new generation”. The teachers believed that the INC Science Camp was able to provide different cultural experiences for the children. “Students were able to gain more knowledge about their own culture through their activities and experiments, and the INC Science Camp helped integrate scientific knowledge into day-to-day activities and discover scientific knowledge in indigenous wisdom”. Teachers expressed that the part they liked the most about the camp was that “it utilized the hands-on teaching model and it applied the contents of the curriculum into the activity modules which significantly helped students to actively participate in the class.” They felt that the relationship between teachers and students were closer and they were able to accomplish the teaching objectives in an easier fashion. The teachers provided very positive feedback about the camp. Some teachers expressed that “it was an innovative way to teach, and by teaming up with students from different grades, students had more opportunities to collaborate and learn from each other." The benefits of the camp included "Understanding the value of indigenous culture, strengthening self-cultural identity, learning how to integrate science and culture in teaching, broadening the thinking of teachers, and encouraging multi-latitude teaching methods."

In addition, the participation from the community and tribal elders is another key element of the project. By working with the community, both the school and the community benefit. The camp not only helped deepen the cultural connotations for the research team, but also allowed the teachers and students to see the true image of their traditional culture. There were four main benefits from the community and tribal elders.

1. The cultural knowledge was beneficial to help the research team adjust the curriculum contents to the needs of each student.
2. The exchange and communication between school and tribal community was established. The cultural teacher was assigned by each of the elementary schools. Therefore, each school became more familiar with the human resources available in the community and the community elders were also able to appreciate the dedication for indigenous education seen in each school.
3. The people in the community as well as the tribal elders learned the teaching methods from the teachers and the research team, helping them to discover the scientific bases which existed in their own culture.
4. This information was very valuable to building a strong teaching force for the third semester indigenous tribal schools which was designed by the Council of Indigenous Peoples.

We acknowledged that it required substantial input and efforts from the teachers to prepare such activities and curriculum. This is another culture, and teachers must become more familiar with it first. Since teachers who are unfamiliar with the culture the students are already used to, they need to put in lots of time and efforts to adjust their mindset and understand the life and culture of the students. After the 16 sessions of INC Science Camp, both indigenous and non-indigenous teachers expressed that linking culture and science together was a new experience for them. The teachers were surprised that scientific knowledge can be integrated into the teaching of culture, and they expressed that teaching one subject in a cross-disciplinary manner was very fruitful. The activities and camp format was a multi-latitude learning experience for both teachers and students.

Conclusion

Under the formal educational institution, indigenous students were repelled by scientific knowledge due to poor performance. They even developed animosity for science which lowered their interest in learning and blocked the advancement of scientific knowledge. Using a fun and nonconventional camp format, indigenous students were able to learn scientific knowledge in their culture. From the statistical analysis of the study, we see that there was a significant increase in the interest of students in science and learning efficacy. The culturally responsive scientific curriculum is more closely related to the life of students. The interactive model strengthens the motivation of students to learn and encourages their interest in basic scientific knowledge.

From the point of view of the teachers, it was challenging to have the teachers from each school be the activity director and instruct the class. However, the research team insisted on having the camp taught by the school teachers. Our interviews and observations proved that we were right in making this decision. First of all, teachers were more familiar with the learning experience of students and there was more interaction between the teachers and students. Second, this helped improve the confidence of teachers in culture and inter-disciplinary teaching of the sciences. Third, the teachers became seeds for the school and the research team for science and cultural teaching.

Indigenous scientific education in Taiwan is not only concerned with the learning methods of students, but also places an emphasis on the development of a teaching force in science.

Recommendations

Based on the results and discussion, the research team came up with the following recommendations:

Most students enjoy the activity format for teaching. These activities helped students to discover problems, and this was very beneficial to the overall instruction of students. Students responded with a very high interest in learning with hands-on experiments and activities In contrast, students motivation to participate was low when instruction .focused too heavily on lecture in order to communicate cultural knowledge.

The results from this study should be carried out in the long term. We have seen significant increases in as interest in the sciences and in learning efficacy in the short term If we can keep the project for the long term, it would be very helpful in understanding the effectiveness of the program and we expect the program to be very valuable in improving the exploration of science and learning efficacy for indigenous students.

For future research, we recommend the extension of nonconventional activities in order to deliver instruction in the sciences g into the formal teaching curriculum.

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