Study on the Promotion of Indigenous Education by Informal Education—the Implementation of Science Education Camps

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Abstract

The conventional schooling is considered the formal education where students acquire knowledge in classrooms. In the formal schooling system, each student receives the same science curriculum. When students did not catch on to the pace with other students, they often lack the opportunity to ask questions and to fully understand the logic and theory behind the science knowledge. Therefore, an informal education can play a significant compensating function for students' learning and development. The informal and open curriculum design such as science camps can incorporate science knowledge with activities to guide students to learn at a gradual pace. In addition, it can include culturally diverse materials which helps expanding students' prospective and making the curriculum more relevant to students' experience.

This study designed an informal education curriculum which integrated the knowledge of indigenous culture in Taiwan. The design of the culturally oriented science curriculum aimed to increase the science interests for indigenous students, and to teach students the traditional culture from different tribes in the science camp. The goals of the study were to understand the positive initiatives for indigenous students to study science, and to develop an effective informal education which can be combined with the formal education, and to include more materials on the traditional culture in Taiwan in the formal education system.

The informal curriculum used in the study was a three-year experimental education program implemented in DaPo Elementary School in Chihshang Township, Taidong County in Taiwan. Students' learning efficacy and level of cultural identity were evaluated. After a two-day science camp, the study observed an increased interest in traditional culture, a significant growth of self-cultural identity among the students, and a significant improvement of students' science knowledge.

1. Introduction

1.1 Research Background and Objectives

With its unique culture characteristics, Indigenous culture is mostly based on the oral and practical learning of daily activities, and often lacks written records. Living in the nature grants a primitive and traditional lifestyle for indigenous peoples. Relaxation and restfulness can be achieved through the practice of traditional culture. As a result, the leisure lifestyle of indigenous peoples is closely associated with traditional culture. Indigenous peoples are the earliest residents on the island Taiwan. They not only learned to coexist with the nature, but utilized the environmental to make life more convenient. Indigenous peoples developed special views of the nature and the world which allow them to use scientific knowledge to live in harmony with the natural environment.

Teaching indigenous children the beauty of their traditional culture through nonconventional method is especially important. Nonconventional education is different from conventional education in that the formal school curriculum emphasizes on teachers lecturing in-class and textbook knowledge. Under the conventional education, the teacher is the active instructor and the student is the passive listener, making it hard to access whether students truly understand and learn the materials, and this is a problem the education sector in Taiwan is concerned about. In addition, the Grade 1-9 Curriculum in Taiwan stresses the importance of "school-base curriculum"and "integrated curriculum"; it encourages teachers to implement diverse teaching methods incorporating with social resource which transforms the role of the teacher from an instructor to a curriculum planner, designer and implementer.

2. Reference Review

2.1 Indigenous peoples in Taiwan and Scientific Theories

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 Dawu 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 Dawu canoe is another important theory in physics. Fu (2004) investigated the making of dry Taiwan shovelijaw carp by the Atayal tribe and analyzed 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 shovelijaw 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.

2.2 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.

2.3 Science Camp

This study use the design of a science camp to implement the teaching modules from the Bunun, Rukai, and Paiwan tribe with new activity designs. Materials from different tribes were added to the main curriculum of the Amis tribe. 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)

3. Research Method

3.1 Method of Teaching Observation

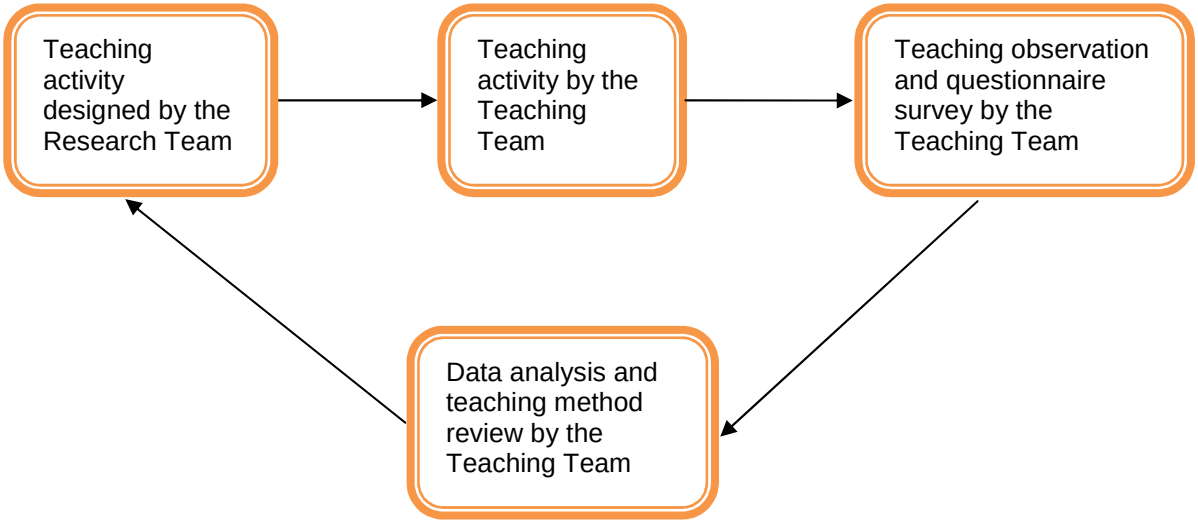
The main research method applied in the study was teaching observation. The teacher-as-researcher concept was developed by Elliott (1990). The essence of the method is for teachers to revise and improve during the process of teaching. Teachers modify their teaching methods based on the practical result, and they play the role of implementer, reviewer, and modifier.

The most important aspect of the method is to carefully observe and record each student's learning situation in class. The instructor and the researcher must focus on their own aspect to observe each student's learning situation and record their reaction toward the material being taught.

3.2 Research Flow Chart

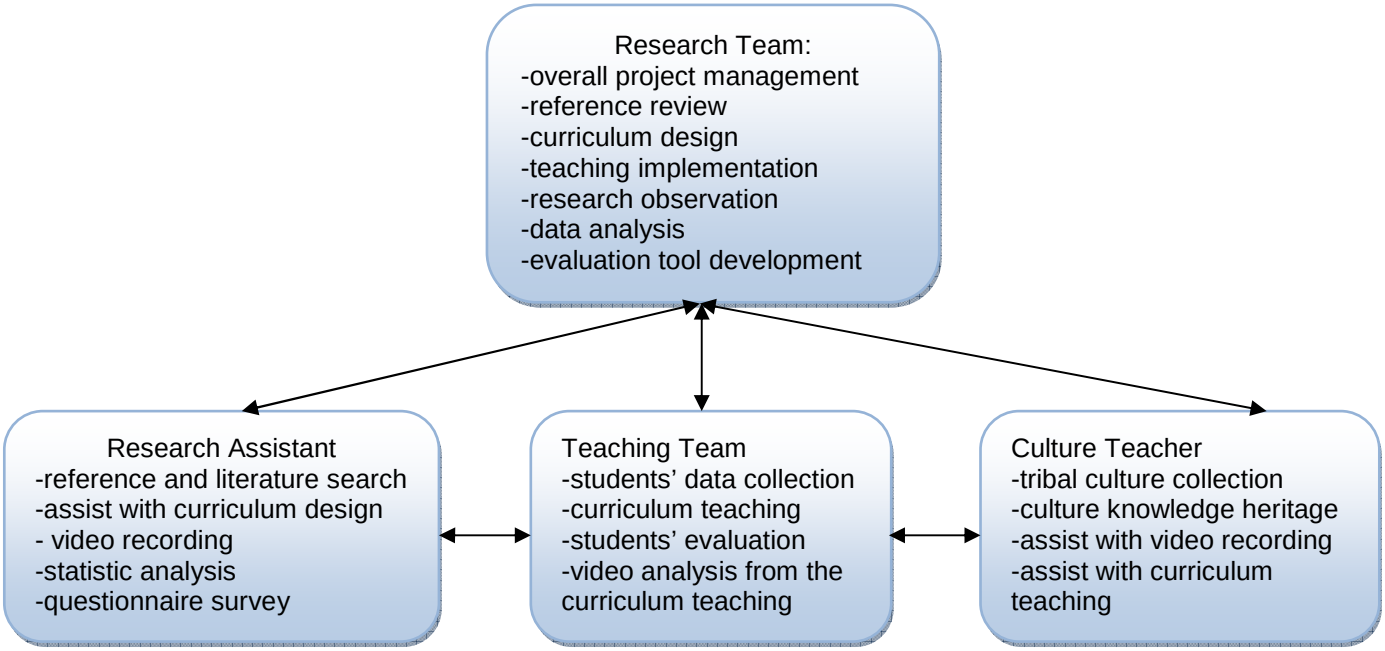
The flow chart for the teaching observation method is as followed:

Graphic 1. Teaching Observation Method



During the research, the Teaching Team carried out the teaching of the curriculum while other team assisted. Video recording was done throughout the entire duration of the science camp, and evaluation surveys were given out at different points of the activities. Results from the evaluation surveys were compared with the video according to each section in order to review the teaching.
The basic research structure is as followed:

Graphic 2. Basic Research Structure



4. Result and Discussion

The study used methods of teaching observation to study students' learning behaviors. Evaluation surveys were given before and after the activities. The evaluation surveys to study the effectiveness of the science camp included two parts, the first part to access the ability of scientific investigation and

the second part to evaluate the learning efficacy of the curriculum. Using quantitative and qualitative methods, the study confirmed that nonconventional science education camp is effective and appropriate for indigenous students in promoting indigenous education.

Table 1. Learning Effects Pre-test & Post-test Data Analysis（n=19）

Item	Pre-test		Post-test		t-value
	Mean	Standard Deviation	Mean	Standard Deviation	
Learning Effects	3.66	0.54	4.26	0.38	3.51**

*p<0.05,**p<0.01,***p<0.001

Table 2. Scientific Inquiry Pre-test & Post-test Data Analysis （n=19）

Item	Pre-test		Post-test		t-value
	Mean	Standard Deviation	Mean	Standard Deviation	
Scientific Inquiry	3.79	0.49	4.07	0.35	2.93**

*p<0.05,**p<0.01,***p<0.001

Fig.1. The Graph of Scientific Inquiry

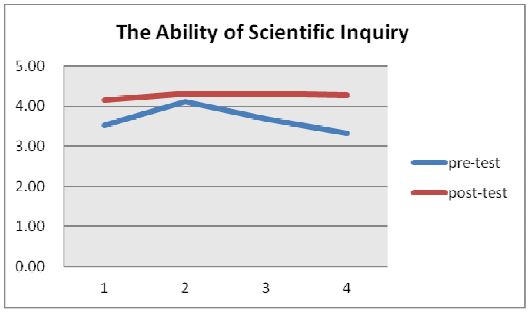
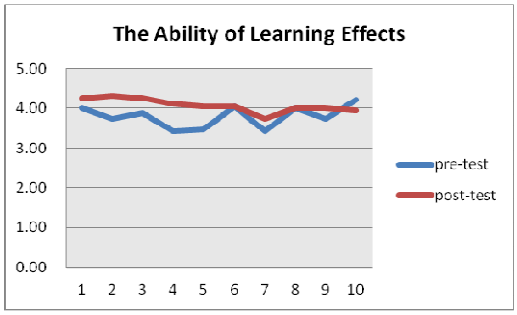


Fig.2. The Graph of Learning Effects



From this open and experimental education camp, the study found that the mean score for the post-evaluation had significantly improved comparing with which of the pre-evaluation. Students were observed to have increased interests toward indigenous traditional culture and exhibited learning interests in both the active and non-active courses. The results indicated that the teaching modules developed by the study can increase students' interests toward indigenous culture and science learning. With constant modification and improvement to make the open and nonconventional education teaching modules more complete, this teaching model can used as an example for the education curriculum in other countries.

This study found that applying students' own personal and everyday experiences into science learning can help students better accept the knowledge taught in class nowadays. Culture can be the bases of teaching which help students receive more concrete and applicable knowledge. Reiss (1993) indicated that science education has been influenced by culture diversity and stressed the importance of making science education more easily accessible to students with different world views and from different social and economical backgrounds. Through the process, the values and contribution of different cultures, ethnic groups, and genders to science can be reaffirmed and scientific theories can be applied to solve problems in everyday lives.

References

[1] Chang, T.L. & Hsin, H.T. (2008) Informal Science Learning and Scientific Education- A Case Study of Taipei Astronomical Museum and National Taiwan Science Education Center. *The application of Information Technology in Education and Teachers' Professional Growth Proceedings* (pp195-206). Changhua: National Changhua University of Education, Taiwan. (in Chinese).

[2] Dierking. L.D., Storksdieck, M. & Falk, J.H. (2007). Evaluation of learning in informal learning environments. Position paper for the Learning Science in Informal Environments National Committee. Washington, DC: National Academies of Sciences.
[3] Elliott, J. (1990). Teachers as researchers: Implications for supervision and for teacher education. *Teaching and Teacher Educa-tion,6*(1), 280-298.
[4] Fu, L.Y. (2004) Science in the Indigenous Life World: Salt Fish. *Aboriginal Education Quarterly, 35*, 5-28. (in Chinese).
[5] Hooper-Greenhill, Eilean (2007). Museums and education: Purpose, pedagogy, performance. New York, USA: Routledge.
[6] Huang, J.Y. (2000) Science Education in the Museums. *Technology Museum Review, 4*(4), 48-57. (in Chinese).
[7] Kelly, J. (2000). Rethinking the elementary science methods course: a case for content, pedagogy, and informal science education, International Journal of Science Education, 22(7), 755-777.
[8] Lo, T.Y. & Chang, C.Y. (2011) Action Study of Implementing Integrating Math and Science Creative Instruction of Sixth Grade Aboriginal Students. *Tzu-Chi University Journal of The Educational Research, 7*, 69-100.(in Chinese).
[9] Reiss, M. J. 1993. Science education for a pluralist society. Buckingham. Philadelphia: Open University Press.
[10] Scribner, S (1984). Studying Working Intelligence. In B. Rogoff & J. Lave (Eds.), Everyday Cognition: Its Development in Social Context. pp.9-40. Cambridge, MA : Harvard University Press.
[11] Stocklmayer, S. M., Rennie, L. J. & Gilbert, J. K. (2010). The roles of the formal and informal sectors in the provision of effective science education. Studies in Science Education, 42(1), 1-44.
[12] Suchman, L. A. (1987). Plans and Situated Action: The Problem of Human machine Communication. New York: Cambridge University Press.