A Case Study on the Science Exploration Experiences of Elementary School Children from Immigrant Families

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ABSTRACT

This research aims to discuss the learning effects for elementary school children whose parents are immigrants when participating in science exploration activities at their elementary school. The case study method is adopted as the methodology. The research focuses on elementary school children of immigrant parents who attend an elementary school in a northern city of Taiwan. By designing, conducting and exploring science experiments, as well as integrating multicultural education ideas and strategies, the design of science teaching activities have provided these elementary school children with the cognition and experience of science. Research instruments include worksheets, students' learning feedbacks and teachers' teaching journals. According to the research results, elementary school children with immigrant parents perform well in science exploration. This indicates that most of them can finish assigned experimental designs and conduction, thereby achieving the integration of skills and science concepts in science learning processes, and showing high levels of learning intention. The research results indicate that the experiential activities of science exploration can effectively promote the science understanding of elementary school children whose parents are immigrants.

Keywords: elementary school children with immigrant parents, multicultural education, science exploration, science literacy

INTRODUCTION

During the process of science education reform, many researchers have discovered that students with different backgrounds have different learning performances. Faced with the increasingly obvious cultural and social differences in students' backgrounds, Tytler (2007) discovered that many students from the minority groups are below the average level of learning in the science classroom, and give up the science related field as their career.

In recent years, families from cross-cultural marriages have changed the population structure of Taiwan. According to the statistics of the National Immigration Agency of the Ministry of the Interior, in Taiwan, the number of spouses of foreign nationality and the mainland, as well as Hong Kong totaled 494996 in August 2014. The statistics of the Taiwan Ministry of Education indicated that the number of elementary school children with immigrant parents has risen from 26627 in 2003 (accounting for 1.39% of all elementary school students) to 157431 in 2013 (accounting for 12.14%), showing an increasing tendency over the past ten years. The heterogeneity of various languages, cultures and family backgrounds of elementary school children with immigrant parents has become a huge challenge when developing science education. Therefore, a number of science education researchers began to value the possible influences of the cultural background of different groups of students on their learning, thereby excluding any disadvantageous factors or obstacles and improving the science learning effects for all students.
In order to understand the learning performance from participation in the science exploration activities of, this study examines the science learning of these students. Through the launch of science exploration experiential activities and the integration of multicultural education ideas and strategies, it expects to develop the sound science literacy of elementary school children from immigrant families.

Regarding the significance of cultivating national science literacy and the sharply increasing number of elementary school children from immigrant families, this research aims to discuss the learning effects from the participation of these children in science exploration activities at elementary school.

LITERATURE REVIEW

The education of elementary school children from immigrant families

With regards to research into the education issues of elementary school children from immigrant families, Chang and Huang (2007) pointed out that it can be discussed from two aspects: (1) the immigrant students themselves; (2) school education. In terms of the first aspect, research themes can be chosen that focus on physical and mental health, language communication, cultural differences, parental participation, family education, social adaptability, social contact and educational ambitions, etc. In terms of school education, research can focus on the quality of educational programs, the adjustment to cross-cultural teaching methods, the offer of school educational opportunities as well as the difficulties encountered.

With regards to various programs, such as the language performance of elementary school children from immigrant families, their academic performance as well as their adaptation to school and life, some related researches show that the performance of elementary school children from immigrant families is relatively weaker than that of native students (Tsai and Lin, 2006; Hsu, 2005). Chen (2009) found that the most common problems faced by children from immigrant families are academic performance, learning attitude, language communication, self-confidence, cultural adaptation and problem-solving ability. It is also known that the root causes to these problems are family, government and the lack of teachers’ time.

Concerning the characteristics of elementary school children from immigrant families, Hwu and Tung (2012) discovered that (1) there are obvious differences between immigrant students and native students with regards to multiple intelligences, parenting style and self-concept. (2) Schools differ significantly with regards to students' multiple intelligences, parenting style and the influence of self-concept. (3) The socio-economic status of the school has a direct influence on students’ self-concept. Moreover, Chen and Chen (2011) explored cases of high academic achievement by elementary school children from immigrant families, finding that the influential factors toward success include (1) a personal active and confident knowledge-seeking attitude; (2) the offering of family funds; and (3) the support system during the pre-school period and after-class tutorial care.

The reasons for the learning difficulties of elementary school children from immigrant families include (1) the disadvantages of family socio-economic status; (2) parents’ lack of instructing capacity or participation in their child’s learning; (3) the preventive psychology of grandparents upbringing or excessive fondness; (4) the problem of academic learning, probably in national language, mathematics and science subjects; (5) cultural adaptation, including the lack of self-confidence and feelings of inferiority; and (6) interpersonal and behavioral aspects (Tang and Huang, 2007; Wu, 2006; Wu and Wu, 2005, 2007).
Tang (2007) stated that the educational problems of Taiwan’s elementary school children who were from immigrant families were mainly focused on the double problems of lack of culture and funds as well as assimilation education. First of all, the proportion of foreign parents is larger due to their low socio-economic status, leading to deficits in material assets. Secondly, the differences in cultural backgrounds make these children short of cultural capital. The multiplied effect of these two factors combined (low socio-economic status and cultural differences) causes the double disadvantages for learning.

Based on a SWOT analysis, Huang (2011) pointed out that the advantages, disadvantages, opportunities and threats for the education of elementary school children from immigrant families include: (1) advantages: multi-channel language learning environment and habits, cross-cultural learning environment and habits; (2) disadvantages: parental difficulty with academic tutoring tends to restrict the children’s growth; economic disadvantages makes children lack a favorable environment for education; (3) opportunities: the government provides new immigrant policies and offers a care and guidance fund for new immigrants as well as their children; and (4) threats: elementary school children from immigrant families are often distorted and slandered, which affects their education and learning; the shortage of supplementary teaching resources. Therefore, Huang (2011) emphasized that educational institutions and administrations should assist elementary school children from immigrant families to develop their maximum advantages and opportunities.

In summary, the educational issues of elementary school children from immigrant families require more attention. Additionally, the way to improve their literacy is based on investing in more educational measures and resources so as to lessen the learning gap for elementary school children from immigrant families.

**Promoting the science learning of elementary school children from immigrant families**

With regards to the concepts and strategies of promoting the learning of elementary school children from immigrant families, many scholars have already done in-depth explorations, of which an important concept is multicultural education. Concerning the connotations of multicultural education, Lin (1997) stated that the tasks of multicultural education include three aspects: (1) making each group acquire full and equal educational and learning opportunities during the process of cultural adaptation, connotation and assimilation; (2) assisting each group to engage in the main trend culture and exert their social status after receiving education and completing their learning; and (3) cultivating the multicultural abilities of the whole population so as to form an equal and harmonious dynamic society.

In addition, Banks (2002, 2003) elaborated that the objectives of multicultural education included five aspects: (1) helping individuals to examine themselves through other cultural views so as to acquire more self-understanding; (2) providing students with more cultural and racial identity options; (3) offering all students the necessary skills, attitude and knowledge in order to adapt themselves to a self-racial culture and a main trend culture, as well as to other cultures; (4) reducing the suffering or discrimination shouldered by disadvantaged group members due to racial or cultural differences; and (5) helping students with their proficiency in reading, writing and calculating. With regard to the objectives of multicultural courses, Liu and Chen (2000) put forward the following aspects: (1) cognition: understanding and identifying self-culture and understanding cultural diversities; (2) affection: cultivating self-concept and erasing stereotyping and bias; and (3) skills: cultivating intergroup relationship abilities, multiple perspectives, and social action abilities, as well as adaptability to a modern democratic society.
Concerning the basic connotations of multicultural courses, Chen (2000) and Lin (2004) pointed out that multicultural courses (1) are oriented toward integrated courses; (2) should accept the understanding and harmony existing within district cultures and between other cultures; (3) should contain an understanding and awakening of global knowledge; (4) ought to take into account equal opportunities and universal acceptance; and (5) should allow students to draw courage from racial equality and racial differences. Sleeter (2005) further emphasized that teachers should identify the concept of multiple cultures from given courses, and at any time to integrate multicultural knowledge into the given courses. This can facilitate the development and practice of multicultural courses.

In terms of the concrete practices of education for elementary school children from immigrant families, Chang and Huang (2007) suggested that (1) the focus should be put on the effectiveness of supplementary teaching; (2) the equality of educational opportunities and educational quality should both be valued; (3) importance should be attached to the cultivation of educators' multicultural literacy; and (4) the application of effective educational methods should be valued. Therefore, when promoting the learning plans for elementary school children from immigrant families, educators should be aware of their characteristics and enrich demanded multicultural literacy. In addition, when conducting teaching activities, educators should attend to the characteristics of elementary school children from immigrant families, and properly use multiple teaching strategies so as to avoid labeling groups. Additionally, educators should aim for high learning expectations and provide full learning opportunities of rich learning quality in order to cultivate the sound literacy of elementary school children from immigrant families.

Regarding multicultural science education within globalization, Elmesky (2011) stressed that science teaching concepts should focus on the correlation between cultural globalization and science education, rather than discussing science and globalization, respectively. It is only when cultural globalization and science education are integrated that we can effectively enhance students' science learning. Fensham (2008) also elaborated that, in the global village, the concept of national science education aims to help all students cultivate the required literacy through science and technological education.

Hare-Mustin and Marecek (1988) stressed that in order to enhance the science learning of disadvantaged groups of students, teachers are required (1) to get rid of social and cultural stereotyping; (2) to treat and educate students equally and, meanwhile, to integrate science fields in the classroom with the characteristics of those students in the teaching context.

Secondly, with regards to the teaching and learning of science and technology fields at elementary school, many scholars have suggested that the enhancement of multicultural educational concepts and strategies can facilitate the teaching practices of science and technology fields at elementary school. When faced with students from different cultural backgrounds, the referential courses and teaching strategies and content should include (1) reinforcement of reading and language ability; (2) the arrangement of tutoring with peer teaching; (3) promotion of the connection between parents and the science classroom; (4) creation of science learning activities with multicultural features (Abruscato, 2004; Bank, 2002, 2003; Bennett, 2007; Lai, 2009, 2011, 2012).

Furthermore, Key (2003) adopted the strategies of course integration and equal teaching, as well as integrated traditional science teaching or Science-Technology-Society (STS) science teaching. The research results indicated that the above courses and teaching are more attractive to students and can help to enhance the science learning achievements of disadvantaged groups of students. Key (2003) further elaborated that (1) course integration means a teacher selects culturally correlated examples, and data and information from different groups to conduct discussions and integration of subject concepts or principles,
as well as inviting students from different groups to join in with the exemplifying and discussing. (2) Equal teaching strategies mean that teachers use multiple teaching strategies and methods to influence the learning styles and language features of different groups of students, as well as establishing students' cultural strengths.

In addition, many researchers have adopted the strategies of cultural connection and course integration, the results showing that these can also promote disadvantaged groups of students to acquire good science learning effects (Adams, Luitel, Afonso, & Taylor, 2008; Aikenhead, 2001; Calabrese Barton, 2001; Elmesky, 2005; Emdin, 2010; Mensah, 2011; Meyer & Crawford, 2011; Snively & William, 2008).

In summary, we should continuously focus on how to strengthen the mutual connection between science and multicultural education as well as how to offer and encourage elementary school children from immigrant families to be actively involved in science exploration learning so as to reinforce both their science and multicultural literacy.

**METHODOLOGY**

A case study was adopted as the research method and the research objects were 30 Grade 5 and 6 elementary school students from immigrant families in a northern city in Taiwan. Through the design, conduction and exploration of science experiments, as well as the integration of multicultural educational ideas and strategies, the design of science teaching activities have provided elementary school children from immigrant families with the cognition and experience of science. The science exploration experiential activities were conducted for three class hours every Saturday morning. The whole process lasted for three months.

The contents included (1) leaf-vein bookmarks, fingerprint identification, homemade wind needles within a total of 14 units (2 class hours for each unit), so as to enhance the skills of science experimentation and learning interest for elementary school children from immigrant families; (2) a science reading activity on a science theme was integrated into the teaching each week (one class hour for each week), including an introduction to scientists, science development discussion and a linked discussion on unit concepts, such as Nobel, Newton, Hooke…etc. These enhanced the stimulation of language and culture, as well as reinforced the recognition and understanding of science development, events and related concepts for the children from immigrant families.

The experiential activities of science exploration in elementary schools are conducted using iPod inquiry teaching, with the hope that it shortens the science learning gap for elementary school children from immigrant families. The steps of iPod inquiry teaching refer to the following: i means invitation, P means prediction, o means operation, and d means discussion (Lai, 2009, 2011, 2012). With regards to the experiential learning activities of science exploration, the question is whether elementary school children from immigrant families can take an active part in the activities as this is the key to developing effective learning. Therefore, it is proposed to invite those elementary students to participate in science exploration experiential activities in a more active way. Therefore, during the teaching procedures, an invitation strategy is first conducted with the use of additional diversified motivations to trigger students to more actively participate in the activities. In addition, prediction and operation strategies are used to reinforce the students’ proficiency in science process skills. Lastly, a discussion strategy is used to improve the proof and explanatory abilities of science exploration for elementary school students from immigrant families.
The research instruments included a worksheet, feedback on learning and teachers’ reflection journals. After the research data were collected, three science and education researchers conducted an expert validity examination, making a triangulation and case-crossover inductive analysis so as to confirm the reliability and validity of the data analysis and findings.

RESULTS AND DISCUSSION

This study conducted science exploration experiential activities with elementary school children from immigrant families. It expected to improve and exert their science learning, thereby achieving the goal of promoting the children’s science literacy. The research results of the exploration activities in the science learning are as follows.

Learning performance of science exploration for elementary school children from immigrant families

Elementary school children from immigrant families are curious, fond of and excited about the process of manual science operation experiments. For example, they were very interested in fingerprint identification. They felt anxious and uneasy while waiting for the appearance of their fingerprint. Once it appeared, they would suddenly rejoice.

In the process of discussion, they gave examples of their mothers' living experiences in their hometown so as to increase multicultural exchanges. For instance, during the leaf-vein bookmark activity, some mentioned that their mothers told them that when dying clothes in Vietnam (plant dyeing), they would boil the plants in hot water and then dye the clothes.

When discussing the floating ping pong ball, students performed the experiment with high spirit and most students were able to figure out that this phenomenon is caused by air. However, if students were invited to give a further explanation of the floating mechanism of the ping pong ball, some had difficulty in giving a complete explanation due to their lack of prior experience. Although they lacked prior experience, they would rack their brains to think about and explain the phenomenon though the exploration activity. Additionally, a lot of those students indicated that they had not fully expressed their views and were ready for exploration.

When elementary school children from immigrant families were making and showing the wind needles, most of them could complete the wind needle design. With regards to the improvement of the wind cup, they were unable to express their innovations due to limited time. Luckily, most students were able to propose an amended method during the discussion. When discussing the outward appearance of the wind needle and its usage, a student stated that “in his mother’s homeland, because of the frequent typhoons, they may place cock-shaped wind needles in the roof”; in general, the theme of wind speed was not strange to the students, and the experimental explorations and making of observation tools were relatively simple. Therefore, elementary school children from immigrant families were very interested in making wind needles by themselves.

When elementary school children from immigrant families were making and showing a simple rain gauge, typhoon Megi had just passed through Taiwan. The students learnt a lot from newspaper and magazine reports, and were very excited when discussing the rainfall. With regards to the concept of rainfall, the students, at the beginning, considered that the size of the mouth of the rain gauge has nothing to do with the measure of the rainfall. Later, they found that a rain gauge with a bigger mouth can evenly receive rainfall and that their observations were more precise after they conducted experiments. This allowed them to change their minds in a thoughtful way. Secondly, with the completion of a simple rain
gauge, when the students were taken outdoors to conduct rainfall simulation measurements, each student was curious and excited. Consequently, they could fully show off their sound science attitude and spirits when undertaking the rainfall observation and record activity. According to the making and exploring of a simple rain gauge, the science themes related to daily life could easily arouse the learning interest of elementary school children from immigrant families. Plus, the discussions on making a rain gauge and observation of the rainfall can further consolidate students’ understanding toward thematic concepts.

When elementary school children from immigrant families made and discussed a hand warmer, teachers would begin with the life experience of using a hand warmer in the winter. At this moment, some students would say: "summer is all year round in my mother’s hometown in southeastern Asia, so my mother prepares hand warmers in winter because she finds it hard to adapt to the winter in Taiwan". Students responded warmly, which also reflects the differences and features of their familial cultural backgrounds. In the discussion, some students sometimes said that they were so curious that they would cut the hand warmer once it had cooled down. They could tell that the inside of the hand warmer was made of black powder. Meanwhile, some other student stated that there was ferrous powder in the hand warmer. The teacher then asked this student to give an explanation. The student told that they used a magnet and found that some powder can be attracted to the magnet, thus they know it contains ferrous powder. Later, teachers further asked whether there were other substances in the black powder. The students did not know how to answer. Suddenly, one student states that there are active carbon and roseite in the powder. Teachers asked the student for the reasons. The student said the name of the substance was written on the package, which made the whole class laugh. Therefore, it can be discovered that elementary school children from immigrant families also have a strong level of curiosity and experimentalism, and can think out ways to solve problems.

Kevin’ case regarding the learning performance in science exploration

In terms of the learning performance of elementary school children from immigrant families toward science exploration experiences, a student was chosen as a case study for illustration as follows. The teachers’ teaching observations and reflection journals are taken as the source for the data analysis. The research object was a male student in Grade six with the nickname of Kevin; he has an ordinary family and both of his parents have jobs. His father is easy going and his mother (Vietnamese) is relatively strict. Kevin’s learning is mainly in the charge of his mother. Secondly, after a talk between the teachers and class instructor, the instructor states that Kevin’s school records rank among the worst in the group. Additionally, as his Chinese is poor, he struggles to catch up with the class, which affects his learning effects. What is worse is that his obvious difficulties in math and science deprive him of any sense of achievement in academy. Additionally, he cannot always finish his homework at home. However, the class instructor also mentioned that Kevin performs well in his observation abilities and picture drafting.

The initial stages in science exploration performance: when Kevin took part in the science program for elementary school children from immigrant families, in the beginning, he was not very good at expressing his thoughts. As he was short of prior knowledge in the group discussion, the teacher found that he was not identified by other students of the same group when he answered questions and in terms of thinking part. However, Kevin was very interested in the experiment. Following the teaching process of combining the application with iPod inquiry teaching, the teachers found that Kevin was gradually able to express his ideas and apply science exploration strategies. Consequently, he has achieved much progress in his science learning.
The learning performance for the leaf-vein bookmark activity: in this teaching activity, Kevin had difficulty in expressing his thoughts during the prediction stage due to his poor performance in science. In the process of discussing suitable leaves for making leaf-vein bookmarks, other students mentioned that acerate cactus or the leaves of the coco plant (too big or too small) are unsuitable for making bookmarks. In the meantime, Kevin mentioned that betel leaves cannot be used for bookmarks either. It was discovered that, through peer discussion, Kevin was gradually able to apply his life experience to the learning; during the experimental operation stage, Kevin was also able to find many leaves and try to distinguish a net-veined leaf from a parallel leaf. This indicates that iPod inquiry science teaching was well received by Kevin.

The learning performance of the slam dunk: in the process of this science experiment, the teachers guide students to think why the Polyflor Dragon Ball can revolve. This time, Kevin went to the platform free and easily, and drew a picture to propose his ideas. However, as Bernoulli's law is too abstract to explain to elementary students, Kevin was unable to give a complete explanation. However, Kevin independently went to the platform and delivered his ideas. This helped him to build his self-learning confidence, so that now he doesn’t regard learning as an obstacle.

The learning performance of the wind needle and rain gauge: during the teaching process of making and exploring, the teachers guided the students to think about the measurement of wind speed and rainfall in daily life through the news of a typhoon. Kevin indicated that a typhoon made him scared. When designing the wind needle, Kevin can freely and easily share his work, and can also discuss with other Grade five students how to measure the wind needle. Therefore, it can be seen that, in the iPod inquiry science teaching, Kevin was able to cooperate with other students to design and build science productions.

The learning performance of the hand warmer: in this teaching activity, which can trigger motivation, the teachers begin with the experience of using a hand warmer in daily life. Kevin mentioned that he had cut the used hand warmer so as to observe it, thus indicating that he is ready to share his experiences of the teaching. In the experiment of making a hand warmer, Kevin was curious about the phenomenon whereby heat can be created from the combination of ferrous powder and other materials. At this time, the teachers asked how it would be possible to lengthen the heating time of the hand warmer. Kevin proposed his idea, which was to separate air first, and slowly open the mouth of hand warmer when it is to be used. This answer surprised all the teachers. It showed that Kevin could apply the principles of science experiments to his life experience, and promote his own thoughts.

In terms of Kevin’s comprehensive learning performance, in the iPod inquiry science teaching, Kevin changed from a student with a poor school record who lacked self-confidence, into a learner who loves science experiments and enjoys the pleasures of science learning. This makes the teachers feel very gratified. Through discussions between the teachers and class instructor, Kevin’s instructor indicated that he has made very good progress during this semester and was able to finish all his homework. Additionally, he has performed well in math and science subjects. Therefore, it shows that iPod inquiry science teaching and learning has certainly had a positive influence on Kevin’s learning.

In summary, following the above research results, many elementary school children from immigrant families demonstrate well learning performance in the experiential activities of science exploration. Most of the students can accomplish the assigned science exploration and operational experiments, and display exchanges for multicultural and life experience. Meanwhile, the case of Kevin fully indicates that the experiential activities of science exploration can facilitate the science learning interest and learning performance of elementary school children from immigrant families. The research results show that the
experiential activities of science exploration, which is integrated with multicultural educational concepts and the iPod method, can really promote the science understanding of elementary school students from immigrant families, and shorten the science learning gap for this disadvantaged group of students.

**CONCLUSION**

In the process of science educational reform in recent years, many researchers have discovered that students from different backgrounds have differential learning performances. Therefore, many science education researchers have begun to value the possible influence of different groups of students with differentiated cultural backgrounds.

This study aimed to explore the science learning issues of elementary school children from immigrant families by adopting multicultural educational strategies, and using the iPod inquiry teaching method to conduct teaching activities for science exploration. The research results discovered that many elementary school students from immigrant families demonstrate good learning performances during experiential activities of science exploration. Most of the students can accomplish the assigned science exploration and operational experiments, and exchange multicultural and life experiences. Moreover, science exploration and operational experiments can facilitate the science understanding of elementary school children from immigrant families. This study states that multicultural education concepts and iPod inquiry teaching are worthy of further research and popularization so as to offer more opportunities for elementary school children from immigrant families to participate in science exploration and experimental experience. This enables such disadvantaged groups of students to actively engage in science exploration, thereby helping to enhance their science literacy and promote the successful science education of elementary school children from multicultural backgrounds.

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**REFERENCES**


