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ABSTRACT

This study investigated the changes that occurred in the knowledge and attitudes of a group of science and mathematics teachers (n=38) who took a museum education course. The course contained lectures and discussions on the rationales and strategies of museum education. The students also learned about the history of museum development in Taiwan and visited the science museum. Qualitative methods were used for collecting and analyzing the data. Findings indicate that although the National Museum of Natural Science played an important role in allowing the teachers to construct meaningful museum experiences, the participants still held many misunderstandings about the museum. After taking the course, the teachers were more oriented to in-depth rational thinking about issues related to museum education. Participants also critically compared formal and informal science learning environments and indicated that they planned to use aspects of the museum education course in their own teaching. (Contains 10 references.) (Author/WRM)

What Changes Occurred? —An In-service Course Focused on Museum Education for Taiwanese Science Teachers.

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ABSTRACT

This study focusing on a group of science and mathematics teachers who participated in a six-week summer in-service program investigated their changes before and after taking a museum education course. The course contained lectures and discussions on rationales, and strategies of museum education. Within the course, the developing history of museum in Taiwan was especially focused on, and a special visit to the science museum was also included. Qualitative methods were used for collecting and analyzing the data, and findings indicated that although the National Museum of Natural Science played the important role for them to construct museum experiences, they showed lots of misunderstandings about the museum. Their thoughts were focused on what they could see in the museum. However, after taking the course and a special visit to the science museum, the teachers were oriented to the in-depth rational thinking about the museum issues. They also compared the formal and informal science learning environments in the way of critical thinking, and expressed what learned in the course would be infused in their school teaching. Their future visits to the museum would be more creative, too. It is concluded museum education course is helpful for Taiwanese teachers.

HISTORICAL BACKGROUND OF THE STUDY

Since the concept of museum was originated from the western world, the institutes like museums were not be introduced to Chinese society until the era that west tide met the traditional culture in China. Actually, North China Branch of the Royal Asiatic Society from Great Britain established the first museum in China, i.e., Shanghai Museum, in 1874. Therefore, the history of the first museum in China was merely no more than one hundred and thirty years by the end of 20th century. Although dozens of museums were established around the occurrence of the Chinese Republic Revolution, the total number of the museum was relatively small if judged by the fact that China was with the largest population spread in the second largest territory on earth. In the first half of century (1874-1924) for the growth of museum in China, the most museum founders were missioners from the western countries. Besides, the Chinese government also built museums, but the number was limited. The museum sponsored by the native foundation or persons did not exist.

The collapse of the Manchu Dynasty provided us a clue to understand how a special case of the museum emerged on the basis of the royal palace in mainland China. In 1912, the Manchu Dynasty was overthrew by patriotic, and the first democratic nation, i.e., the Republic of China, in Asia was established. However, the last emperor still controlled the power inside Forbidden City. Ultimately, last emperor was exiled in 1924 after a quarrel inside the army. The Royal Palace in Beijing was finally released and transformed to be the National Palace Museum (NPM). Since then, the area of Forbidden City was opened to the public.

In contrast, Taiwan, an island 100 miles away from the southeast coast of mainland China, has been influenced by the both Oriental and Occidental cultures for the last four hundred years. In 1895, the island became Japanese colony after Manchu Dynasty lost the Sino-Japanese War. After Japanese came to this island, they executed the fieldwork all over Taiwan for the purpose of resource exploitation. The field study had produced abundant of objects. A decade after Japanese annexing the island, the collection provided naturalists with basic resources to found the first museum of natural history in Taiwan. Taiwan was under Japanese control for 51 years (1895-1945). Since Japanese lost the World War II, the Republic of China took over Taiwan again. At that time, the museum was also passed to the Chinese government. Taiwanese provincial government was authorized to take charge in the management of this museum, and renamed it as Taiwan Provincial Museum.

In 1949, i.e., three years after winning the war over Japan, the executive party (KMT) of the Republic of China transferred to the island for the loss of the civil war to Chinese communists. Along with the path of the transfer, KMT government carried the abundant treasures of the National Palace Museum (NPM) and National Central Museum (NCM) to Taiwan. All of the collections were finally stored together in the suburb of Taipei City, and exhibited to the public in Taiwan in 1965. This museum used the same name as what NPM had in the mainland, and became well known in the world.

Basically, National Palace Museum and Taiwan Provincial Museum could be regarded as the representatives in Taiwan. Both museums were founded by the outsiders—Japanese colonial government and the exiled government from mainland Chinese. The majority of collections in the National Palace Museum were from the emperors and royal families. Fundamentally, this museum could be defined as a history museum. After the visit to NPM, visitors were expected to get a general picture of Chinese culture through four-thousand-year history. However, Taiwan Provincial museum has presented quite a different dimension in terms of the collection. Because the work was done indigenously, the native biological species, inorganic rocks, and Taiwanese aboriginal objects were abundant in the museum. Even though the origins and the nature of the collections were different, both museums dominated the enterprise of the museum in Taiwan from mid-1940s to mid-1980s. They also oriented how Taiwanese society to view the enterprise of the museum. These museums in Taiwan have made little change for decades. Such a situation also led Taiwanese citizens to construct the somehow a stereotype of perception to the museum. The visit to the museum was not regarded as a usual event in Taiwanese daily life. Even more, most of the Taiwanese citizens did not experience the visit to the museum.

According to such a history background, Taiwanese adults over 35 did not have the museum experience during childhood. Even though some of them have visited the museum, they just took the cruise-course in the exhibit hall. The in-depth concept relevance to the museum was not easily been constructed. Thus, the relationship of the public and the

museum remained loosely linked.

The decade of 1980s was looked as the turning point after the enterprise of museum in Taiwan behaved as a sleeping lion for decades. The government in Taiwan set a 6-year plan in 1979 to facilitate the cultural construction for balancing the misled from over-emphasis on the economic growth in the country. Based on the project, the construction of culture centers, art galleries and large-scale science and technology museums was planed and seen as one of the routes for promote citizens' literacy by creating the educational opportunities easily access to the general public. According to the project, the National Museum of Natural Science (NMNS) was as the first newly founded museum in 1986. After the opening, this institute has led a continuous impact on Taiwanese citizens on the different aspects. Over two and half million visitors were attracted to visit NMNS each year. It was also mentioned as one of the interesting places for Taiwanese public to visit. A certain of studies have been done to investigate the responses from the visitors of NMNS. The report indicated that the most frequent reasons for Taiwanese people to visit the museum were 1) to get along with family members during the leisure time, and 2) to eager to learn some novice experiences (Liu, 1992; Chin, 1994). However, even if the motive for general people to visit the museum remains at a high level in the recent years, rare studies focused on Taiwanese to investigate how they constructed their museum experiences.

According to the statistical data from the National Museum of Natural Science (NMNS, 1995), over half of visitors come from the groups for field trips arranged by schoolteachers. And, the second large proportion was comprised of family groups (Chin, 1998). Rare visitors come to the NMNS alone. But for both class and family visits, the guided leaders such as teachers and parents, as mentioned before, did not construct their learning experiences based on the museum visit from their childhood. Therefore, most of them constructed and elaborate the museum experience right after the emergence of NMNS. And, others even experienced the trip to the museum at the same time and situation as what their kids did, while they selected the museum as the place for the field trip. Under such a circumstance, the fact that what teachers and/or parents thought about the museum and the education in such institutions become an important issue for Taiwanese museum educators to study. Especially, the second museum, the National Museum of Science and Technology (NMST) based on the same project as NMNS, participated in the museum market of Taiwan in 1997. It also reported that the total number of museum in Taiwan was over 140 in 1997(Division of Culture, 1998). The quantity of museum has swiftly increased after the official six-year project was fulfilled. However, on the other hand, both curators and educators should pay more attention to the issues like how ordinary people construct their museum experience and the way to improve its quality, since the big changes have happened in the world of museum around Taiwan.

Therefore, a group of science and mathematics teachers who participated in a

summer in-service program were focused for investigating how they construct and renew their museum experience through elaborated with the situated learning in the environment of NMNS. In the study, an individual course focused on museum education was developed, and through the course, the data were collected for answering the questions such as:

1) What were their previous experiences related to the museum?

2) What were the most significant changes through the period of taking course? and

3) What made such changes happened?

SIGNIFICANCE OF THE STUDY

The answers obtained from the study could provide Taiwanese museum curators with information for understanding what and how changes about the experiences from the special adult visitors--teachers, and furthermore to develop the suitable courses or programs to help teachers equip themselves in terms of the ability for the museum education. For Taiwan, quite different from the experiences in the Occidental world, the development of museum did not follow the evolutionary route of history, and government and general public paid attention to such informal learning settings just ten years ago. Therefore, the results of this study would tell us a story based on the special developing route in Taiwan!

THEORETICAL UNDERPINNINGS

The science museum is regarded as one of the most suitable science learning contexts for its containing consensus, teaching models, objects, and text (Gilbert & Boulder,1998). Prist & Gilbert (1994) indicated that students learned in the museums by interacting with each other, with teachers, parents, and adult helpers, with the display objects, and by relating experience to their prior experience.

In order to help students learn science meaningfully, both workshops and in-service programs are usually provided by the science museum (Danilov, 1980). Some colleges or universities also established the co-operative connection with museums to provide in-service teachers with special programs for earning the credits. For instance, the National Museum of Natural Science in Smithonia Institute worked together with George Washington University to offer an eight-month anthropology program for high school teachers (Selig,1983). Through attending the program, a communicative framework was established among teachers, anthropologists, and curators. Old Sturbridge Village and Worcester State College provided a 3-credit summer course for in-service teachers (Sebolt,1981). While finished, participators were awarded the diplomat. The University of Ottawa and National Museum for Science and Technology offered a program for special teachers. Four-week program contained in-house teaching program and real activities with the students in the museum. The results showed that both teachers and students grew in the cognitive and affective domains. According to the formative and follow-up assessments, it

is believed that the participating teachers improved their ability in teaching. Furthermore, their professional ability and sound museum experience constructed by interacting with the museum would facilitate his or her students learning in the context of museum.

The evidences showed relatively long program with focused on the specific topics were helpful. Therefore, museum education course offered on the basis of the co-operative relationship between museum and university is especially needed for Taiwanese teachers, because the special developing history of museum in this society. This study is the first museum education course developed by a college teacher and provided for in-service teachers with credits in Taiwan. Responses from the teachers will lead us to develop more suitable course syllabus and teaching strategies. We also look forward to sharing our experience with people who interested in the issue that how teachers' professional ability grows by co-operating with the non-formal educational system.

DESIGN AND PROCEDURE

In order to realizing teachers' previous museum experiences and how they construct and renew such experiences, a group of science and mathematics teachers (N=38) who participated in the final year of a four-year-long summer in-service science education program offered in a normal university were chosen for the study.

Each summer session lasted for six weeks. In the program, the researcher acted as the lecturer to offer them a 2-credit course focusing on the museum education. The course syllabus comprised 1) the rationales for informal and museum education, 2) the strategies used in informal learning environment, 3) the evaluation of museum education, 4) the comparison of the Taiwanese and Occidental history for the development of the museum, and 5) a visit to the science museum. Because these teachers had visited to the science museum (NMNS) as a team during their first summer in the program, therefore the researcher especially arranged the visit with a quite different focus. The targets of visit included 1) viewing special and permanent exhibits, 2) listening to the interpretation, 3) exploring in the naturalist center, and 4) visiting storage areas. Before and after the visit, the teachers needed to turn in 1000-word essays for describing their previous museum experiences and the renewals after the visit. In the class session, the discussions were also recorded. Researchers wrote the field notes after each session, and two teachers were selected for in-depth interviews. The qualitative data from the various sources were then analyzed and the findings were validated by triangulation method.

FINDINGS

1. THE FIRST MUSEUM EXPERIENCE IN THE LIFETIME

Few teachers (N= 5) mentioned they had the museum experience during childhood. Interestingly, three fifths of course takers (N=22) indicated National Palace Museum was

the first museum to visit. The reason is believed that the history of this museum is long enough, and its collection is composed of the treasures through the history of Chinese culture. According to teachers' responses, the first visit to NPM was mainly between adolescence and college-age.

> *I was brought up in Tainan City (a city located in southern Taiwan). I did not have museum experience until I moved to Taipei for the undergraduate study. While I was a freshman, I visited the National Palace Museum, which was my first museum visit. (T06)*

> *While I visited National Palace Museum as a junior high student, I had a feeling that this museum not only was a huge place, but also had lots of invaluable collections for exhibition. However, I did not really understand the meanings about the collections. According to my judgement as a science teacher, I doubt that National Palace Museum more focuses on preserving the collection and presenting the exhibition. I don't think curators set education as their first priority. (T25)*

Only one teacher (T27) mentioned Taiwan Provincial Museum was his first museum to visit. However, he misspelled this institute as "Taiwan Provincial Museum of History" in the essay. Actually, it is the museum related to the natural history. The discordance can be found in his description after viewing the exhibition in that museum :

> *I remembered that it was an exotic experience in the museum. I presumed that the exhibits in the history museum should be the items such as books written or read by ancient people, and living things used by human beings several hundred or even thousand years ago. However, I found lots of the specimens like fossils or model of lives exhibited in the exhibit hall. I thought these exhibits should be collected by biology museum; I asked why these items existed in a history museum. (T27)*

This meant he was not able to tell apart the definition of the history museum and natural history museum. The disagreement also made him confused about how museums were classified.

Only one-third teachers mentioned NMNS as the first museum to visit in the lifetime. However, the fact tells us that NMNS played as an essential role in the Taiwanese adult with the age around 35. For instance, one participant described how NMNS connected to his personal life :

> *I was a junior at the college when the National Museum of Natural Science was opened to the public. Because my school was located in the central Taiwan, therefore, I attended the interest group organized by the*

school and acting as a docent for the NMNS. To tell the truth, I just provided the minimal level of the service for visitors. My understanding about the museum remained superficial. I did not have the opportunity to touch the issues behind the curtain of the museum. (T11)

Besides NMNS, NPM, and TPM, the National History Museum (NHM), which was established in Taipei in 1955, were mentioned among teachers group. According to the essays from the respondents, eight people mentioned NHM. Among them, one (T31) indicated it was his first museum to visit in the lifetime. But the time happened in his college year. To summarize, the museum experiences of the sampled teachers were not constructed too early. NPM played the major role; however, NMNS replaced its place after 1986. All teachers came to learn novice perspectives about the museum after the opening of NMNS. It is believed that most of sampled teachers, who grew up in the central or southern Taiwan where was no museum before 1986, could not obtain museum experience from their neighborhood. Interestingly, most of them had their first museum experiences guided by the parents or school field trip to Taipei City. If they lacked such an opportunity before high school years, the only chance to visit museums in Taipei was the time after they entered the college there.

Interestingly, some teachers, but not many (N=3) mentioned that they had the museum experience abroad. Among them, for example, T29 illustrated she had ever visited the British Museum of Natural History, the Space Museum of Hong Kong, and the Louvre in Paris. While observing the exhibits, which were looted from China one hundred years ago and now shown in the British Museum of Natural History, she wished that our society should work together to make our belongs go home. The museum experiences from the trip to the nations dominated by western culture have enriched teachers' perceptions of the museum issues. But not many teachers could have such trips to remote countries. In the interview, T29 described her long trips to the museums in Europe by using a Chinese proverb--- "Travelling for thousands of miles is better than reading thousands of books". The oversea trips to foreign museums were so precious for a citizen, like T29, who did not experience the museum as a portion during her growing age. It is doubtless that the brand new experience has brought her abundant information in terms of continuous learning.

2. The Perception of the Function of Science Museum

None of teacher had the comprehensive understanding of the functions for the museum before taking the course. After the class was offered, most teachers commented it has improved their understandings. As shown in Table 1, their understanding was mainly

Table 1. Teachers' Understandings of the Functions for the Museum

Pattern \ Function	Education	Exhibition	Collection	Research
Pattern 1	●	●		
Pattern 2	●	●	●	
Pattern 3	●	●	●	●

expanded from pattern 1 to pattern 2, which meant the acquisition of perception on collection was major event after the visit. Relatively, pattern 3 seldom existed in this teachers group.

Comparatively, the functions such as exhibition and education which museum has are much easier to be understood by visitors than the research and collection done by museum curators. There is no doubt that all of teachers (N=38) expressed they didn't have trouble in understanding the role of exhibition and education in the museum because both were tangible in the exhibit hall by experiencing the exhibits and the educational activities.

Among them, for instance, a teacher (T22), recognizing that both functions had direct impacts on the society, suggested that the development of exhibits interesting to the visitor is needed：

> *Science museum can be seen as an entity for the purpose of science education and social education..... In order to motivate the active participation of the visitors for learning, the interactive exhibits should be taken into account. (T22)*

This statement indicated she realized museum exhibits were mainly developed for achieving the educational objectives.

Another teacher (T01), judging from her real field experience in NMNS, has asserted exhibits and educational activities could provide invaluable resources for her teaching in science. She used to recognize what she could see and utilize in the exhibit hall as what so-called resources. However, she was further to include the collection on the backstage of museum as the part of resources for teaching after experiencing the visit to the storage areas of NMNS：

> *The visit to the storage areas of NMNS has brought a wonderful feeling to my mind. It is really a resources bank for our society. What we had seen attracted me to keep digging the treasures from the bank. Since the treasures are so rich, I believe that digging will be a long-term effort. (T01)*

T01 used to focus on the objects and activities of NMNS for exploring. After the

visit to the storage area, she expanded her definition for so-called museum resources. Being influenced by the event of the visit, she recognized the role of storage rooms as resource bank, and began to know collection as the part of treasures.

During the whole-class discussion, one of the science centers in Taiwan--the National Taiwan Institute of Science Education, was mentioned among teachers group. The content of discussion exposed teachers' confusions on the definitions between science center and science museum. Although both institutions have been covered in a special topic, what teachers discussed showed that they could not tell the difference between science museum and science center. For instance, the following statement expressed by T38 revealed such an ambiguity :

> *The science museum was a public place for education, and science center was the institute for doing the scientific research. (T38)*

Here, his definition for science museum has indicated how he interacted with such kind of institution. But his incorrect definition for science center might come from the interference by the name of research center. Actually, dozens of research centers were built in Taiwan after 1980s. Since both institutes use the same word—center—in their full names, therefore, it is likely for the general public to regard the science center as a place mainly for doing the research.

According to the field notes written by the researcher, the role of research in the museum is not easily understood by teachers :

> *Although four functions were illustrated in the lecture, teachers did not really understand 1) what is the purpose for the museum to do the research? 2) why does a museum need to do research? And 3) what kind of research does the museum need to do? All of these questions were not easy for these teachers to understand.*

Since the ordinary people lack the direct experience to see curators doing their research, it is a usual phenomenon that the science museum is misunderstood as a place mainly, even exclusively for facilitating the educational purposes. Although the course offered the special topic and field trip to the inside part of museum, teachers' change was mainly found in the realization of the role for collection. But for research, it is still a tough part for them to understand. The following statement from T01 tells us why general public could not figure out the important role of research for a museum.

> *As a science teacher for more than ten years, I did not know that the museum had the functions such as research and collection until the visit to storage areas. After the visit, I became acquainted with the fact that there were a group of curators behind the exhibit hall doing such thing. Seldom general public knows that. (T01)*

The perceptions of museum visits according to teachers can be generally summarized as Table 2.

Table 2. The Perceptions gained after 1st and 2nd Visit to NMNS during the Summer Program

1st Visit in Summer One	2nd Visit in Summer Four
To View Exhibits and Attending Educational Activities	To Experience the Interior Function
To Think Over how to Utilize the Resources Presented in the Exhibit Hall	To Clarify the Role and Functions Played by Museum
Visit Arranged Suitable for the Public	Visit arranged for Comprehensive Understanding

Therefore, in conclusion, education was widely accepted as the most important function in the museum by the teacher. Compared with exhibition and education presented as the concrete objectives for the educational purposes, the function of research undergone in the science museum was invisible and abstract for the general teachers. That is the reason why none of course taker actively mentioned the research as one of function for the museum during the discussion period of the class. Although after the visit took place, the awareness of research was aroused, the logical link of research to other basic functions has not been well established.

3.EXTRAORDINARY EXPERIENCE FROM THE SPECIAL ARRANGEMENT

As illustrated in the previous section, most of teachers usually talked about what they had seen in the exhibit hall in the discussion before basic philosophy of museum was introduced to the class. Especially before the visit took place, their thoughts were easily to be confined to the educational activities and the exhibits that provided in the museum. However, through taking the course, the participants became more thoughtful, since class discussions and lectures had provided them the background for in-depth consideration on the basics of the museology, and the foundations for the exhibits and activities designed for the educational purpose. For instance, Over half of teachers compared the differences between this and previous visits：

> *The major activity of my previous visits to the NMNS was focused on viewing the exhibitions and attending the educational activities. But this time, I got acquainted with what was stored inside the museum after visiting the storage areas. I think it is the precious part of this*

museum. I look it as an extraordinary experience. (T37)

During the summer program, we visited the NMNS as a group for two times, one in the first and another in the final summer. I remember interpreters dominated the first visit. They led us to see and explain the exhibits for us. On the contrary, the instructor arranged the second visit for us. Therefore, we could see the collections in the place intangible to ordinary people. Through the explanations from instructor's lecture before the visit and the on-site guidance by curator, I am amazed at how the work was done and what the purpose for the museum to collect the objects. After the visit, I became to know the research and collection provided the representation of museum to the public. (T28)

The visit arranged by course lecturer that provided them the experience in the storage area was seen as one of the strengths in the course (N=33). Among them, T32 described the opportunity for him to get in the storage areas was just a switch movement form the front to the back stage：

It was more like the fact that a naughty boy watched the opera in front of the stage as a usual audience for a while, and then he suddenly intruded into the back of stage and found more funny things which he did not experience before. (T32)

Even though the collected objects were manufactured for being stored either on the shelf or inside the cabinet, the visit to storage areas for viewing objects has motivated teachers to think over their relations to exhibits. In other words, teachers' idea such that how stored items were transformed to be exhibits shown for the public was elicited as such：

After viewing the objects stored in the museum, I became interested in the issue that how curators developed the exhibits or educational activities based on what they had collected. (T23)

The designer's creativity was remarkable. After the visit, I tried to imitate their thoughts and the strategy used for making an object for exhibition. (T06, T42)

Teachers' extended thoughts stimulated from the experience in storage areas also include：

Curators work on the back of stage. Few people pay attention to them. But they keep working enthusiastically. The way that curators devote

to the work is worthwhile for us to emulate. (T32)

The investment in terms of the labors and budget for sustaining museum work is large. The supports from the government and the society are urgently needed. (T42, T32, T41, T07)

The products of research and collection accumulated in the museum can be seen as a historical record in the society. It is priceless for the human being. (T25)

To compare with the long-term and large-scale work in the museum, I really feel that the individual is relatively small. (T20)

The characters such as persistence, devotion, co-operation, value judgement, and support from the society could be summarized from their statements. Apparently, the chance to see the work done inside the museum made teachers to extend their thoughts to the philosophy of life.

Since the role of collection in the museum was covered in the lecture, the research relevance to the specific domain of collected objects was spontaneously inferred and teachers primitively made the possible connections between them. The following field notes according to researcher's observation described the event of visiting storage areas and its impacts：

Since teachers did not pay much attention to the functions of collection and research before the course, a special arranged visit to the NMNS adopted the cruise in the storage areas was given for building a whole picture about the function of museum. The areas for viewing included the rooms storing the ethnic items, fossils, and amphibian and reptile specimens. Along with the cruise, lecturer gave the interpretation based on the nature of the collected items and the research relevance to the collections. Especially, a museum curator, Mr. Huang, was invited to guide an introductory talk in the storage room for the amphibian and reptile specimens. Mr. Huang also included some research that they had done or they would do in the future based on the collection. After the introduction, teachers were allowed to observe the specimens embedded in the jars on the shelves in the room, and proposed the questions freely. While viewing the specimens in the storage areas, teachers were amazed at the abundance of the collections in the NMNS.

The value of observing collected objects was validated by the responses from teachers：

I am interested in the collection inside the storage room. As a biology

teacher, I know this area has collected almost all of native Amphibian and Reptiles species. Museum curators have made lots of efforts in the research relevance to the conservation of the native species. It is meaningful to our society. (T37)

Based the experience got from the visit, teachers tried to make the connection of the collection and research. Although the laboratory was not as the spot for visit, Mr. Huang's introduction has motivated teachers to think over how museum curators used the collections to do the research. A teachers commented：

After the visit to the storage area, I learned that the research and the collection were the basis of the science museum. If there is no strong team for doing the research, the exhibits and the educational activities will shrink. From curator's talk, I found the self-confidence of a professional people. Now, I can understand why the curator emphasized that the research and the collection as the soul of the museum. (T32)

The input of information about the collection and the research has led teachers to imagine its possible usage in attaining exhibitive and educational objectives. Teachers were still not able to define the role of research for museum precisely. But it was at least a begin for them to think over why a science museum needed the research and how researcher's findings were effectively understood by visitors through designers' efforts.

4.THE CONSIDERATION FOR THE APPLICATIONS OF RESOURCES AND THE STRATEGIES SHOWN IN THE MUSEUM

During four-year-long summer study at NCUE, teachers were trained mainly by a package of core courses infused with the spirits of science education such as constructivist learning, co-operative learning, and problem-centered teaching strategies, etc.. Because of the special arrangement by lecturer, this visit to museum was with the first time for teachers to confront with an informal context in a systematical way. Motivated by the novice experience, they began to consider the possible ways to apply what they had learned from the summer courses in real teaching.

I have learned the concept of constructive learning and co-operative learning during summer in-service program. The visit have convinced me that the museum as a resourceful place suitable for enriching students' learning experience. I think it is a sound place for class visitation by adopting the theories what I have learned. (T16)

In addition to the concern on the arrangement of visit, T16 also found that the behavior of visitors was worthwhile to observe during the cruise in the exhibit hall：

In the exhibit hall, I found the behavioral patterns of visitors were interesting. Some exhibits attracted more people and some didn't. Some attracted people for longer time; some did shorter. I tried to figure out the reason. I also believed that the understandings of visitors by observation could help me develop appropriate visiting programs for enhancing the effectiveness of education. (T16)

According to the observation on the interactions happened between interpreters and the audience, it was concluded that visitors' challenges brought much more pressures to interpreters than what teachers encountered in the classroom. For instance, a teacher (T21) described how he felt about the interpretation given to the general public：

While I listened to the interpretation, I also made an observation on the interaction between the interpreter and the audience. I found the responses from audience could be either positive or negative. In other words, the interpreter was facing a changeable learning environment. It was more complicated than what happened in the classroom. If the interpreter did not present the topic in an interesting way, the visitor would not stay at the seat just as what kids did in the classroom .The were free to leave. (T21)

Based on the observation, he was aware that the strategies used in the informal settings were strong in motivating audience's active participation, and worthwhile to be applied in the teaching of classroom：

Although exhibits were shown individually in the hall, the interpreters tried to organize the information for presentation systematically. It was really a good example for me to learn how integrate the instructional materials holistically. (T23)

Teachers also proposed the following questions to reflect upon how to improve their science teaching：

1) *What did the interpreters emphasize?*
2) *What kinds of strategies were used in the interpretation? and*
3) *What were the strengths and weakness for the teachers' classroom instructions and interpreters' interpretation? (T06, T32, T45)*

By observing interpreter's performance, teachers had learned strategies used in the informal context were helpful for improving their teaching. Consequently, they were further to suggest the discussion with interpreters might be good for schoolteachers to grasp new ideas.

I found museum interpreters faced quite a different situation from us. They especially need to pay much attention to visitors' motivation. The ways used in the interpretation are benefit for schoolteachers to learn. I suggest a workshop or the discussion session involving interpreters and schoolteachers would be helpful for those who teach in the formal educational system. (T17)

Since the naturalist center of NMNS was treated as one of the focused spot for this visit, its potentiality for being utilized was also discussed. Eight teachers mentioned it as a sound place for students to learn the nature of science. They said：

This place is free for the public interested in the study for nature. People can use this center for inquiry, study, and exchange the information. (T37)

Naturalist center is equipped with specimens and facility such as microscope and reference books. These offer people to solve their problems through the investigation. I think it is a good place for kids to do some exploration if guided by teacher of parents. (T31)

The learning pattern that happened in the naturalist center is in a holistic way. Learner over there can learn the integrative concept. (T19)

After teachers visited the naturalist center, they become more aware of the essential role of the hand-on activities played for learning science. They also indicated that less attention was paid to this area before because its location was so far from the exhibition area. In order to compensate for the low rate of utilization, lecturer arranged this isolated area as special spot to visit. After the exploration at this center, teachers found it was very suitable for independent active learning or learning partial guided by the teacher.

Besides the areas like exhibits hall and naturalist center mentioned as appropriate for instructional purposes, the techniques such as multi-media, diorama, and label text writing developed as the part of an exhibits were also illustrated. The way adopted by curators for integrating the concepts had enlightened teachers in designing the suitable strategies for presenting scientific concepts through the holistic approach in the classroom. T42 said：

I not only observed the way exhibits were developed, but also eager to apply the ideas in designing the instructional materials. (T42)

Since values of informal context for children's learning were confirmed after the visit, teachers suggested the involvement of parents were an enforcement. Such suggestions came from those teaches who brought their children together for the visit. They mentioned

the interaction with children made them feel parent-children learning was quite an effective strategy for both kids and adults. T05, accompanied by his son during the visit, reflected his experience in the interaction with the child：

> *While viewing the exhibits and listened to the explanation, my son usually asked me the questions from his observation. His questions made me reflect myself. I asked myself if people really understand the meaning of the exhibit. Through the process of explanation, was it effective for improving the understanding ? (T05)*

The teachers, T03, T05 and T17, indicated that they would like to bring their children and act themselves as a family group member learning in the science museum. They agreed that parents-children interactions were an indispensable part as learning in the museum context.

5.THE ENLIGHTENMENT FROM THE STS-BASED EXHIBITS

Most of teachers mentioned the awareness of the environmental problems had been aroused after they visited the science museum for the reason that the exhibits and educational activities were infused with the STS elements. After viewing the exhibit hall, they also became to learn the reason why science concepts should and could be expressed by connecting with the personal life experience.

In the visiting period, teachers were especially impressed by two special exhibitions entitled as "Turtles" and "Viewing our Family ~Taiwan~ form the Outer Space". The awareness of environmental issues was easily aroused in teachers group for its being developed on the basis of local issues. For instance, five native species of land turtles were shown as live objects in the diorama; therefore, visitors could observe live turtles inhabiting in a simulative environment. Under the topic of "Turtles", the track of sea turtle cruising around the West Pacific Ocean was used as a model for demonstrating how ecologists devoted the conservation of endangered species.

Besides that, several domestic items or cultural symbol relevance to turtles exist in Chinese society. These items were abundant in the daily life of general public in China. For example, the shells of turtles were carved with the characters and used for predicting the blessing of the future around fifteen centuries B.C.. Turtles have also been regarded as the symbol of long living for Chinese people. However, The number of Chinese people who knows the cultural meaning of the object has decreased in the last decades. After visiting the special exhibition as "Turtles", teachers were amazed that even an unremarkable topic like turtles for layman could be treated as valuable things for professionals. And such curators would make efforts to collect items continuously. A teacher (T01) said：

> *The usual things are always potentially to become meaningful for professionals. By observing what and how they provide the items with*

meaning, I found that we always neglected the gems existing around us. (T01)

By observing a special exhibition like "Turtles", teachers also found a special topic needed the involvement of a group of curators from various backgrounds such as zoologists, anthropologist, exhibit designers and science educators. The ultimate aim for their working together is to make the educational objectives come true.

Reminded by turtles as exhibits, a teacher (T06) shared his previous experience in raising the turtle during childhood. He mentioned the viewing "Turtles" in NMNS was a touching event for him. While being interviewed, he recalled how he treated it as a pet. Although he is a mathematics teacher, the establishment of core concept by connecting to his experience became easier by means of exhibition under the museum context. He assured that :

After the visit, I have confirmed the importance of conservation. Although I had the experience in raising the turtle during my childhood, to tell the truth, I did not make any connection with the issue relevance to the conservation. What I got was just a set of knowledge and a growing feeling to turtles. After the visit, I became to know the basic theory of conservation, and connect it with my previous experience. Now, I understand why human being should do conservation. I especially appreciate there were lots of the exhibits developed on the basis of local materials. These were so close to our lives. Not as the learning experience we got in the school before, it was not from other countries. I am proud of what curators have done for our own society. (T06)

Another special exhibition—"Viewing Our Family ~Taiwan~ from Outer Space—showed a macroscopic map of Taiwan as a major exhibit. On the map, there were detail subjects such as cities, townships, highways, railroads, rivers, plains, mountains and accessory islands, etc.. This map presented Taiwan so clearly that attracted teachers to locate the place interesting to them in the exhibit room. For those teachers who grew up in Taiwan, what had shown on the map was meaningful for them. Based on the map, they could easily make the connection with their previous experience or what they were experiencing recently. For example, some tried to find the cities where they came from (T18, T22). Some tried to make a picture about the land plan proposed by the government (T36). For staying on the campus of NCUE for summer in-service program, they also tried to locate where the campus and NMNS were (T03). Teachers had the unanimous response that the activity for reading such a huge and detail map was so interesting. A teacher (T45) said :

I felt so wonderful while I read the map. Peers gathered together to form several informal groups and found the specific area or object on the group or individual basis.....While viewing the map of Taiwan, I pretended myself as a pilot flying on the sky of my country. I observed my land like a bird, watching where I was born, and the place I devoted to. It was a precious experience to me. An unforgettable memory! After the visit, I have got more acquainted with my homeland than before. (T45)

Teachers were also interested in the techniques used for picturing the surface of Taiwan, and the way that the information was transformed to be a readable map (T22). Since over half of the teacher here taught physics, they especially indicated that the techniques could be used as an extensive material for teaching STS issues. And, the elements related to the satellite map could be elaborated and used for the authentic teaching through a variety of strategies.

6. The Willingness to Construct a Set of Collection for Class

At the end of course, teachers also presented what they were going to do in the future. Among them, two mentioned that the arrangement of a room for special collections in their schools would set forth. They also tried to promote a continuous process for collecting special items from local community.

For explaining why he planned to do so, a teacher (T30) mentioned：

After I have viewed the variety of specimens stored in the NMNS, an idea comes to my mind. I think schoolteachers like us can do the similar thing in the school. We can develop a project for students to gather the items interesting to them. This can be done as a whole-class project involving all students. Or, the class is divided into several groups, and then each group chooses a special field to collect the objects. I might call it as "the museum for class". (T30)

Furthermore, T30 even indicated the accumulation of objects could be used for improving the learning environment in school. She said：

Junior high teacher like me could play the same role as the museum curator. I suggest that teachers in school could do the collection of natural resources possible for instructional purpose. In school, we can organize a group of teachers to work as a team for collecting the resources and arranged these to be exhibited to students in the specific room. Teachers can be more focused on the community resources to collect. Therefore, These are more related to the daily life of student. If

a group of schoolteachers could work together for this project, there will be abundant materials suitable for instruction accumulated in the school. It would be not only good for the teaching in the school, but also useful in organizing the project-based learning both for students and teachers.

Such a plan could be looked as an extensive idea elaborated from the museum work for collection. Although merely two course takers mentioned the idea, however, the suggestion at least represented how teachers elaborated their thoughts after the learning.

T03 shared his extensive ideas about how he defined the museum after taking the course :

Because I was brought up in Kinmen (a small island 100 mile away across the strait from Taiwan, but only 5 miles from the coast of mainland China), I didn't think there was so-called "museum" in my hometown before I took this course. But you know Kinmen is a place abundant with both natural resources and cultural monuments. After I learned the definition of museum from Professor Chin's lecture, I change my belief for the reason that I find Cultural Gallery of War Region, the Victory Memorial Hall of August 23rd Combat, and Kinmen National Park could be treated as the members of museums. After the class offered, I have refreshed my understanding of museum. All of these are beneficial for my students. After I return to Kinmen, the concept about the museum will be infused as part of my class elements. While taking the field trip to the above places, I will introduce the concept of museum to my students. (T03)

It is really an unexpected objective that teachers were further to elaborate and extend the concepts and made the connections to what they had experienced in the real life. It could be seen as one of the harvests for lecturer to offer such a museum education focused course for in-service teacher. Apparently, the learning is not merely the acquisition of the concept framework, but also as an integrative process for their whole life experience.

CONCLUSION

None of the museum education course offered for the pre- and in-service teachers in Taiwan before. Before NMNS opened to the public, most of Taiwanese people only regarded the opportunities of education come from schools. However, people in Taiwan have changed their views about the education, and the way of the education in the last decade. It is believed that the emergence of NMNS in Taiwan plays the important role for such changes. The findings of this study tell us teachers had lots of misunderstandings about the museum before taking the course. However, this course made them adjust their

perceptions of the museum and museum education. The focus of thinking and teaching held by teachers were also changed. Here, we suggest if Taiwanese teachers would like to be an effective facilitator for education, they need the museum education course designed in the systematical way. Both formal and non-formal educational systems should work together for making it come true.

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