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Bringing the World of Science Centre to Primary School

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Abstract

"Bringing the World of Science Centre to Primary School" is designed as a university-community project that enable knowledge transferring occurs from the University to target communities such as teachers, students in targeted district (Kuala Muda, Kedah). This project is implemented through several phases such as developing science kits (based on local culture), several modules and informal science activities (Mobile Science Laboratory). In 2009, only six primary schools were involved in this project and in 2010, 13 schools were involved. Findings revealed that most schools gave positive responses to this project and the Mobile Science Laboratory was transformed into the Mini Science Centre located at Sekolah Kebangsaan Teluk Wang. At the end of this project, a "Virtual Science Centre" will be built and "A Young Scientist in the Community Symposium" will be held in Sekolah Kebangsaan Teluk Wang. It is hoped that this programme can provide significant contributions in sustaining a scientific culture in the targeted community, Kuala Muda, Kedah.

***Keywords**: university-community projects, informal science learning*

Introduction

Science is stereotyped as a difficult, abstract and boring subject. Until now, the students' ratio of 60:40 (science: arts) is still hard to achieve in the Malaysian school system. Students keep away from science because it is often associated with low scores in examinations. The question remains whether science is studied for the purpose of examination. Can science be learned only in a formal class and bounded by a fixed syllabus?

In fact, learning science is not necessarily to be done only during formal school hours, tied to the standard science curriculum and dependent on the presence of teachers in the classroom. This is due to the fact that students can discover scientific concepts in their daily life which is outside of school hours and the school compound. This type of learning is known as informal science learning. Informal science learning can take place either at home, museum, science camp, at the end of the school or through everyday experiences. It can complement and become the backbone to the formal teaching and learning of science. Informal learning contributes significantly to students' science learning as a big portion of the student's daily life is

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not spent in school. Most of the day, a student's life is filled with activities outside of school, whether at home, shops, parks, supermarkets, football fields, parks and so forth.

Although the existence of science centres such as The National Science Centre and Petrosains KLCC in Kuala Lumpur (the capital city of Malaysia) function as informal science learning centre, the logistical factors such as school's location far away from Kuala Lumpur reduced the possibility for rural students to enjoy the benefits from these two informal science learning centres. Kuala Muda, Kedah is the location of this project which is an example of a remote location that is far away from both science centres. Most schools in Kuala Muda, Kedah are categorised as rural schools. In fact, many students in those schools are from low-income parents working as farmers, fishermen and rubber tappers. Thus, the informal science programme is designed for these students to have the opportunity to enjoy the excitement of informal science learning, the same experience available at the National Science Centre and Petrosains, KLCC, located in Kuala Lumpur.

Sher (1983) has written that rural schools have recognisable tendencies, such as less specialisation and less equipment than schools in non-rural areas. He found that rural schools tend to exhibit a tendency toward teaching the basics and more reliant on the unique qualities of individual teachers. Consequently, students in rural areas probably are at high risk when they are put under these circumstances. Ghose (1982) examined out-of-school science and technology education as a means of achieving rural development in South East Asia. His study originated from the finding that the education provided to school children was found lacking. Ghose (1982) described the situation in this way: "Formal education was found inadequate to meet the challenge of national development in general and rural development in particular" (p.19). These inadequacies were summed up in four points: (a) the curriculum is unsuited to agriculture, though agriculture is the primary means of making a living.; (b) the curriculum tends to be "bookish in nature" and thus tends to alienate young students; (c) formal schooling tends to be inefficient in areas with high-drop-out rates among students; and (d) limited economic resources do not allow formal education to be spread to everyone.

Informal science education can fill the gap through activities like science clubs and science camps (Ghose, 1982). These activities complement formal education throughout Asia. In the Philippines, for instance, science clubs played an additional community service function. Through these clubs, students conducted "analysis and resolution of community problems through out-of school science education laboratories" (p.22). Such clubs were also active in India. Ghose (1982) reported that science fairs can also play a community service role with the examination of realistic and relevant problems. Nachtigal (1995) suggested that science project based in the community context of the rural areas can make a significant impact on environmental and business issues of rural locations. Oliver (2007) also concluded that science education in rural areas can have a much stronger connection to the community in which the schooling takes place. Ghose (1982) found that when modern mode of infrastructures was not widely available in rural locations, students seemed primarily interested in science related to local vocations and phenomena.

Methodology

Programme Bringing the Science Centre to the Primary School was designed in an innovative way through several phases to allow the collaboration between the university and the target communities, knowledge transfer and informal science learning culture to be sustainable among the target community. In the first phase, researchers developed and designed science kit experiments based on local elements in Kuala Muda, Kedah because most of the present kits available did not reflect the local culture characteristics. Thus the kits in this project are unique. The elements used in those kits are traditional foods such as *Maman* citrus, fish, preserved fish

and trickling *Benderam* that are usually sold in night markets of Kuala Muda Kedah. Instead of using litmus paper, students will test these traditional foods to identify its' acidity or alkalinity nature by using red cabbage juice. In addition, fish species diversity in the sea or paddy fields in Kuala Muda, Kedah will be used as a basis for designing student activities to identify types of fish that can be found in the sea near Kuala Muda Kedah, in Kuala Muda River and in the paddy fields around Kuala Muda, Kedah.

The next element to be focused on is the fishing activities off the above of Kuala Muda. By using the fishing activities, students were introduced to the concept of light which is moving straight associated with the position of fish in the sea. Students also develop or construct a solar boat and are then asked to discuss the potential of replacing diesel boats with solar boats in the future. Besides, the Tsunami disaster that hit Kota Kuala Muda will also be simulated by a tsunami model which was built by the researcher team. Using the model, an explanation will be given on the creation and consequences of a tsunami and why mangrove swamps of Kota Kuala Muda Kedah should be sustained to reduce the impact of the tsunami on the area near the beach.

Besides kits, several modules of informal science learning have been published to enable informal science learning to be conducted in a planned and effective manner. These modules are based on effective science pedagogy such as Problem Based Learning approach, Brain-Based Learning, Multiple Intelligences, Constructivism and Science Process Skills. In addition, these modules are also linked with traditional game activities and science concepts. Until now, the institutions that support informal science learning either abroad or in Malaysia only produce modules that focus on the activities of informal science experiments. There is no informal science learning modules integrating innovative approaches to teaching science based on learning theories such as constructivism and brain-based learning theory.

Therefore our modules from this project have the potential to be commercialised due to its uniqueness and effectiveness since the activities in these modules was developed based on Problem Based Learning approach, Brain-Based Learning, Multiple Intelligences, Constructivism and Science Process Skills. In fact, one of these modules is very unique when we integrate the use of traditional games with the science concepts.

The second phase of this project programme is to promote informal science learning in the target communities (teachers and students in the district of Kuala Muda, Kedah). Thus, the Mobile Science Lab project enables the learning experience of a science centre to be brought directly to the schools around Kuala Muda, Kedah. The Mobile Science Lab consists of mobile science kits experiments, which can be taken anywhere and is configured as science stations close to the situation in a real science centre. The Mobile Science Lab project consists of 12 stations that can be installed either in the school hall, canteen, class and so on. Each station has "hands-on" science activities which involve low-cost materials and can be found in the students' everyday life. The activities were implemented by using innovative pedagogical approaches such as Problem Based Learning approach, Brain-Based Learning, Multiple Intelligences, Constructivism, Science Process Skills and Education for Sustainable Development.

Each station is operated by a facilitator (lecturers, students and staff from the School of Educational Studies, Universiti Sains Malaysia). For this project, we moved from one school to another school. There are 12 stations in the Mobile Science Lab project:

i. Station 1 - Model organs and members of the Human Body
ii. Station 2 - Life Cycle Organisms
iii. Station 3 - Planet of Incredible
iv. Station 4 - Volcano
v. Station 5 - Magnetic Field
vi. Station 6 - Solar Energy

vii. Station 7 - Is Yeast alive?
viii. Station 8 - Miracle Cabbage
ix. Station 9 - Model Tsunami
x. Station 10 - Growing Fish
xi. Station 11 - Come Sail
xii. Station 12 – Floating

For each session, the number of students involved in Mobile Science Lab was 100 students. These students were divided into groups of 10 students per group. Each group rotated from one station to another station within two to three hours. The student movement was controlled to avoid discipline problems. Some groups may not be able to finish all the activities in a certain station due to time limitation. They were given a sheet of paper at the beginning of the session to record the data or experience on what they will learn in each station.

Results and Discussion

In 2009, the Mobile Science Lab project had visited six primary schools in the district of Kuala Muda, Kedah as follows:

1. Sekolah Kebangsaan Simpor
2. Sekolah Kebangsaan Kota Kuala Muda
3. Sekolah Kebangsaan Taman Ria
4. Sekolah Kebangsaan Ibrahim
5. Sekolah Kebangsaan Tikam Batu
6. Sekolah Kebangsaan Sungai Pasir

Most teachers and students gave positive responses to this project. All schools that were involved in this project were excited with this project especially on the concept of learning science through the Mobile Science Lab. They also enjoyed the project since most of the facilitators were lecturers of Universiti Sains Malaysia (USM). In their perception, they were amased because the lecturers were willing to meet 'people' who were students and teachers in the remote areas. The commitment displayed by these lecturers is the icon of the concept of university-community project.

The involved schools look forward to the next Mobile Science Lab visit next year. They also expected that the number of stations and the time given be extended so that more students can experience informal science learning environment similar to the learning science environment in a science centre. In fact, this project seemed like having a science festival at the end of the year. The pilot project in 2009 inspired a similar programme in the year 2010. Several improvements were made in 2010 by increasing the number of informal science stations from 12 stations to 20 stations, and trained facilitators with skill-based approach to Problem Based Learning, Constructivism, Guided Inquiry, Multiple intelligence and application of Science Process Skills and Education for Sustainable Development. The activities also became more interactive and mysterious in order to make it more exciting and to raise students' curiosity. In fact, the Mobile Science Lab has been extended to five hours so that students can really enjoy the informal science learning environment. The number of schools involved in 2010 also increased. The schools were:

1. Sekolah Kebangsaan Batu Empat
2. Sekolah Kebangsaan Jeniang (Pusat)
3. Sekolah Kebangsaan Tuan Syed Jan Al-Jafri

4. Sekolah Kebangsaan Pinang Tunggal
5. Sekolah Kebangsaan Convent
6. Sekolah Kebangsaan Tikam Batu
7. Sekolah Kebangsaan Seri Jerai
8. Sekolah Kebangsaan Hashim Awang
9. Sekolah Kebangsaan Teluk Wang
10. Sekolah Kebangsaan Pantai Perai
11. Sekolah Kebangsaan Kongsi
12. Sekolah Kebangsaan Bedong
13. Sekolah Kebangsaan Penaga

Most of the schools involved gave positive responses and they felt it was an honour when selected to be visited by a team of USM Mobile Science Lab. The success of Mobile Science Lab in the primary school has inspired secondary schools in the district of Kuala Muda, Kedah to express their support for this project. Thus, the District Education Office in Kedah requested for the USM Mobile Science Laboratory team to visit secondary schools in Kuala Muda, Kedah occasionally. However, the challenge was to identify to what extent that informal science learning activities is suitable for students in secondary school students. Therefore, the team has to design informal science learning activities that are more complex, and related science concepts in line with secondary school students' levels of cognitive development.

The next challenge is to ensure that the Mobile Science Lab programme is not only an 'outreach' programme but rather more of a sustainable project. Sustainability in the mobile science laboratory is defined as the assurance that this informal science learning activity can be continuously conducted by the school without the USM team. To sustain their responsibility towards this project, the school community in Kuala Muda Kedah districts should collaborate with each other. Three strategies were developed to achieve this goal, namely to ensure knowledge transfer occurs from the University to the community, acculturation of informal science learning in the target community and nurturing a sense of 'ownership' by the school for the Mobile Science Lab programme. Those three strategies were translated into a series of planned actions. The first action was to create a mini-science centre at one school in Kuala Muda Kedah district which is similar to the concept of informal science learning activities found in the Mobile Science Lab programme. This Mini Science Centre is located at Sekolah Kebangsaan Teluk Wang, Sungai Petani, Kedah. Unlike the Mobile Science Laboratory, this centre is static. However, the activities and the materials used are still the same based on the principles of informal learning of science in the Mobile Science Lab project. The existence of this Mini Science Centre at a chosen school allows teachers and students to enjoy informal science learning at the appropriate time on their own. This Mini Science Centre is also different from Petrosains, KLCC since the materials used in that centre were low cost and can be found in the students' daily lives. It also based on several learning theories, suitable pedagogy proven to be effective and is modified from time to time based on research results of the Science Education lecturer from the School of Educational Studies, USM.

The next plan is to ensure knowledge transfer occurs from the University to the target communities. Transferred knowledge should include the following aspects:

1. Theory and practice of informal science learning
2. Skills to design informal learning of science
3. Skills in using low cost materials and to design experiments in science
4. Skills to facilitate students to carry out informal scientific experiments
5. Knowledge and skills to develop programmes the Mobile Science Lab
6. Knowledge and skills to set up a Mini Science Centre
7. Knowledge and skills in implementing community-based informal science

8. Knowledge and skills to collaborate with appropriate organisations to implement programmes for informal science

A series of workshops were held to enable the knowledge transfer. These workshops involved 20 primary schools in the district of Kuala Muda, Kedah. Each school sent several science teachers to attend a science workshop. Lecturers from the School of Educational Studies and invited speakers from Petrosains ran the workshop to share their experience conducting informal science learning. At the end of the workshop, all teachers were given the task to organise their own programme and set up their own Mobile Science Lab and Mini Science Centre at their respective schools. As a result, presently, 200 informal science experiments have been successfully produced by the primary schools involved in the Mobile Science Lab project and this number is expected to increase when all the involved schools implement the programmes of Mobile Science Lab. Meanwhile 20 Mini Science Centres were successfully developed through this project. Each Mobile Science Laboratory and Mini Science Centre conducted by each school has their own uniqueness and strength to show their creativity and commitment in this project. The autonomy that was given to the schools to translate their ideas in reproducing the Mobile Science Laboratory and Mini Science Centre according to their own creativity gave them a sense of 'ownership' of the purpose to make sure that informal science learning become a school culture. The success of the schools involved to implement programmes of the Mobile Science Lab and the Mini Science Centre is an indicator that the teachers involved were successful in mastering science knowledge and skills of informal learning. The feedback received from the school administrators that the Mobile Science Laboratory and Mini Science Centre programmes should be annual events just like Sports Day. The reason is that they felt that these programmes benefited the entire school community and had new dimensions in learning science which can be part of co-curricular activities that the same time had a positive impact on students' academic performance.

The most challenging task is to enable students to master the knowledge and skills in applying informal science learning. To achieve this goal, project based learning is the appropriate approach. In this approach, students were asked to perform the science projects that can contribute to improve the quality of life of local communities (community-based science projects). To support these students' projects, several workshops were designed to train science teachers as facilitators in order to guide students to develop the community-based science projects and the Virtual Science Centre as a medium of online communication between teachers, students and lecturers about their progress in doing these projects. Furthermore, the Virtual Science Centre also provides a platform for students to discuss among themselves these community-based projects. The developed Virtual Science Centre has the same characteristics as a real Science Centre which allowed students to experience informal science learning regardless of the limitation of time and space. This Virtual Science Centre is the first in Malaysia since the National Science Centre and Petrosains, KLCC did not have one. Thus, the Virtual Science Centre of the School of Educational Studies, USM is one step ahead of the National Science Centre and Petrosains, KLCC in the context of informal science learning. The developed Virtual Science Centre has also allowed students from school districts of Kuala Muda, Kedah to virtually interact with scientists and lecturers from USM. In this Virtual Science Centre, there is a virtual world where students are given a virtual character in the virtual world. Lecturers or scientists from USM are also given virtual characters. These characters or avatars appeared in the virtual world and they will communicate with each other to discuss the science projects. All activities performed by the virtual characters can be seen by computer users who visit the Virtual Science Centre. Thus, the communication session will take place in more attractive ways and this situation can motivate students to maintain their interest in this community-based science projects. Experts in informal science learning and informal science learning community around the world are also invited to attend virtually in this Virtual Science

Centre so teachers in the district of Kuala Muda, Kedah can interact with them on the latest developments in informal science learning at the global level.

The biggest event in 'Bringing the World of Science Centre for School' is to organise A Young Scientist in the Community Symposium which will be held at the Sekolah Kebangsaan Teluk Wang, Sungai Petani, Kedah. This Young Scientist in the Community Symposium is the continuing activities in community-based science projects. A Young Scientist in the Community Symposium is unique since this event is different from science competitions which are held in Malaysia and throughout the world. The uniqueness of this symposium is the terminology used that is "Scientist Community" which means scientists who conduct scientific research to solve the problems faced by local communities or improve the life quality of local communities. Thus, any findings in those scientific researches should directly affect the local community. The theme for this symposium is "Science in the Children Community" and the objectives of this symposium are:

1. To provide a platform for students to present their findings or results from their scientific projects related to their community.
2. To provide an avenue for students to discuss, exchange ideas and experience the process of science projects related to their community.
3. To instil an understanding and networking among the participants about the best approach to do science projects related to their community.

This symposium is similar to scientists' meeting where students will discuss, exchange ideas and debate their findings and results of their science projects in their local community. In appreciation of all students in this symposium, the winner will be awarded medals such as gold, silver and bronze medals. The winner of this symposium is evaluated based on their science projects that have a meaningful contribution to their local communities. Besides, the science projects by students, intellectual discourse will take place between teachers and lecturers about the best practices of informal science learning.

Conclusion

"Bringing the World of Science Centre to Primary School" is designed in an innovative way so as to enable the university to be directly involved in the target communities, with knowledge transfer occuring from the university to target communities (teachers and students of schools and the district of Kuala Muda, Kedah) while sustaining informal science learning culture among the target community members. This goal is achieved through several phases:

- designing informal science experiment kits that contain elements of local culture
- modules publication for the implementation of informal science learning activities based on proven effective pedagogical approaches
- organising the Mobile Science Lab USM
- establishing a model for the Mini Science Centre
- organising Mobile Science Labs initiated by the schools from district Kuala Muda, Kedah
- establishing of Mini Science Centres initiated by school from district Kuala Muda, Kedah
- promoting community-based science projects by students from Kuala Muda, Kedah
- developing the Virtual Science Centre
- organising The Young Scientist in the Community Symposium

Indeed, this collaborative university-community project gave an impact on target communities so that they are more skilled in making decisions when faced with scientific issues in the real

world. These skills are essential skills on making decision socio-scientifically. In fact, this programme also provides an alternative to target communities on better ways to teach and learn science, besides enhancing their interest and understanding of the science concepts which can improve their science achievement. The experience in doing this project has in fact increase the expertise among the lecturers in informal science learning that aims to 'humanise' science through the relationship and contribution of science directly to the communities.

In addition, this project also succeeded in making science as a part of the students' life. As a result, it could minimise the assumption that science is a difficult and boring subject to learn. Through this project, students could be more motivated to learn science because science can be learned outside the classroom and not just for passing the examination but as a pleasure to appreciate life more meaningful. Hence, a scientific culture can be developed among the target communities in line with Vision 2020 to produce a scientific community that is not only a consumer of science and technology, but is also a contributor to science and technology.

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