

## **Engaging Secondary School Students in Authentic Research Projects Based on Environmental Science Theme**

Tan Lik Tong, Beverly Goh Pi Lee and Subramaniam S/O Ramanathan

### **KEY IMPLICATIONS**

- The engagement of students and teachers in the Project Based Learning (PBL) ecotoxicology-based workshop provided an effective model for teaching of nature of science (NOS) and scientific inquiry (SI).
- The study showed that students participating in project work required explicit instructions and scaffolding in order to better understand the scientific method of SI.
- Teachers' confidence in project work was enhanced through participation in professional development in-service workshop as well as the use of the ecotoxicology handbook published under the Office of Education Research (OER) project.

### **BACKGROUND**

Realizing PBL as an important alternative pedagogical tool, the Ministry of Education in Singapore introduced Project Work (PW) in 2000 at all school levels, ranging from primary to pre-university levels. The main objectives of introducing PW are to equip students in Singapore for the challenges of the 21st century and to achieve its vision of Thinking Schools, Learning Nation (TSLN). Since the inception of

PW, a number of research conducted at primary to junior college levels have shown its positive effects on students. Based on these studies, there is general consensus among educators that the objectives of PW are being met and that students have benefited by participating in PW. Majority of these studies were perception-based research, and there is a lack of studies in assessing students' understanding of NOS and SI through project work.

### **FOCUS OF STUDY**

The nature of this study relates to OER's research directions in at least two key programmes on Curriculum & Instruction and Teacher Learning & Professional Development. For instance, significant findings related to the positive impact of PBL on students' learning outcomes, especially on NOS and SI concepts, could lead to its greater implementation as an effective method of student learning. In addition, engaging school teachers as partners in PBL in this study aligns with OER's key research interests, particularly in science education and teacher professional development. Moreover, the teacher-scientist partnership model could lead to better understanding of issues pertaining to PBL as well as provide recommendations

on its implementation. This will therefore enable us to develop a more effective and sustainable PBL programme within the school system.

## KEY FINDINGS

A series of questions pertaining to the students' understanding of NOS and SI were given to the students who participated in the ecotoxicology workshop. The students attempted the same set of pre- and post-test questionnaire prior to as well as after participating in the workshop. Both the pre- and post-test questionnaire responses from students were needed to answer research questions, such as "How did Environmental Science PBL and interaction with professional scientists impact/change secondary school students' understanding on the nature of science (NOS)?" and "How did Environmental Science PBL and interaction with professional scientists impact/change secondary school students' understanding on scientific inquiry (SI)?" In summary, the students' views of NOS and SI remained largely unchanged after participating in the PBL programme. We also found the data to be rather fragmented. In addition, the study revealed that explicit instructions and scaffolding were required to enable students to better understand NOS and SI.

## SIGNIFICANCE OF FINDINGS

The PBL ecotoxicology-based workshop serves as an effective model for professional development of teachers as well as to facilitate informal teaching and learning between students and their teachers or scientists. Owing to the positive response from teachers, we have been conducting annual PBL

workshops, based on the model used in the study, as in-service courses since the first run of the workshop in 2014. We are currently developing in-service workshops to engage primary school students and teachers.

By participating in the project work related to ecotoxicology theme in this study, students were able to acquire some of these skill sets, particularly collaboration. However, one area that is lacking is in students' critical thinking skills. In addition, the study revealed that students need to be taught explicitly the process of project work, which includes crafting of research question(s), designing of experiments, data collection and analysis as well as report writing.

## PARTICIPANTS

A total of 44 participants, including students and teachers, from nine schools took part in the study. The students are either from secondary schools (e.g., Secondary 3 students) or junior colleges (e.g., JC1 students).

## RESEARCH DESIGN

Both secondary school students and their teachers participated in a 3-day PBL ecotoxicology workshop conducted at NIE. The study employed both quantitative and qualitative methods in answering research questions. Data collection methods to address PBL impact on students' learning outcomes, including concepts in NOS and IS, were based on pre- and post-questionnaires, observations at workshop, face-to-face meetings and interviews.

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