

## Incorporating Nature of Science Elements in A-level Physics Lessons in Singapore

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### KEY IMPLICATIONS

- Using history of light to promote nature of science (NOS) among pre-university students.
- Enhancements in understanding of a number of NOS attributes is achieved using relatively short intervention times.
- Intervention can be done in either the classroom or laboratory to foster NOS attributes.

### BACKGROUND

Traditional science teaching generally tends to present science as content that needs to be mastered by students in order to pass examinations. Little effort is devoted to construct evidence for the content presented, validated or revised or how scientific knowledge is produced. There is a considerable chasm between the way science is taught in the classroom (ready-made science) and the way science operates in practice (science –in-the- making). Reform movements in science have thus emphasized on the need to make the teaching of science a better mirror of the way scientists work. Such efforts include teaching science as inquiry and teaching the nature of science (NOS) alongside the knowledge and processes of science.

The A-level H2 Physics syllabus, which was implemented in 2016, places greater emphasis on the need for students to appreciate NOS:

This study focused on the topic of light to see how NOS understanding can be promoted among pre-university students using either a classroom-based approach or a laboratory-based approach.

### FOCUS OF STUDY

This project seeks to develop lesson packages that can be used to promote NOS understanding among students. More specifically, the focus is on the development of separate packages for laboratory-based NOS as well as classroom-based NOS on the topic of light. Exploring the effectiveness of these packages can provide useful insights into how NOS can be promoted among students. An appraisal of the NOS views of students before and after intervention can provide insights on the effectiveness of these lesson packages in promoting NOS understanding among students with the facilitation of the instructor.

### KEY FINDINGS

- Both the laboratory-based workshop and the classroom-based workshop, using the history of light to foster NOS understanding among pre-university students, was found, to be, overall, effective.
- Generally, students made gains in a number of aspects of NOS but not in all the aspects. This is evidenced by both the student

responses to the NOS questionnaire as well as follow-up interviews.

## SIGNIFICANCE OF FINDINGS

### Implications for practice

- Classroom-based NOS approach can be easily adopted to foster NOS understanding among students using a historical approach.
- Laboratory-based NOS approach can also be used but it entails the setting up of experiments and use of relevant equipment, which may entail cost and time. However, the advantage is that students get to observe firsthand the experimental observations in this kind of approach.
- Good facilitation skills on the part of the teacher are needed to promote NOS understanding using either approach.

### Implications for policy and research

- The design principles and insights gained from this NOS research, which focused on one topic in Physics, can be extended to other topics in the sciences.

- There is a need to incorporate NOS into teaching of science – not all aspects can be promoted but there is scope for catering to specific NOS attributes or understandings within the context of a topic.
- Professional development programs for teachers would be helpful to hone their skills in fostering NOS understanding among students.

## PARTICIPANTS

6 schools participated in the study. Students are JC1 or equivalent.

## RESEARCH DESIGN

Two approaches were used in the development of the lesson packages for exploring NOS on the topic of light – laboratory-based workshop and classroom-based workshop. The former was conducted in NIE while the latter was conducted in school.

The effectiveness of the workshops on the NOS views of the participants was assessed using a shortened version of the Views of Nature of Science Questionnaire Form B (VNOS-B) as well as the full version of the Form.

A case study approach was adopted for this research.

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