
Title	Developing a learning progression for teaching climate change in school geography
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Developing a Learning Progression for Teaching Climate Change in School Geography

By *Chang Chew Hung*

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In Singapore, climate change was included in the Upper Secondary School syllabus as early as 2008 to achieve quality education and to highlight the real world relevance of the causes, impacts and management of climate change. Students' understanding and conceptualisations of climate change, however, are often found to be inaccurate, erroneous and incomplete (Chang & Pascua, 2016; Wang, 2004). In particular, they are unable to build on what they have already learnt (e.g., atmospheric processes and social relations) to develop an accurate and comprehensive understanding of climate change.

Research Problem

Several questions arise, including "Why were students unable to build on what they have learnt and why are there continued misconceptions?" and "How can students progress in the learning of key geographical concepts?". From earlier research, Chang & Pascua (2016) have found that the common misconceptions that students have about climate change include, regarding greenhouse gases as a thin layer that traps heat rather than being ubiquitous in the lower atmosphere; greenhouse gases destroy the ozone layer; heat destroys the ozone layer and that heat trapped by the greenhouse gases destroys the ozone layer. If we can analyze and identify the component concepts and progression of learning these concepts, a systematic way of correcting these misconceptions can be achieved.

Learning Progression Framework

Learning progressions are mapped to describe the successive development of

sophisticated understanding to achieve the mastery of a topic, which are defined by the achievements of milestone anchors over a span in time. The upper anchors define what students are expected to know and do at the end of the progression while lower anchors define and describe the prior knowledge and skills of the learners before they enter into the progression. The learning progression framework can help students build on their knowledge and correct the fragmented and often incomplete understanding of climate change. The learning progressions developed can help learners advance in their understanding. This has implications on the design, structure and sequence of the curriculum to facilitate the achievement of knowledge, understanding, skills and competencies.

Hypothetical Learning Progression

The research project has developed five learning progressions based on the causes, impacts and management of climate change. Table 1 shows an example of the learning progression ►►

Level	Description on Level of Achievement
Hypothetical	No evidence of understanding.
Lower Anchor (LA)	a. Students understand that all matter contains heat energy. b. Students can describe heat gain/loss in our everyday life (P3/P4 Science Syllabus).
1 (1A)	Students understand that the Sun is the primary source of heat and light energy that drive weather on Earth (P5/P6 Science Syllabus).
2 (2Aa)	a. Students can identify if some common gases are greenhouse gases (Sec 1 Geography textbook, p. 101).
2 (2Ab)	a. Students can describe how greenhouse gases trap heat in the atmosphere (Sec 1 Geography textbook, p. 101).
3 (3A)	Students can use the concepts of incoming and outgoing radiation to explain the natural greenhouse effect (Upper Sec Geography text).
4 (4A)	Students can explain energy exchange in detail, and the process of the greenhouse effect about how heat is trapped, e.g., LWR (Upper Sec Geography text).
Upper Anchor (UA)	Students can argue that the natural greenhouse effect keeps the Earth warm within its natural variability. They can also critique if the natural greenhouse effect is responsible for the observed climate change in the last 150 years (Year 1 University course at NIE).

Table 1. Hypothetical learning progression for natural greenhouse effect.

► developed on the natural greenhouse effect and the different anchors of that described the levels of achievement.

Based on the hypothetical learning progression, to achieve the upper anchor of understanding of the energy balance and natural variability, students need to understand incoming and outgoing radiation, energy exchange and explain the natural greenhouse effect at anchors 3 and 4. To explain the natural greenhouse effect, students should first be able to describe how greenhouse gases trap heat in the atmosphere and identify greenhouse gases at anchor 2. Prior to anchor 2, students should be able to understand that the sun is the main source of heat and light energy at anchor 1 and describe heat gain and heat loss in everyday life at the lower anchor.

It is important to note, however, that learning is not linear and students need not necessarily follow the progression to learn about the natural greenhouse effect. It is also not mandatory to achieve the previous anchor to progress to the next

anchor on the progression. In addition to the learning progression on the natural greenhouse effect, we have also developed the learning progressions for the enhanced greenhouse effect, human interaction and climate change, impacts of climate change and the management of climate change.

Contributions to Geography Education

This research project is one of the first attempts to describe the learning progression for climate change education in Singapore. It is also a consolidation of earlier research of students' misconceptions in climate change learning progression based in Singapore. In addition, we employed a cross sectional study rather than longitudinal study to provide a pragmatic solution without having to compromise the assumptions of the need for understanding learning across different levels in the education system. The research also aims to provide an empirical validation of the learning progression model for the improvement of student learning in Geography. The

data from Singapore can contribute to the existing international research on learning progressions. Implementation of the learning progression model in schools can also contribute to curriculum making in Singapore.

References

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