Learning Progressions for Climate Change: How does it look like in Singapore’s school geography?  
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Outline
- Background
- Research Problem
- Methodology
- Theoretical Learning Progression
- Discussion

School Geography in Singapore
- The inclusion of climate change in Upp Sec Geography came to the picture as early as 2008. Deals with climate change causes, impact and management.
- At pre-u level climate change is examined in relation to sustainable development in the 2016 revised syllabuses

Problem
- Climate change is an important topic in geography
- Students are unable to build on what they have learned (e.g., atmospheric processes and social relations) to develop an accurate and comprehensive understanding of climate change

Per Capita CO2 emissions by country

Problem
- Students' understanding has been found to be erroneous, inaccurate and incomplete conceptualizations (Chang & Pascua, 2016; Wang, 2004)
- a great disconnect between actual climate science knowledge and perceived knowledge (McCaffrey & Buhr, 2008).
Research Problem

Mental models

How is it learnt?

- Understanding requires strong **knowledge base**
- Students need geographical **understanding**
- How do students **progress** in their learning of key geography concepts?

Progression unpacked

- LP is concerned with how learners **advance** in their understanding
- how to design, structure and sequence the curriculum to facilitate the **achievement** of gradual gains in knowledge, understanding, skills and competencies.
- This is different from **continuity**
Learning Progression

- Learning occurs in a continuum
- **Upper** Anchors - describes what students are expected to know and are able to do by the end of the progression.
- **Lower** Anchors - prior knowledge and skills of learners as they enter the progression (can be other subjects - e.g. math, science, history etc.)

Research Design

Research Question:
How can Learning Progression help students learn climate change **better**?

Research Implications

- This can be further understood in terms of how LP will:
  - enhance the design of teaching and learning of climate change in Geography education
  - improve students’ engagement with the content of climate change as a topic in Geography education
  - facilitate the enactment of improved and empirics-based approach to teaching the topic of climate change in secondary school Geography

Phased approach

- **Phase 1**
  - Develop Hypothetical Learning Progression (HLP) (10 months)

- **Phase 2**
  - Development and validation of strategies, i.e. Empirical Learning Progression (ELP) (1 year)

- **Phase 3**
  - Pilot (1 year)

Nature and Scope of Phases 1 to 2

- To define the lower anchors at each level.
- Continue **document analysis** to design HLP (e.g. Syllabus).
- Collect and go through the **assessment** (school exam papers) for the new curriculum about CCE.
- Start to contact school for the approvals for the study and to sign the relevant ethics approval forms.
Empirical Learning Progression

• The results of the assessments will be designated as the Empirical Learning Progression (ELP).

Empirical Learning Progression

• Determines if students are progressing toward the upper anchor as expected, or if new instructional strategies must be introduced.

Participants

• 20 teachers will be recruited for the FGDs. In addition, 10 teachers will be participating in either one-on-one or paired interviews.
• Following a cross-sectional sampling scheme, students will be selected from different year levels (N=1200).
• The interviews will be conducted with 30 students.

Participants

• The interview participants will be selected from the pool of respondents as indicated here:

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary 1</td>
<td>20</td>
</tr>
<tr>
<td>Secondary 1</td>
<td>20</td>
</tr>
<tr>
<td>Junior College</td>
<td>20</td>
</tr>
<tr>
<td>University</td>
<td>20</td>
</tr>
<tr>
<td>Total</td>
<td>80</td>
</tr>
</tbody>
</table>

Theoretical Learning Progressions

- Natural Greenhouse Effect
- Enhanced Greenhouse Effect
- Human-Environment Interaction and Climate Change
How would an LP for climate change look like?

Learning Progression on Natural Greenhouse Effect as a cause of Climate Change (Geographical Concepts: Physical Processes)

<table>
<thead>
<tr>
<th>Objective</th>
<th>Description of Level of Achievement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Anchor</td>
<td>Students can identify the factors that contribute to the enhanced greenhouse effect.</td>
</tr>
<tr>
<td>Upper Anchor</td>
<td>Students can explain the enhanced greenhouse effect and its impact on the atmosphere.</td>
</tr>
</tbody>
</table>

1. The enhanced greenhouse effect refers to the rise in Earth's average temperature due to increased greenhouse gases released by human activities.
   - True
   - False
   - Not sure
2. Increase in greenhouse gas concentration also means more absorption of longwave radiation and reflection by Earth and more longwave radiation being re-emitted and reabsorbed in the atmosphere.
   - True
   - False
   - Not sure
3. The enhanced greenhouse effect is the result of increased greenhouse gases released into the atmosphere.
   - True
   - False
   - Not sure
4. Which of the following are sources of greenhouse gases? Select the correct answer(s) (more than one may be selected).
   - Deforestation
   - Burning of fossil fuels
   - Agriculture
   - Urbanization
   - Solar power plants
   - Industries
   - True
   - False
   - Not sure

How would an LP for climate change look like?

Learning Progression on Enhanced Greenhouse Effect as a cause of Climate Change (Geographical Concepts: Physical Processes)

<table>
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</thead>
<tbody>
<tr>
<td>Lower Anchor</td>
<td>Students can explain the enhanced greenhouse effect and its impact on the atmosphere.</td>
</tr>
<tr>
<td>Upper Anchor</td>
<td>Students can critically evaluate the role of enhanced greenhouse effect as a relevant cause for climate change and its impact on the observed climate change in the last 150 years.</td>
</tr>
</tbody>
</table>

Rank the greenhouse gases in terms of their relative contribution to the enhanced greenhouse effect, starting from the highest to lowest.

Use the numbers from 1 to 5 to rank the greenhouse gases where 1 represents the highest contributor and 5 is the least contributor.

- Methane
- Water Vapour
- Carbon dioxide
- Sulphur dioxide
- Nitrous oxide
- Chlorofluorocarbons (CFC)

The enhanced greenhouse effect is responsible for the observed climate change in the last 150 years.

- True
- False
- Not sure
Theoretical Contributions of the LP model to Geography Education.

- A first attempt to describe the Learning Progression for learning about climate change.
- A consolidation of earlier research in LP with the inclusion of the data from Singapore curriculum artefacts.

Empirical Contributions of the LP model to Geography Education.

- Validation of LP in improvement of student learning in Geography.
- Build on the existing research in LP with the inclusion of the data from Singapore.
- Implementation of the LP to schools to examine the improvements to the curriculum making process in Singapore.

Contributions to methodology

- Cross-sectional study rather than longitudinal study.
- If this works, it will provide a pragmatic solution that does not compromise the assumptions of the need for understanding the learning across different levels in the education system.
Thank you
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