Cognitive Acceleration Through Science Education (CASE) in the Irish Primary School

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Aims of Primary Science

- Develop students’ knowledge and understanding of scientific concepts
- Foster positive attitudes towards science
- Develop students’ scientific literacy
- Develop a scientific approach to problem-solving
Primary Science Curriculum

Conceptual Understanding
- Living Things
- Energy and Forces
- Materials
- Environmental Awareness and Care

Procedural Understanding

Working Scientifically

Designing and Making
Rational for the study

Varley et al., (2008)
- Lack of student led investigations
- Under-development of students’ scientific skills

NCCA, (2008)
- Students’ HOTS highlighted as area of concern
- Recommends a culture of thinking be promoted within the teaching of primary science

TIMSS (2011)
- Poor reasoning skills
- 35% of students able to apply their knowledge and to explain everyday scientific phenomena
Aims

- Assess whether the CASE methodology could be integrated into the teaching of science at all levels in an Irish primary school,
- Evaluate the teachers’ implementation of the lessons and identify areas of difficulty
Pillars of CASE

Schema
Concrete Preparation
Cognitive Conflict
Social Construction
Metacognition
Bridging

Adey, Shayer & Yates 2001
Why CASE?

- Embedded within the context of science
- Continuously shown to have positive effects on students thinking skills (Shayer, 1999; Adey et al., 2002)
- Has previously shown to have positive effects in promoting Irish students’ thinking abilities (Gallagher, 2007; McCormack, 2009)
Mapping the CASE lessons onto the primary science curriculum

<table>
<thead>
<tr>
<th>Lesson No.</th>
<th>3&lt;sup&gt;rd&lt;/sup&gt; Class Lesson</th>
<th>Schema</th>
<th>Strand Unit/ Skill</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Climb that mountain</td>
<td>Introductory Activity</td>
<td>Working Scientifically</td>
<td>Interpret information and offer explanations</td>
</tr>
<tr>
<td>2</td>
<td>Make that Box</td>
<td>Introductory Activity</td>
<td>Design and make</td>
<td>Planning, making, evaluating</td>
</tr>
<tr>
<td>3</td>
<td>Who am I?</td>
<td>Classification</td>
<td>Human Life/Plant and animal life</td>
<td>Diversity in human and animal skeletons</td>
</tr>
<tr>
<td>4</td>
<td>All these Bones</td>
<td>Classification/Seriation</td>
<td>Human Life</td>
<td>Identify different human bones and their function</td>
</tr>
<tr>
<td>5</td>
<td>What makes me move?</td>
<td>Concrete Modelling</td>
<td>Human Life</td>
<td>Investigate how people move (bones/joints)</td>
</tr>
<tr>
<td>6</td>
<td>Where do I live?</td>
<td>Classification</td>
<td>Plant and Animal life</td>
<td>Investigate plants and animals that live in local and wider environments</td>
</tr>
<tr>
<td>7</td>
<td>How am I Adapted?</td>
<td>Causality</td>
<td>Plant and Animal life</td>
<td>Observe and explore ways in which plants and animals are adapted to their environments</td>
</tr>
<tr>
<td>8</td>
<td>What am I?</td>
<td>Causality</td>
<td>Plant and Animal life</td>
<td>Observe and explore ways in which plants and animals are adapted to their environments</td>
</tr>
<tr>
<td>9</td>
<td>How Hot are You?</td>
<td>Classification</td>
<td>Heat</td>
<td>Thinking about the temperatures of ordinary objects</td>
</tr>
<tr>
<td>10</td>
<td>Hotter or Colder?</td>
<td>Variables</td>
<td>Heat</td>
<td>Learn that heat can be transferred</td>
</tr>
</tbody>
</table>
General Programme

- Focus on theory
- In-class coaching
- Encouraged to reflect
- Collective participation
- Co-operation with principal
Whole School Implementation

Lesson Reflections

Implementation

Confidence
CP = Concrete Preparation
CC = Cognitive Conflict
M = Metacognition
Teachers’ Implementation

Concrete Preparation

Cognitive Conflict/Social Construction

Teachers improved in their implementation of the pillars of concrete preparation and cognitive conflict.
Teachers’ Implementation

Concrete Preparation

Cognitive Conflict/Social Construction

Metacognition

Bridging

Difficulty in engaging their students in metacognitive discussions and relating students’ thinking to other areas.
Senior Infants/First Class (Group A)
Distinguish between **Cognitive Extension** and **Metacognitive Thinking**

Consciousness of thinking

<table>
<thead>
<tr>
<th></th>
<th>Distinguish between CE and MT</th>
<th>Refer to consciousness of thinking</th>
<th>Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>✔</td>
<td>✔</td>
<td>T14, T17, T21</td>
</tr>
<tr>
<td>2</td>
<td>✗</td>
<td>✔</td>
<td>T6, T9, T15, T25, T27</td>
</tr>
<tr>
<td>3</td>
<td>✗</td>
<td>✗</td>
<td>T1, T2, T3, T7, T8, T10, T11, T13, T18, T19, T23, T24, T26, T29</td>
</tr>
</tbody>
</table>
Key Finding and Recommendations

- CASE can be integrated into the teaching of science in Irish primary schools
- Future Implementation should involve the whole school
- In-class coaching
- Focus on developing teachers knowledge of and pedagogies in metacognition
Junior Cycle Student Award

- Managing Myself
- Managing Information and Thinking
- Communicating
- Working with others
- Being Creative
- Staying Well

“Reflecting on and evaluating my learning”
Teachers

• “The lessons stop me spoon-feeding them as much because I’m able to see that they can think for themselves” (Senior Infants)

• “I will be more thorough in future in assessing, monitoring and encouraging their thinking skills” (1st Class)

• “It has changed my approach to facilitating investigations. I am more conscious about giving the children greater autonomy and time during their discussions and investigations. I am better at asking leading and guiding questions without giving too much information” (4th Class)

• “It’s a very valuable methodology – especially in how it ‘transfers’ modes of thinking to other subjects – namely geography and maths but surprisingly, history” (6th Class)