

**Appendix:** An extract of the rubric used to assess and quantify enacted PCK on a four-point scale

	Limited (1)	Basic (2)	Developing (3)	Exemplary (4)
Students' prior knowledge	<ul style="list-style-type: none"> <li>• No facilitation of discussions that uncover and address students' prior knowledge.</li> </ul>	<ul style="list-style-type: none"> <li>• There are seldom discussions that uncover prior knowledge.</li> <li>• The teacher provides prior knowledge as standardised facts.</li> <li>• Most gaps and challenges in the prior knowledge are thus not exposed and addressed.</li> </ul>	<ul style="list-style-type: none"> <li>• The teacher facilitates rich discussions that uncover some of the relevant prior knowledge.</li> <li>• The teacher acknowledges correct understanding and addresses some gaps and challenges in the prior knowledge.</li> </ul>	<ul style="list-style-type: none"> <li>• The teacher facilitates rich discussions that uncover most of the prior knowledge.</li> <li>• The teacher acknowledges correct understanding and adequately addresses gaps and challenges in the prior knowledge.</li> </ul>
Curricular saliency	<ul style="list-style-type: none"> <li>• The teacher does not discuss ideas that are prescribed in the curriculum.</li> <li>• The new concepts are not developed from or linked with corresponding prior knowledge.</li> <li>• The sequencing of concepts is illogical, and the interrelatedness of the concepts is not explained.</li> <li>• The relevance of the concepts is not explicit.</li> </ul>	<ul style="list-style-type: none"> <li>• The teacher discusses only a few ideas prescribed in the curriculum.</li> <li>• A few of the new concepts are developed from or linked with corresponding prior knowledge.</li> <li>• The sequencing of concepts is illogical, and the interrelatedness of concepts is seldom explained.</li> <li>• The relevance of the concepts does not support conceptual understanding.</li> </ul>	<ul style="list-style-type: none"> <li>• The teacher discusses most of the prescribed ideas.</li> <li>• Most of the concepts are developed from or linked with corresponding prior knowledge.</li> <li>• The sequencing of concepts is logical, and the interrelatedness of concepts is often explained.</li> <li>• The relevance of the concepts involve scaffolding towards generic concepts.</li> </ul>	<ul style="list-style-type: none"> <li>• The teacher discusses all ideas prescribed in the curriculum.</li> <li>• The new concepts are developed from or linked with corresponding prior knowledge.</li> <li>• The sequencing of concepts is logical, and the interrelatedness of the concepts is explained.</li> <li>• The relevance of the concepts reveal scaffolding towards specific concepts.</li> </ul>

<p>What makes it difficult to teach this concept?</p>	<ul style="list-style-type: none"> <li>• No facilitation of discussions that uncover students' understanding of concepts and difficulties.</li> <li>• The teacher makes no effort to help students understand difficult concepts.</li> </ul>	<ul style="list-style-type: none"> <li>• Discussions that uncover students' understanding of concepts and difficulties are seldom facilitated.</li> <li>• A few areas of students' difficulties are addressed.</li> <li>• The teacher's attempts to explain difficult concepts by providing standardised phrases, e.g. "the field line points away from a positive charge."</li> </ul>	<ul style="list-style-type: none"> <li>• The teacher facilitates cognitive discussions that uncover students' understanding of some concepts and difficulties.</li> <li>• The teacher addresses some areas of difficulty while expanding on the explanations.</li> </ul>	<ul style="list-style-type: none"> <li>• The teacher facilitates cognitive discussions that uncover students' understanding of concepts and difficulties.</li> <li>• The teacher addresses most areas of difficulty, starting from gatekeeping concepts and expands on the explanations.</li> <li>• The teacher confirms correct understanding afterwards.</li> </ul>
<p>Representations including analogies</p>	<ul style="list-style-type: none"> <li>• Representations are not used to support the discussion of concepts.</li> </ul>	<ul style="list-style-type: none"> <li>• Representations are seldom used to support the discussion of concepts.</li> <li>• Most of the concepts that require representations are discussed without utilising them.</li> <li>• When used, the representations are poorly developed and mostly ineffective.</li> </ul>	<ul style="list-style-type: none"> <li>• Representations are often used to support the discussion of concepts.</li> <li>• The representations used to support conceptual change or conceptual development. Or</li> <li>• Multiple representations are used to support the teaching of one concept.</li> </ul>	<ul style="list-style-type: none"> <li>• Multiple representations are used to support the discussions of various concepts whenever necessary.</li> <li>• The representations serve various purposes; conceptual change and development with regards to prior knowledge and new concepts.</li> </ul>

<p>Conceptual teaching strategies</p>	<ul style="list-style-type: none"> <li>• There is no facilitation of discussions that promote conceptual change and development.</li> <li>• Some of the major concepts are explained incorrectly.</li> <li>• Students are hardly involved as the lesson is completely teacher centred.</li> </ul>	<ul style="list-style-type: none"> <li>• The teacher seldom facilitates discussions that promote conceptual change or development.</li> <li>• Some concepts are explained inadequately.</li> <li>• Students are seldom involved in the lesson through questions.</li> </ul>	<ul style="list-style-type: none"> <li>• The teacher facilitates discussions that promote conceptual development or change.</li> <li>• Most of the concepts are explained using conceptual approaches.</li> <li>• Students are sometimes involved in the lesson through questions.</li> </ul>	<ul style="list-style-type: none"> <li>• The teacher facilitates discussions that promote conceptual development and change.</li> <li>• All concepts are explained effectively using a variety of conceptual approaches.</li> <li>• Students are involved in the lesson through questions.</li> </ul>
---------------------------------------	---	---	---	---