ACER Portfolio Project

TEACHING FIELD: Secondary Science
LEVEL: Highly Accomplished

ENTRY 1: Building conceptual understanding of science

The ACER Portfolio Project focuses on the research and practical challenges involved in developing valid and feasible methods by which teachers can demonstrate how they meet the Australian Professional Standards for Teachers at the highly accomplished level. Entry 1 is one of four portfolio entries for secondary science teachers.

ENTRY 1: Building conceptual understanding of science

Introduction

Highly accomplished science teachers provide students with coherent, cohesive and purposeful sequences of learning opportunities that build students' conceptual knowledge and understanding of science. Teachers have a high level understanding of science content-knowledge, and the relevant curriculum requirements that they can translate into worthwhile and challenging learning goals and for their students.

Highly accomplished science teachers are aware of and can identify the diverse learning needs of their students and the factors that influence their learning of science. They can identify the cognitive level, capabilities and other significant factors that affect the learning of individual students, and they can take these factors into account when planning and implementing a science program. They provide flexible learning pathways that are related to the students' learning needs, and revise their teaching programs and strategies in response to student feedback.

Highly accomplished science teachers have extensive curricular and pedagogical content knowledge. Using a variety of strategies, they elicit students' prior knowledge, conceptual understanding and ability to communicate. They draw on current issues and students' experiences and interests, and they are strategic and creative in designing personalised activities that extend students' conceptual knowledge, understanding and ability to communicate. They are innovative in the use of resources available to them, including current technologies.

Highly accomplished science teachers draw on a repertoire of formative and summative assessment methods to monitor students' progress effectively. They clearly and deliberately include these into the planning of work sequences. They diagnose their students' conceptual understanding and use these diagnoses to provide timely feedback and intervention strategies to guide students' conceptual development. They are adept in providing students with methods and opportunities to reflect and evaluate their own learning and that of their peers.

Highly accomplished teachers of science use information gained from multiple sources to guide their students' learning and inform their teaching. They report to different audiences on the progress and achievement of individual students and their cohort against the articulated learning goals.

Highly accomplished science teachers keep abreast of science knowledge and educational research relevant to their practice. They engage in effective modes of professional learning, based on insightful analysis and evaluation of feedback about their practice.

Overview of the portfolio entry

In this portfolio entry you will demonstrate how you:

1. Set appropriate long-and short-term learning goals for your students, referenced to the Australian Curriculum: Science,
2. Engage students purposefully in activities that build their knowledge and understanding of important concepts in science over time,
3. Engage students purposefully in activities to effectively apply and communicate science knowledge and conceptual understanding.
4. Establish and manage students' learning activities, probe their understanding of scientific concepts in meaningful contexts, addresses alternative conceptions and provide feedback that enables students to make progress.

You will provide evidence by means of:

- **Three work samples** each from two students in the same class that provide evidence of how you demonstrated the points above.
- **Teacher artefacts:** materials made or selected by the teacher as part of the teaching/learning sequence to guide and support the two students in their learning.
- A **written commentary** that (a) describes the context of your teaching, your teaching and learning plan, and your reasons for choosing two students and them, (b) analyses of the students' work samples and how they demonstrate development toward your learning goals, and (c) reflects on the learning outcomes for each student and its implications for your practice.

Note: this entry should not duplicate the same teaching/learning sequence or be based on the same students as those of the other entries within this Science Portfolio.

Design framework

This entry is designed to enable you to provide evidence of how you meet the standards for highly accomplished teachers in your current teaching context. You will demonstrate your science content knowledge and pedagogical content knowledge and practice in relation to building the science conceptual understanding and communication skills of your students.

The entry is referenced to:

- The Australian Professional Standards for Teachers (Australian Institute of Teaching and School Leadership) at the Highly Accomplished career stage. http://www.aitsl.edu.au/australian-professional-standards-for-teachers/standards/career-stage/highly-accomplished
- Australian Curriculum: Science (AC:S) http://www.australiancurriculum.edu.au/science/rationale
- Research on best practice for teaching and learning science that informed your practice in relation to this entry

Australian Professional Standards for Teachers, Australian Institute of Teaching and School Leadership (AITSL) Relevant to Entry 1

This entry requires you to provide evidence of your accomplishment relevant to the following *Australian Professional Standards for Teaching* at the Highly Accomplished career stage

Standard 1: Know students and how they learn
Standard 2: Know the content and how to teach it
Standard 3: Plan for and implement effective teaching and learning
Standard 4: Create and maintain supportive and safe learning environments
Standard 5: Assess, provide feedback and report on student learning
Standard 6: Engage in professional learning

An emphasis for this entry is on Standards 1, 2, 3 and 5 although your entry will also relate to Standards 4 and 6.

Australian Curriculum: Science

The overall **aims** and **content structure** of the science curriculum are clearly articulated. http://www.australiancurriculum.edu.au/science/aims and http://www.australiancurriculum.edu.au/science/content-structure

The science content is described in the Australian Curriculum: Science (AC:S), relevant to the year or phase of learning of your students.

http://www.australiancurriculum.edu.au/science/curriculum/f-10?layout=1

Although the three strands of the science curriculum are interrelated and are expected to be taught and learnt in an integrated way, this entry focuses on the ***Science Understanding*** strand in particular. http://www.australiancurriculum.edu.au/science/content-structure . However, your entry will demonstrate how your teaching makes a contribution to developing associated knowledge of *Science Inquiry Skills* and *Science as Human Endeavour.*

Note*: Individual jurisdictions may have mandated variants of the AC:S. If so, the relevant curriculum documentation should be referenced*

This entry does not prescribe how you will teach the science content knowledge, the type of strategies to use or the kind of opportunities and activities you provide for your students to build and communicate their understanding; these are matters for your professional judgment given the circumstances of your teaching and the particular requirements of your students. http://www.australiancurriculum.edu.au/science/implications-for-teaching-assessment-and-reporting

Research on effective teaching practice in science

There is a considerable body of research about learning science and best practice for teaching science. You will draw on and reference this research, explain how it has informed your approach to teaching and learning in science, and relate it to the opportunities you provided that enabled **your** students to build and communicate their science conceptual understanding.

Requirements for Entry 1: Building conceptual understanding in science

Your **work samples from two students**, your **artefacts** and your **written commentary** will provide evidence of how you have enabled these students to make gains in the development, application and communication of their knowledge and conceptual understanding relevant to the requirements of this portfolio entry.

The class/students you select and the teaching/learning sequence should be different from those featured in your other portfolio entries in science.

Student Work samples

The two students and the three sets of work samples for each student that you select for this entry should provide you with the opportunity to demonstrate your professional knowledge and practice to best advantage. Work samples should provide evidence of the scientific concepts being studied, your feedback on the students' progress in building and communicating their conceptual understanding over time.

Guidance is provided in the ***Supporting information****.*

Artefacts

The artefacts you select must support this particular entry. Guidance on selection is provided in the ***Supporting information*****.**

Requirements for assembling, formatting, digitising and electronic submission of items are provided….

Written commentary

Your written commentary will assist assessors in making judgements about your accomplishment in relation to this entry. Your written commentary will consist of 6 components as follows:

1. School context (… page)

In this section you will outline the characteristics of the school and the wider community that provides the context for your teaching and learning environment, including:

1. Type of school, its location (rural/remote/urban), jurisdiction (State, Catholic, Independent), Level (e.g. primary, secondary, F-12); single/multi-campus, co-ed/single sex boys/girls *[use drop-down boxes].*
2. Total school enrolment, year levels, number and size of classes.
3. Mandated curriculum requirements. (Note: you school/jurisdiction may mandate a variant of the Australian Curriculum. Please give relevant details if this is the case.)
4. Demographic composition and characteristics of the school and wider community, for example: cultural, ethnic and socio-economic backgrounds, diversity of language, integration of students with disabilities.

2. Teaching context

In this section you will describe the characteristics of the class you are teaching, the resources available to you, and other factors that might influence the teaching and learning of these students in science at this time.

2.1 What is the year level, the age range and the number of students in the class?

2.2 What is the nature of the space/facilities in which you teach science to this class?

2.3 What features of school programming might affect your teaching of this class?

2.4 What resources are available to you that facilitate or limit teaching and learning in science?

2.5 What are the characteristics of the class you are teaching that influenced the way you designed the teaching/learning sequence?

3. Research on effective teaching practice in science

In this section you will select and reference two to four authoritative studies in the field of science teaching and learning that have influenced the way you teach scientific concepts.

Make specific reference to why and how you have applied the research findings to the learning opportunities you have provided for your students in the context of this entry.

3.1 Explain how and to what extent your prior knowledge/understanding of educational research findings affected or informed your approach to teaching for this entry?

4. Planning

In this section you will describe your overall plan for the unit of work during which students produced the work samples you will analyse in the next section. Where appropriate, refer to artefacts that you are submitting to support your entry (e.g. guidelines to the activities).

4.1 In your planning, what were the overall goals for the sequence of teaching and learning that led to the activities that generated the work samples? Why were these goals important for your students?

4.1 What challenges were inherent in the specific science concept(s) you planned for your teaching? (You will need to describe these in relation to building students' conceptual understanding and communication skills.)

4.2 Describe the activities you chose to assist students to meet your learning goals and how they catered for differences among your students. Describe how you planned to assess student progress toward those goals.

4.3 In planning the sequence of learning activities, how did you make meaningful connections between the relevant content descriptions of the *Science Understanding* strand and those of *Science as Human Endeavour* and *Science Inquiry Skills* (or their variants)? How did you provided meaningful contexts for the students to develop their understanding of the science concepts being studied?

4.4 Briefly describe the two students you have chosen to be the focus of your entry. Refer to them as Student A and Student B. What particular challenges to your teaching did each present?

4.5 What was the intention of each of the three activities that were designed for the students to generate work samples relevant to this entry? How did the activities relate to each other as a sequence?

5. Analysis

In this section you will analyse each student's developing knowledge and understanding of the science concepts relevant to this unit of work, using the work samples produced by each student for each of the three activities, as your primary source of evidence. For each student (A and B), explain:

5.1 Why you chose these particular work samples to submit? Explain, with reference to each student in turn, what each of the three work samples tells you about that student's progress towards achieving the conceptual goals and communication skills that you identified in your planning.

5.2 How you monitored each student's progress, assessed their conceptual understanding and ability to communicate, and how you used this information to guide their learning? Make reference to specific evidence of the strategies you employed for each of these three aspects.

5.3 What gains in learning were achieved by each student, as evidenced by the work samples?

5. Reflection and evaluation

In this section you will reflect on and evaluate your teaching practice and your students' achievement of the overall goals of the teaching/learning sequence. You will discuss its implications for your teaching, in particular how you planned to follow-up with students A and B.

Make specific reference to the student work samples and your analysis above in section 4..

6.1 To what extent was your knowledge of the two students effective in influencing your teaching strategies you used to generate the work samples?

6.2 How effective was your monitoring of the students' progress in enabling them to build and communicate conceptual understanding? Make reference to the work samples.

6.3 Describe, justify and explain the modifications, if any, you made to the planned sequence of activities to meet challenges that arose.

6.4 How did the students' learning outcomes inform your subsequent teaching practice/approach for these students?

How will my entry be assessed?

Your entry will be confidential, anonymous and will be assessed by trained peers using the attached Evaluation Guide [link]. .

An entry that meets the highly accomplished level provides clear evidence that the teacher has planned and implemented a purposeful, coherent and cohesive sequence of learning activities that has developed students' knowledge and understanding of a major concept in science and their ability to communicate that knowledge and understanding.

Entry 1 Secondary Science: Building conceptual understanding in science

Summary of requirements

Components of the portfolio entry	Limits*	Comments
Student Work Samples (SWS)	2 sets (A & B) of 3 samples generated from activities	The SWS provide evidence of your teaching practice and each student's learning. The three work activities selected must be the same for both students. SWS must be generated by the same 2 students in the same class for each of the 3 activities.
Teacher Artefacts	8 pages	These indicate the materials used to guide and support ts student learning and the activities used to generate the SWS. Must **not** replicate the student work samples.
School context	1p Not scored	Describes the characteristics of the school and wider community that may influence your teaching practices .
Teaching context	1p Not scored	Describes the characteristics of students in your class. of the class and how they influence your teaching
Written commentary:	12pages (max).	Describes, analyses and evaluates a unit of work in which you have developed students' knowledge and understanding of science concepts.
Research on effective teaching practice in science	References 2-4 articles One page max.	Demonstrates how educational research has informed your approach developing students' knowledge and conceptual understanding in science.
Planning	3 pages	Provides the outline of the planned teaching/learning sequence Outlines the intentions of the 3 selected activities, both as individual activities and as a set Describes and demonstrates your knowledge of science content
Analysis	3-4 pages	Demonstrates how you have developed students' conceptual understanding in science and their ability to communicate science understanding Shows that you can interpret and critique your teaching practice in relation to students' learning, as evidenced by your analysis of student work samples and associated artefacts.
Reflection and evaluation	3 pages	Describes your ability to use knowledge about students' learning and your teaching practice to further improve students' learning outcomes, and subsequent teaching practice.

Supporting information: guidance for preparing your portfolio entry

How to demonstrate your practice to best advantage

Selection of the two students

The two students you choose will be from the same class and should provide different kinds of teaching challenges. By this means you can demonstrate your knowledge and practice to best advantage by drawing on a variety of strategies in your teaching that personalise learning. The two students and their work must be anonymous, referred to only as Student A and Student B, and Work samples as A or B1, A or B2, and A or B3.

Selection of the scientific concepts

It is important that you select scientific concepts or ideas that:

- relate directly to curriculum requirements (AC:S or mandated variant)
- are substantial enough to make meaningful connections with the strands of *Science as a Human Endeavour* and *Science Inquiry Skills*
- are substantial enough to build on as a coherent whole over a period of a minimum of 3 weeks to a maximum of 10 weeks.

Selection of the activities

Select three activities from the overall teaching-learning sequence that will provide ample opportunity for your students to engage actively and purposefully in meaningful contexts. The activities should help to build the students' conceptual understanding appropriate to their level of understanding, background and needs; they should meet the curricular requirements and take into account the overall context of your teaching.

The **activities** could be selected from the introductory phase, the exploratory or developmental phase, or from the last phase in the teaching/learning sequence. Allow sufficient intervals of time between selected activities to provide the opportunity for conceptual understanding to become apparent.

As a whole, these activities will provide evidence of your science knowledge and your teaching skills. They should enable you to show the conceptual challenges you pose, the resources you use, and the strategies you employ to build students' conceptual understanding over time.

The activities should provide students with the opportunity to demonstrate and communicate their development of reasoning, critical thinking and conceptual understanding in relation to the particular scientific concepts being studied.

The individual activities could take place during the course of a lesson or over multiple lessons, they could be on-site or off-site, be virtual or real.

Selection of the work samples

Not all activities that students engage in will generate samples of their work. The activities you ultimately select for this entry should be rich enough to lead to the generation of individual work samples that provide evidence of your teaching practice (including any intervention strategies), student engagement and how you helped them to build and communicate their conceptual understanding in meaningful contexts.

It is strongly recommended that you avoid samples that rely on reproduction of factual information or terminology. Instead, choose examples of work that represent individual student's thinking and conceptual understanding, together with your feedback about the work they have produced.

It is worthwhile **monitoring the progress of more than two students,** possibly the whole class, and collecting samples of their work. Having collected such evidence over time, you will have greater scope for choosing two students who will enable you to present the best evidence in the three activities of how you have facilitated their **growth in conceptual understanding** and associated skills. The two students could present very different challenges to your teaching, thereby providing evidence of your broad repertoire of knowledge and skills.

To achieve this it may be beneficial to keep a journal record of the teaching-learning activities , and plan in advance to collect original or copied/scanned/photographed teaching materials and student work samples from every activity.

The three selected work samples generated by each student (Student A and Student B) should form a set which with relevant artefacts, will enable you to conduct an in-depth analysis of your teaching and the student learning.

***Note**: Specific requirements for assembly and submission of the selected work samples can be found …*

Selection of artefacts

The artefacts you select must support this entry. Review the questions required to complete the written commentary as these will help guide the choices you make about the material to submit to support your responses. Ensure that you adhere to the requirements for submission. *[link…]*

Teaching artefacts should not replicate the student work samples but should illustrate, for example, your teaching plan, and strategies for implementation.

Selection of Research findings

Although you may be influenced positively by professional colleagues and adopt, adapt and share ideas and practice, for this entry you are expected to source and reference authoritative research studies that have influenced **you** in teaching science. A comprehensive literature review or analysis is not expected in this section of your entry, but a specific explanation of how your professional reading has informed and helped you maintain the currency of your practice in relation to this entry is required.

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