DigiExplanations

Explanations

An *explanation* is a statement or set of statements that clarifies the reasons, causes, context or principles that underpin a particular scientific phenomenon. The word derives from the Latin term *explicatus,* which means to provide reasoning for. Explanations are central to the discipline of science as one of the goals of the discipline is to conduct research to provide explanations leading to a deeper understandings of various phenomena. In plain English, an explanation explains why things work, what something is or how things happen. They often provide cause and effect relations include a time sequence and use action verbs.

An explanation of a scientific concept usually has five elements:

(i) Introduction: starts by naming or specifying the concept or posing a question;
(ii) Engagement: create a "need to know" by connecting with the audience and pitch at the right level eg generate why someone should look and so, perhaps a real life problem or issue
(iii) describes elements or components of the concept in an appropriate order;
(iv) explains how the elements relate or connect to each other. This is the indepth sciece
(v) provides an example; and
(vi) summarise with a concluding statement, perhaps so what.

Universities
In Faculties of Science, **explanations** and ways to communicate them have an important role in the Australian Learning and Teaching Standards especially in regard to: (i) Threshold Learning Outcome 1, *Understanding Science*, states that students need to demonstrate a coherent understanding of science by "explaining why current scientific knowledge is both contestable and testable" and "explaining the role and relevance of science in society"; (ii) Threshold Learning Outcome 2, *Scientific Knowledge* by "demonstrating well-developed knowledge in at least one disciplinary area"; and (iii) Threshold Learning Outcome 3, *Communication,* by "communicating scientific results, information or arguments, to a range of audiences, for a range of purposes, and using a variety of modes."

In Faculties of Education, **explanations** and ways to communicate them have an important role in the Australian Institute for Teaching and School Leadership (AITSL), standards especially for Standard 2, *Know the Content and how to Teach it,* especially in regard to: (i) 2.1 "demonstrate knowledge and understanding of the concepts, substance and structure of the content and teaching strategies of the teaching area" and 2.2 "Implement teaching strategies for using ICT to expand curriculum learning opportunities for students".

Schools
Most school science syllabuses have a fundamental aim that students should be able to explain science concepts. For example, the Australian National Curriculum states: "Science provides an empirical way of answering interesting and important questions about the biological, physical and technological world. The knowledge it produces has proved to be a reliable basis for action in our personal, social and economic lives." (ACARA, 2012, p. 3). The Science requirements in the USA are similar. According to the US National Science Education Standards:

> The *Standards* call for more than "science as process," in which students learn such skills as observing, inferring, and experimenting. Inquiry is central to science learning. When engaging in inquiry, students describe objects and events, ask questions, construct explanations, test those explanations against current scientific knowledge, and communicate their ideas to others. They identify their assumptions, use critical and logical thinking, and consider alternative explanations. In this way, students actively develop their understanding of science by combining scientific knowledge with reasoning and thinking skills. (1996, p. 2)

Teaching Strategies to Promote Explanations
There are several teaching strategies that promote explanations:

1. One way is for teachers to make what is required in an explanation explicit according to a five step procedure (McNeill & Krajcik, 2008): (i) making the framework explicit by being clear to students the type of structure of explanation needed; (ii) modelling and critiquing explanations whereby teachers show students examples of good explanations; (iii) providing a rationale for creating explanations so that students know why they need to be clear about their reasoning; (iv) connecting to everyday explanations meaning that the reasoning is based on common sense; and (v) assessing and providing feedback to students meaning that will only improve their explanations if they get explicit suggestions on the strengths and weaknesses of their reasoning.

2. Writing Scientific Explanations
It is important that students are provided with frameworks for explaining science concepts. These have been called informative texts and can have the following parts: (i) write an introduction clearly stating the problem or question; (ii) write a sequence of steps or results which may involve providing evidence; (iii) write an implication; and (iv) write a conclusion.

3. PEEL (Project for Enhancing Effective Learning) Procedures
This is a community of practicing teachers primarily based in Australia that devise strategies to support student learning. Some of those that have related to improving student explanations Explanations by teachers can involve collecting and reshaping ideas from students, offering a "story", giving students new words to be practiced. Some of the suggested strategies are:

- POE: This stands for Predict, Observe, Explain whereby students predict what is going to happen when they see a demonstration, they observe what happens and then provide an explanation of the phenomena individually or in groups.
- Summarising a discussion with a diagram. A concept map can be drawn with the central term in the middle and other related term extending from it.
- Postbox: Students in a group each are required to write and explanation of a concept on a piece of paper. These are then passed around the group or swapped with other groups and then each group decides on what is the best combination of suggestions for the explanation.

4. Digital Representations

Increasingly students are using their own digital technologies such as mobile phones, ipads and computers to create digital representations to explain science concepts. They can make podcasts (audio explanation), video (audio and image) as well as animations (see slowmation) to explain science concepts. These can be shared with others by uploading to internet sites such as YouTube or to other sites such as "60 Second Science" or "Scientific American."

References

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