# Practical teaching activities and scientific methodology

**Matthew:** [00:00:04] Hi, I'm Matthew, and I'm here today to talk about practical teaching activities and the scientific methodology.

**Matthew:** [00:00:10] Part of the focus for the new study design is to make it more accessible to schools that may be restricted in the size of the school and also the resources they have. A way to allow this to happen is to increase the flexibility of the practical teaching activities. The scope of the practical tasks includes plant and or animal management, experimental field trips, scientific trials, experiments and data analysis, business or entrepreneurial practices, including value adding activities, investigative reporting on best practice and virtual reality experiences. These are listed on page 2 of the study design.

**Matthew:** [00:00:49] When conducting and planning some of these practical teaching activities, such as scientific trials and experiments, the expectation is that the scientific methodology is followed. The scientific methodology can be found in the cross studies specifications of the study design. This methodology is used by other studies, which is why it is beneficial to maintain consistency. There is not an expectation for students to create their own method, but there is scope for students to develop or adjust method relative to their context.

**Matthew:** [00:01:25] What I would now like to do is talk through to the development of an experiment that can be completed in the classroom. A benefit of this experiment is that it requires a very small amount of space and utilizes equipment that is common in science prep room.

**Matthew:** [00:01:41] The first step in the scientific method is to develop a research question. For this experiment, the aim is to find the optimum concentration of a hydroponic nutrient solution to grow tomato seedlings. From there, the student would be required to develop a hypothesis or make a prediction where they need to propose an expected outcome. This is to be based on prior knowledge or research. Students are then required to conduct investigations, follow the method to allow for the collection and recording of data. During this stage, students would greatly benefit from being able to identify the independent and dependent variables as well as other control variables. Students would also benefit from being able to identify the control and explain the importance of a control in an investigation.

**Matthew:** [00:02:34] In front of me, what I have here is I have six different beakers. In each of the beakers, we have nutrient solution. As we can say, each beaker is labelled and it labels and explains what concentration of the hydroponic solution is in each. On top of the beaker here, we actually have a plastic petri dish that my lab techs have been able to drill a hole in. The tomato seedlings have been carefully placed through those wholes and around the stem they've been wrapped with some cotton wool. It's wrapped firmly enough to hold the plants in position, but not so tight that it restricts their growth.

**Matthew:** [00:03:13] As part of the planning and undertaking of the investigation, we now need to consider all of the variables. Firstly, the independent variable. In this instance, it is the concentration of the nutrient solution. The independent variable is the factor or feature that is changed by the investigator and will usually influence the dependent variable. The dependent variable is a variable that measures the effect of the independent variable. This can be challenging for the students to identify as I can become confused with what they are trying to find out versus what they are measuring or recording. In this experiment, the aim of what we are trying to find out is which nutrient concentration results in the greatest growth. But we need to be able to define what the greatest growth means. One of them could be measuring the length of the root. Another could be the height of the plant. Something else you might be able to do is count the number of leaves. By selecting all or some of these variables and analysing the results, students will understand how the plant's growth is affected by varying concentrations of the nutrient solution. All other variables need to be considered and then controlled if possible. These controlled variables are kept constant during the investigation to ensure that they do not impact on the interpretation of the relationship between the independent and the dependent variables.

**Matthew:** [00:04:43] Variables that are controlled may include the temperature, light, amount of solution, variety of tomato, etc. These variables may be numerous. If these cannot be controlled, they can affect the growth of the plant and valid conclusions may not be able to be made.

**Matthew:** [00:05:04] Next is the control condition, often confused by students with controlled variables. This is a vital part of any experiment, and its key role is to provide a comparison between each experimental condition. The control condition in this investigation would be the solution with known nutrients added. This enables us to say that it is the nutrient concentration that contributes to the growth and health of the planet. Another important consideration is repetition of multiple trials. Increasing the number of trials increases the reliability of the investigation, but resources need to be considered in a school environment. The use of a logbook is always preferred as it enables the students to ensure accuracy and consistency when recording their results and observations. Students will need to be out to record data in an appropriate format. Using the collected data, students will be required to analyze and evaluate the results to be able to draw evidence based conclusions. In all investigations, students and staff are required to comply with safety and ethical guidelines.

**Matthew:** [00:06:15] Thank you for listening to me today.

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