TEACHING ENQUIRY
with MYSTERIES INCORPORATED

The Development, Implementation and Evaluation of a Transition Year Module Based on the Principles of the Teaching Enquiry with Mysteries Incorporated Project.

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Outline of the Project:

The aim of this research project was to develop teaching materials specifically for Transition Year science. However, the lessons themselves will be focused on the Teaching Enquiry with Mysteries Incorporated (TEMI) approach, which uses mysteries to engage pupils.

***Research Questions*:**

- Does TEMI promote pupils' motivation to explore science concepts further?
- Does the TY TEMI module encourage pupils' intentions to pursue a Leaving Certificate science subject?

Transition Year (TY)

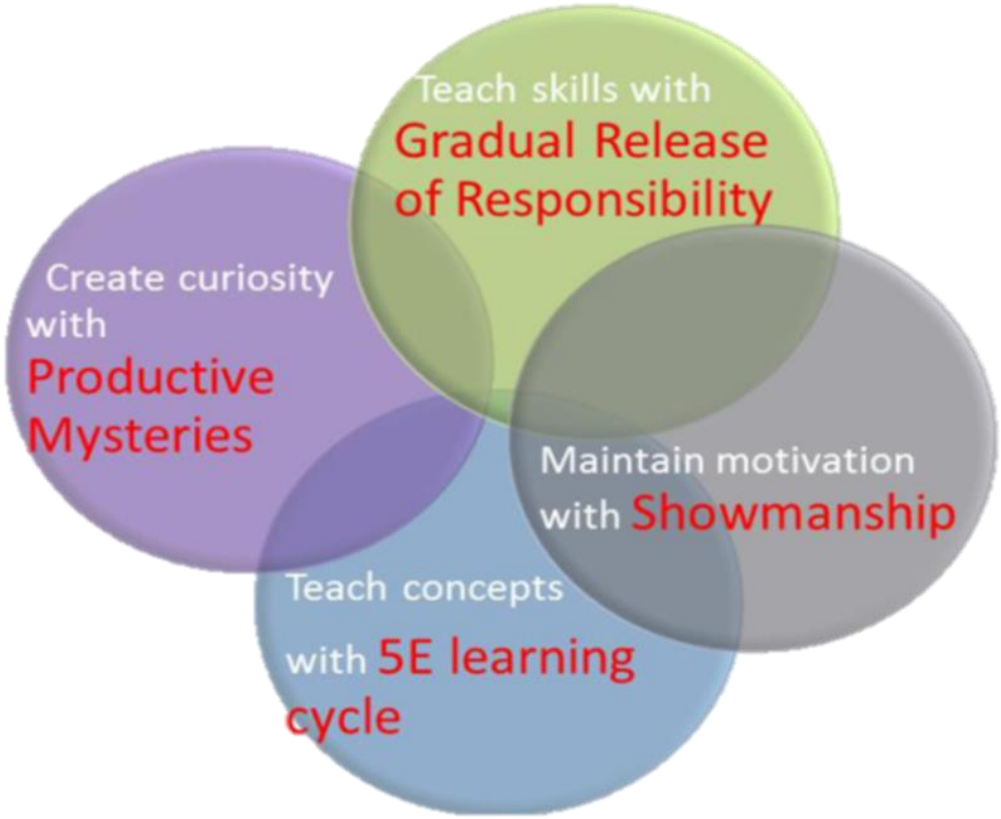
- TY is a non-academic “gap” year that is unique to the Irish secondary education system, and is aimed at promoting pupils’ social and personal development (Clerkin, 2012). It is offered to pupils in their fourth year of second level education in Ireland.

- It is perceived as “a bridge to enable pupils to make the transition from Junior to Senior Cycle.” (Department of Education, 1993, p. 3).

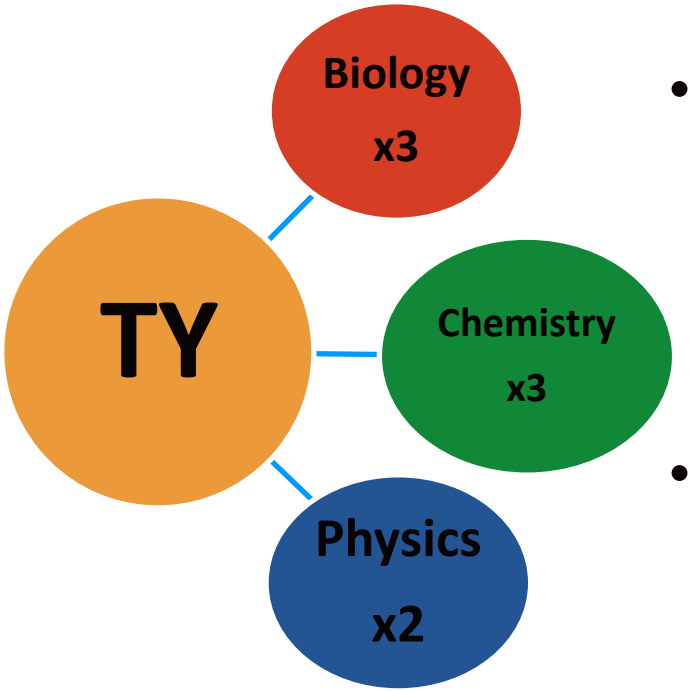
Teaching Enquiry with Mysteries Incorporated (TEMI)

- The overall aim of the TEMI project is to develop teachers' enquiry based teaching skills in science and mathematics (TEMI, 2013).
- The goal is to provide support needed to achieve this which includes the production of exciting new resources (TEMI, 2013).
- TEMI lessons are based on the 4 innovations of TEMI

TEMI – 4 Innovations



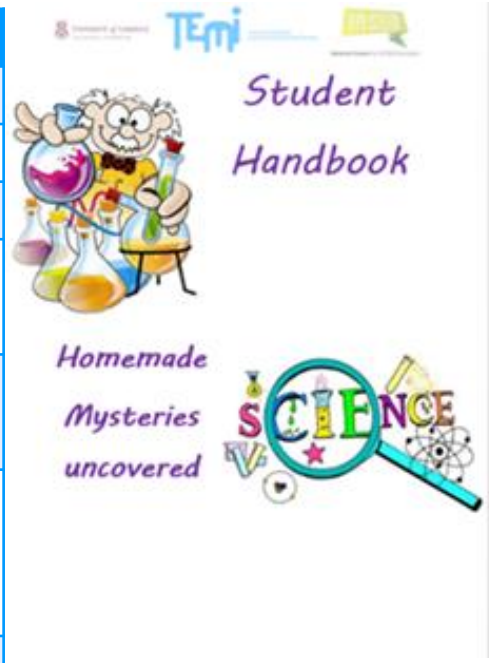
Development: TY module

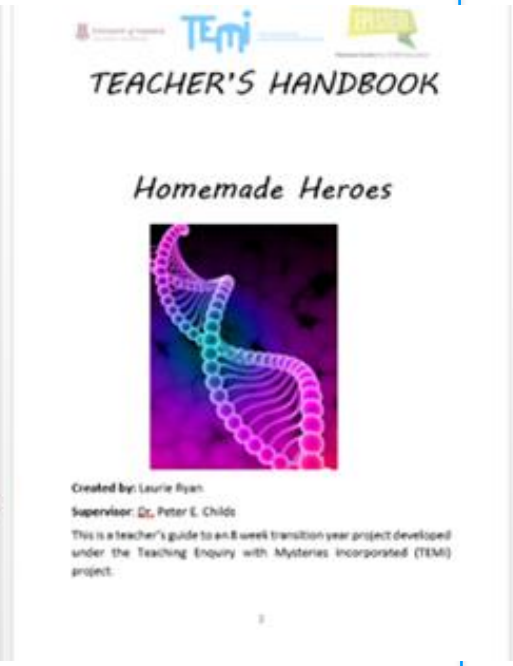


- *Transition Year Module = 8 weeks*
- *This module was called '**Homemade Heroes**' and contained mysteries that could be carried out using mainly household materials.*
- *Each week has a different focus e.g. enzymes/density/centre of gravity.*

Outline of the TY Module

Topic Title (scientific topic covered)
1 What floats your boat? (Density)
2 Bubble trouble (Surface Tension)
3 Move your body (Centre of Gravity)
4 Food for thought (Enzyme denaturation)
5 The disappearing act. (Absorbent Polymers)
6 Now you see it! Now you don't! (Acids, bases and Indicators – hidden messages)
7 Ice, Ice baby (Depression pt. of Ice)
8 What's going on? (Alcohol Fermentation)

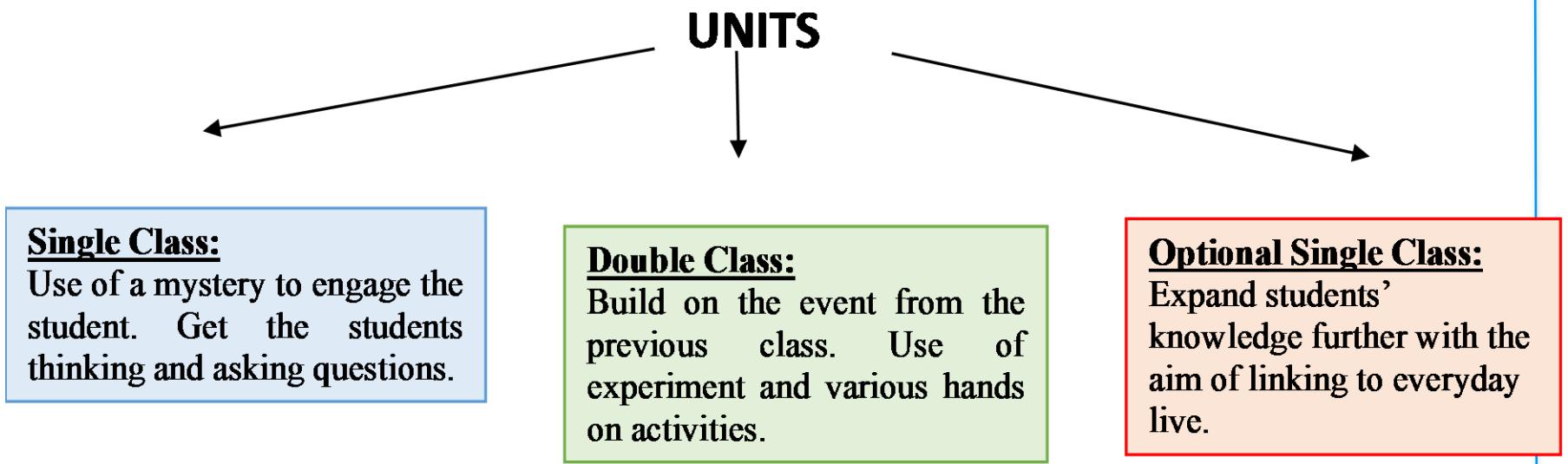




TY Module

The module follows the same lesson structure as the previous TY science modules created at the University of Limerick (UL) (Childs *et al*., 2013) while also incorporating the 5E module.

Outline of module design

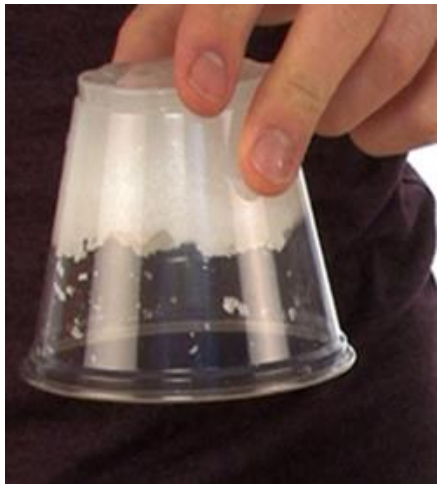


How did it fit in to the structure?

Single	Double	Optional Single
1st step included the ***engage*** phase, in this module it was always a mystery/discrepant event. This is followed on with the ***explore*** stage, getting the students to think about how they could test/trial and eliminate possibilities . Finally, the ***explain*** stage was introduced once all ideas were investigated.	This lesson focused on the ***Expand*** stage. It allowed the pupils to work on there own and carry out experimentation. ***Evaluation*** included the conclusions and worksheets.	This was an optional single class that extends form what they had covered in the previous classes. It was outside of the 5E model.

ENGAGE: Add water to a Styrofoam cup containing hydrogel.
Where does the water go when placed in the cup.?

EXPLORE: Use a clear plastic cup with the same trick. what is the powder?



EXPLAIN: pupils will have some background on polymers.

EXPAND: Test for the best brand of nappy. It is important to ensure a fair test is carried out.

EVALUATION: was based on the results and the pupils ability to form conclusion

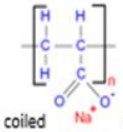
Inside the Teacher handbook

Aim: To introduce students to hydrogels.

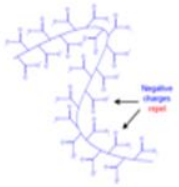
Objectives: Students will be able to explain how hydrogels work and their function.

Students will become competent in experimental procedures ensuring a fair and accurate test.

Teachers Background: In this unit we will look at the varying level of absorbance in nappies and discuss similar materials that are used. Students will all be familiar with nappies and their function but not the material present in them. **Hydrogels** are polymers that can absorb water but also contain hydrophilic groups. Polymers are known as a large molecule made up of chains or rings of linked monomer units. Hydrogel is often polymers containing carboxylic acid groups with the most common being poly sodium propenoate which is shown below.



The polymer chains are normally coiled up. If you take away all the Na particles, the chains uncoil. This is due to the negative charges on the oxide ions along the polymer chain all repelling each other as shown in the picture below. Water molecules are then attracted to the uncoiled chains, and the hydrogel absorbs up to 500 times its own weight of water. One of the main uses of this polymer is in nappies.



Water molecules are attracted to the negative charges by hydrogen bonding. When salt is added to the hydrogel, the chains start to change their shape and water is lost from the gel. Urine does contain salt, and these salts impede the performance of the sodium polyacrylate. Scientists have modified the polymer to counteract the effects of the salts in urine. Hydrogen bonds are what hold the water molecules to the polymer.

Hydrogels are used to make:

- Soft contact lenses
- Nappies
- Wound dressings
- Drug delivery systems

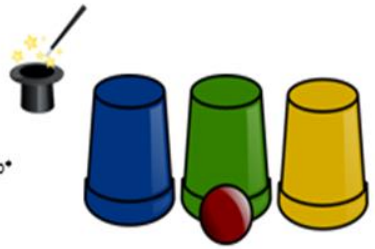
Single Lesson: Hide and Seek

Aim: To introduce the topic of polymers- hydrogels to the students.

Discrepant event:

Engagement:

Materials:



- 3 clear plastic cups
- 3 white polystyrene cups
- Hydrogel from a nappy approx. 1Tbsp*
- Water 100 mL
- Plastic zip lock bag

***To remove the hydrogel:**

- Place a new nappy on the piece of newspaper. Carefully cut through the inside lining and remove all the cotton-like material. Put all the stuffing material and plastic lining into a clean, zipper-lock bag.
- Scoop up any of the powdery material that may have spilled onto the paper and pour it into the bag with the stuffing. Blow a little air into the bag to make it puff up like a pillow and then seal the bag.
- Shake the bag for a few minutes to remove the powdery hydrogel polymer from the stuffing. Notice how much powder falls to the bottom of the bag.
- Carefully remove the stuffing and the plastic lining from the bag and check out the powdery polymer left in the bag. Repeat steps 1-4 with another diaper, if needed, to get 15 mL of the hydrogel powder.
- Now it's time to mix the powder with water to see what happens. Pour 15 mL (1 Tbsp) of hydrogel powder into a 266 mL plastic cup. Measure 100 mL of water and pour it into the cup along with the powder.
- This should be tested before trialling with students as tap water will also affect the absorbance level due to ions present.

Method:

1 cup contains hydrogel and 2 contain nothing.

1. Use the white cup first so students can't see what is happening.
2. Place 15mL approx. of hydrogel in a cup.
3. This is the cup that the water will be added to. 100mL will be added by the teacher.
4. Teacher will then switch the places of the cup with the other two that will be present (that contain no water and no hydrogel.) numerous times so the students will have to follow the cup.
5. Teacher will then ask students to pick the cup containing water.
6. When the teacher pours over all 3 cups no water comes out.

Inside the Pupil handbook

Unit 1: The disappearing act

Single Lesson: Hide and seek

What do you think has happened in the cup? (Write as many ideas you can think of no matter how crazy)

Next demonstration: can you expand on and try explain what you seen in the previous demonstration.

Can you think of advantages or disadvantages to the way this works?

Name uses for this material. And any items that might be similar.

What is the link between what you have just seen and the picture your teacher showed you?

Cat litter why is this not used instead? Think about this

- Have you seen cat litter before?
- What does it look like?
- Feel like?

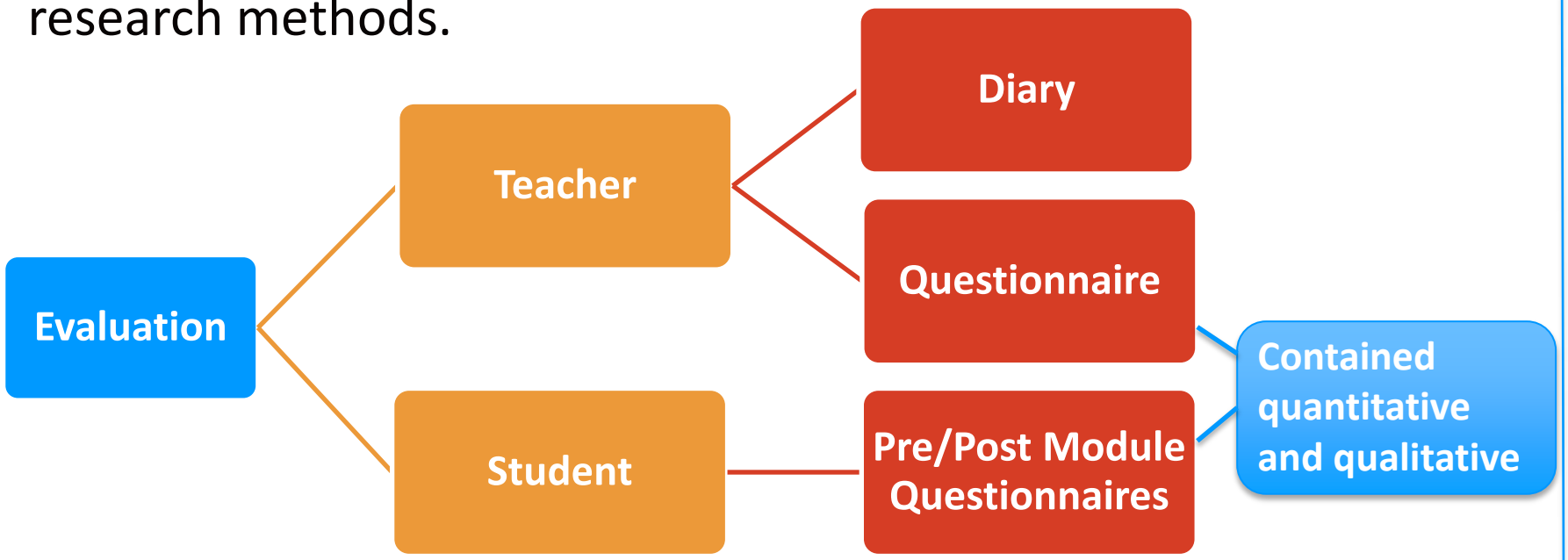
You just watched a video clip what new information did you just learn?

How can we test 2 different nappy types against each other? (Remember: What needs to be kept constant to ensure a fair test?)

How can we test different age groups against each other?

Evaluation

The research was trialled and data gathered during School Placement for Pre Service Science Teachers(PSSTs) in UL. School Placement is a 10 week teaching block, the brief time-span of the research project meant an emphasis was placed on time-efficient research methods.



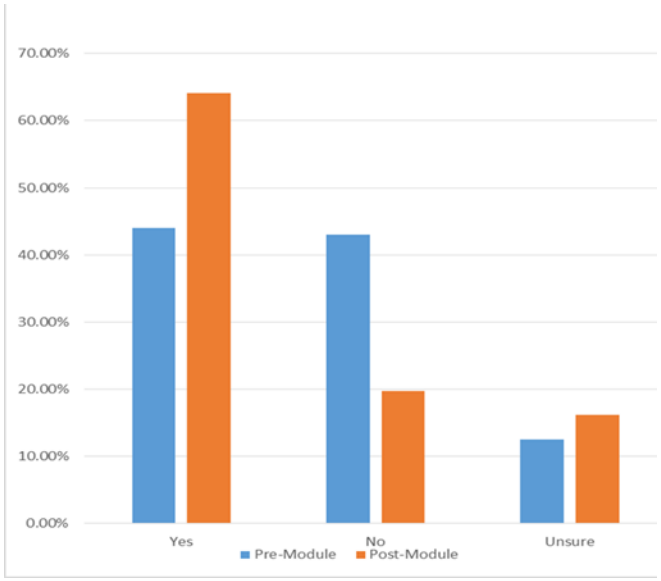
Data Collection

Source	Details
Researcher (Teacher)	Class size of 25.
6 Pre-Service Science Teachers (PSSTs)	77 students in total, with classes ranging from 9-27 students.

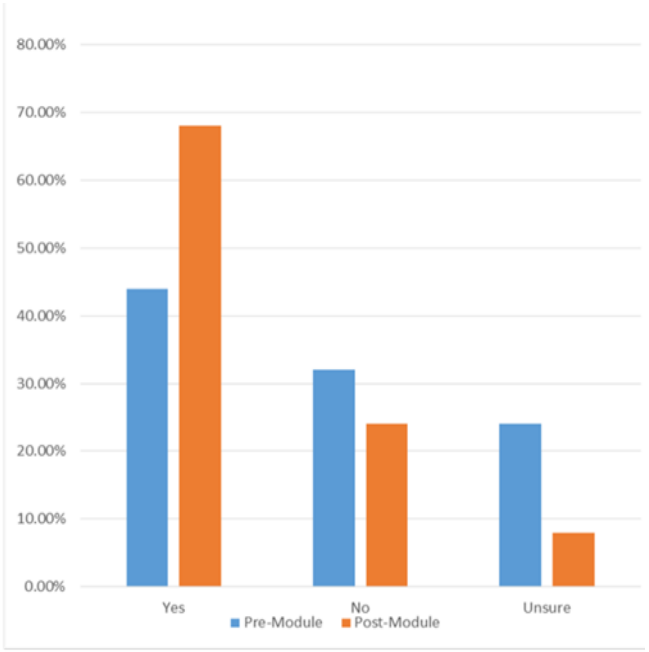
- *The participating schools were a mixture of single sex (girls/boys) and co-educational schools.*
- *The collected data was analysed using the IBM SPSS Statistics (Version 22) software.*

Results

Does the TY TEMI module encourage pupils' intentions to pursue a Leaving Certificate science subject?



PSSTs



Researcher

Results

- There was a 22% increase in the amount of pupils wishing to pursue a Leaving Certificate subject in the researcher's group. While there was a 20.1% increase in the PSSTs group of pupil's.

- All PSSTs commented on how modules similar to this one could help students' understanding and interest in science.

- Pupils found the TY module more interesting and enjoyable than Junior Certificate science

Results

Does TEMI promote pupils' motivation to explore science concepts further?

- The results in the researcher's questionnaire showed that there was a 44% increase in pupils motivation after the researcher implemented the module.
- In the PSSTs' questionnaire there was a 19.5% increase in the pupil's motivation.
- The teacher diaries also suggested that students were motivated to investigate themselves after the initial lessons.

Limitations

- Only 7 schools including the researcher and 6 PSSTs took part in the study, which offered a small sample size.
- Some students did not answer all of the questions on the questionnaire resulting in absent information.
- All PSSTs commented on the fact the post-questionnaires had a lower level of responses due to Transition Year events and that some participating students did not complete all lessons trialled by the teacher.
- The School Placement block only allowed a 10 week window to trial the lessons and this proved to be too little time.

Conclusion

- TEMI had a large impact on the students' motivation in all the student groups.
- TY is a chance to sell the science subjects to students (Childs, 2007) while increasing student interest and promoting science in a way they may not have experienced before (Hayes, Childs & O'Dwyer 2013).
- The TEMI TY module offers a new and exciting way to introduce topics and allow for pupils to investigate .

Thank you,

If you would like a copy of the module contact:

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References:

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