Elementary Science

TESS India

Unit 2:

Using groupwork: floating and sinking

Teacher Education through School-based Support in India
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The TESS-India project (Teacher Education through School-based Support) aims to improve the classroom practices of elementary and secondary teachers in India through student-centred and activity-based approaches. This has been realised through 105 teacher development units (TDUs) available online and downloaded in printed form.

Teachers are encouraged to read the whole TDU and try out the activities in their classroom in order to maximise their learning and enhance their practice. The TDUs are written in a supportive manner, with a narrative that helps to establish the context and principles that underpin the activities. The activities are written for the teacher rather than the student, acting as a companion to textbooks.

TESS-India TDUs were co-written by Indian authors and UK subject leads to address Indian curriculum and pedagogic targets and contexts. Originally written in English, the TDUs have then been localised to ensure that they have relevance and resonance in each participating Indian state's context.

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Contents

Introduction

Teaching elementary science to small groups encourages students to be active, rather than passive, learners. Learning in small groups provides students with an ideal opportunity to develop a number of key scientific skills, including:

- using scientific vocabulary in a practical context
- making predictions about what might happen during and after an experiment
- making careful observations
- recording their findings and communicating them to others.

Working with students in small groups also offers teachers valuable assessment opportunities. Through careful questioning, teachers are more able to tailor students' learning to their particular needs, such as whether they require additional guidance or opportunities to be challenged further.

In the following sections you will explore ways of planning and implementing groupwork in your elementary science classrooms and consider the useful assessment opportunities that it offers.

Learning outcomes

After studying this unit, you should be able to:

- organise your classroom to promote effective groupwork
- plan for and use groupwork effectively to help students predict, explore and hypothesise why objects float or sink
- identify ways that groupwork can provide assessment opportunities.

1 Working in small groups

What are the issues related to working in small groups? Activity 1 asks you to think about the benefits and challenges.

Activity 1: Benefits and challenges of working in small groups

Part 1

1 In your view, what are the benefits of using small groups to conduct a simple experiment in your class? Note down at least two that you can think of.

2 What are the challenges you might face when working with small groups? List at least two.

Discussion

Some of the ideas you might have noted are listed in Table 1.

Table 1 The benefits and challenges of working in small groups.

Benefits of working with small groups	**Challenges of working with small groups**
Allows all the students to experience hands-on learning Offers every student the opportunity to share ideas with their peers and ask them questions Allows students to practise key scientific skills such as prediction, observation and recording Enables teachers to make careful observations of their students' understanding	What if I don't have enough equipment for each group to use? What will happen if the students from one group need help when I am working with those in another group? How long will it take for me to move around all the groups and monitor all my students? Will the more reserved pupils feel dominated by those with stronger personalities in their groups?

Part 2

Now look at the challenges that you listed and the ones in the table above.

How might you overcome these challenges? Note down as many ideas as you can.

Discussion

These may have been some of the solutions you thought of:

- Split the class so that some groups of students do the experiment while the others do another task that does not require the use of the associated equipment. Then switch the activities over, either in the same lesson or a subsequent one.

- Explain the activities carefully before starting the groupwork and ensure that everyone is clear about what they are expected to do.
- Incorporate one or two extension activities in case any groups finish early.
- Make examples of work available for the students to refer to if they need help.
- Group students in different ways for different activities to give them opportunities to work with others.
- Restrict the time you spend with each group so you can monitor and support as many of them as possible. Alternatively, focus on a number of groups each day and ensure you spend time with all the groups over several lessons.

Now read the Case Study 1, which will help you to think about and organise an activity with small groups for your own class.

Case Study 1: Mrs Vimala organises her class to do a practical investigation

Mrs Vimala wanted to give her elementary science students a more hands-on understanding of the subject, but wondered how this would be possible with a class of 53 students and only very limited resources and equipment. She decided to divide her class in two. One half worked independently on a science-related task and the other half did a practical activity in small groups of three or four. Here she describes how she facilitated the practical activity.

Over a period of time I collected a number of different objects that float and sink that I could use in my classroom. I collected a range of objects made from a variety of materials. These included coins, stones, straws, nails, corks, clay balls, tin foil, pieces of wood, leaves, paper and pencils. I made sure I collected enough items for each group to test.

I began the lesson by displaying the objects at the front of the class so that all my students could see them. I then asked them to predict which objects would float and which would sink when placed in a tray of water. While they were discussing this in their groups, I drew two circles on the board. In one I wrote ‘Floats’ and in the other I wrote ‘Sinks’ [Figure 1].

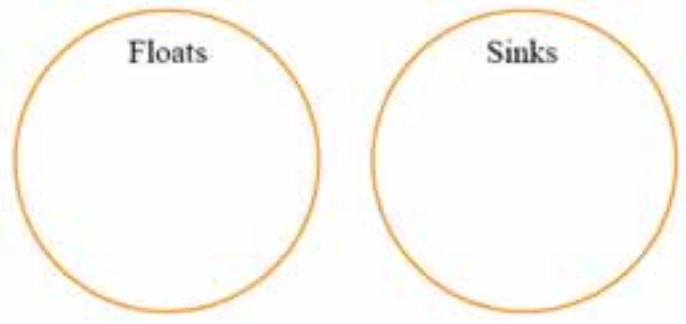

Figure 1 Predicting whether objects will float or sink in Mrs Vimala’s class.

When they had finished, I asked a student from one of the groups to give their predictions as to whether one of the objects would float or sink, and checked whether the other students agreed. I then did the same with a student from the next group with a different object, until most objects had been discussed. I wrote the name of the object in the respective circle, leaving it outside both when the students were unsure or disagreed as to whether it would float or sink.

I distributed a small container of water to each group of students and a range of materials including a metal object, such as a nail or coin. I asked them to test each material to see whether it floated or sank, and to record their results on a piece of paper on which they drew two circles, as on the board. I also asked them to note down what materials the objects were made of, in order to encourage them to start to think of common materials that would float or sink.

My students were surprised by some of their results, such as the discovery that one piece of wood floated and another sank. In their groups they then discussed possible reasons why some objects floated and others sank. I asked them to consider any similarities they could identify between the objects that sank and the objects that floated, and to test their ideas with the objects they had in front of them. One group of students noted how the denser objects sank while the less dense or hollow objects floated.

After a few minutes, I invited one or two groups to share their ideas with the rest of the class. I then asked them to choose an object that sank, such as a coin or stone, and work out how to make it float. One of them took a piece of wood that he knew would float, based on his observations from the previous experiment, and put a stone on it. The stone, which previously sank in the water, now remained above it, on the floating wood. I challenged my students by asking them if the stone was really floating or not.

Other students experimented with different materials by changing their shapes to make them float, leading to interesting discussions.

After the lesson, I reflected on the aspects of the lesson that I felt had gone well and those that I would change or improve for next time. The students were motivated and engaged. I could see how they were learning from each other and how feeding back at intervals during the lesson allowed them to consider different possibilities. However, next time I would not spend so long discussing each group’s predictions. I would ask for a few examples and move on with the experiment. I changed this when I worked with the second half of the class, and the lesson flowed more smoothly.

Pause for thought

Think about your own teaching. How often do you do the following in your science lessons? Choose between never, occasionally and often:

- Organise your classroom so that some children are working independently without your support.
- Organise your classroom so that all the students are working in small groups or pairs.
- Provide opportunities for your students to discuss their predictions in small groups.
- Ask your students to solve a problem in a group, such as making an object that usually sinks float.

2 Organising small groupwork

There are many ways of organising groups of students, each with its own advantages and disadvantages.

One method is to divide the students into mixed ability groups. Able students can benefit from working with less able students, by helping and supporting them. Less able students learn from their peers and ask them questions.

Other ways of organising students include:

- same ability groups
- friendship groups
- random groups

Activity 2: Organising small groupwork

What do you consider to be the advantage of organising groups in these four different ways? Note down at least one advantage for each type of group.

Discussion

How do your notes compare to those in Table 2?

Table 2 Advantages of types of groups.

Group composition	Advantages
Mixed ability groups	The more able students can explain their ideas and thinking The less able students can gain new ideas
Same ability groups	All students are the same ability level and learning can be supported or extended according to their needs
Friendship groups	Students may be more motivated and comfortable
Random groups	Students have the opportunity to work with pupils they know less well Groups are quick and easy to organise

Which groupings do you currently use or would you like to use in your elementary science classroom?

There are several ways of organising random groups to vary their composition. Can you think of any?

At times, you may want to give your students a particular role within their group. A benefit of this approach is that it allows for the differentiation of students' contributions, according to their ability. Another is that it promotes team collaboration. These roles could include the following:

- **Leader:** Responsible for keeping the group on task and ensuring that all group members take turns and are heard.
- **Encourager:** Encourages conversation, asks open-ended questions and guides the discussion towards consensus.
- **Recorder:** Writes down the group's solution or ideas.

While some students will tend to lead and others will tend to follow, everyone should be given an opportunity to experience different roles within a group over time.

It is not always necessary for you to allocate individual students specific tasks within a group, however. It can be very helpful for them to make these decisions themselves.

Roles are not always a requirement of group activities. It is therefore also important to give students the freedom to participate in any way they can.

Continuous and comprehensive evaluation (CCE)

Working with your students in small groups allows you to make observations about their understanding and attainment in elementary science.

After a demonstration or simple experiment, ask your students to explain why something happened. You can do this with any topic that you are currently covering in your class.

You could ask questions like:

- Why do you think the wood floated and the coin sank?
- How does a boat float?
- Can you explain why some objects float and other objects sink?

Keep notes of which students are able to explain why or how something happened, and which are less confident and cannot provide a clear explanation. By doing this, you can identify which of your students need to have a particular scientific concept reinforced and which are ready for the next challenge, so that you can respond to them appropriately.

3 A lesson plan for groupwork

Having looked at how to organise groups of students, you should now watch and reflect on the video in Activity 3. Then use the ideas in Activity 4 to form a lesson plan.

Activity 3: Using groupwork to explore floating and sinking

Now watch the video below about using groupwork to allow students to talk about why objects float and sink. If you are unable to watch the video, it shows small groups of students predicting which objects will float and sink and develop their ideas by talking in groups and testing. Each group then writes a statement about why they think things float or sink. You may also find it useful to read the video's transcript. Please note that the video will be available in early 2014.

Make a note of what the students learned by doing this and what questions their hands-on experimentation led them to ask.

Activity 4: Creating a lesson plan

Use the ideas in the list below, or any of your own, to plan a group investigation about floating and sinking.

- Fill some balloons or plastic bags with water and some with air. Will they float or sink?
- Make a boat to carry a toy or another object. You could use a range of different materials and ask the children to predict which would work the best before testing each one.
- Take the students outside to collect items that they think will float or sink. Can they build a raft with the natural materials that they found? Whose raft is the most effective? How can this be tested?
- Give the students a ball of clay or Plasticine. Ask them to predict if it will float or not, and then get them to test this. If it sinks, get the students to modify their material until it floats by itself.

When planning your activity, consider the following:

- How will you organise your class? Will all the students be involved in the small group experiment, or will you divide the class into two and arrange for half of them to do another task independently? If the latter, what task will you give them?
- How will you ensure that all the students are clear about what they will be doing?
- What do you want your students to learn from the group activity? What are the learning objectives?

- Will your activity take place in the classroom or outside in the school grounds?
- Will you use mixed ability groupings, same ability groupings, friendship groupings or random groupings?
- Have you allowed time for your students to explore and investigate without your intervention?
- What questions will you ask to measure your students' attainment and understanding during and after the activity?

When you are ready, implement your lesson plan.

Pause for thought

Think back at the lesson that you undertook with your elementary science students.

- What three things went particularly well?
- What would change if you were to teach the lesson again?
- How did using groupwork enable your students achieve the learning objectives of the lesson?

Continuous and comprehensive evaluation (CCE)

The following activity could be used with older students to assess their understanding of upthrust forces that enable objects to float.

You will need:

- a netball, or any large or medium-sized ball filled with air
- a rubbish bin or large bucket filled with water.

In small groups, ask your students to push the ball under the water. They will be able to feel the upthrust force as the water is displaced and pushed aside.

After your students have felt the upthrust force, ask them to draw a diagram to show what is happening. Can they explain this through their drawing or notes? You may wish to ask some of them to explain verbally as well.

It can also be useful to ask your students to revisit their drawings and explanations at the end of the lesson as well, so that they can amend their previous versions in the light of their growing understanding. This will provide you with valuable evidence of your students' progress and attainment over the duration of the lesson.

You could ask more able students to tell you what they think would happen if the ball was made of different materials such as wood, steel, sponge or stone. Allow them to draw diagrams to explain the different forces that would act on the different types of balls.

4 Summary

In this unit you explored some of the issues involved in integrating groupwork into your elementary science lessons. You planned and delivered a group activity, and considered the assessment opportunities that groupwork provides. The unit also provided tips on group organisation and some ideas for encouraging group collaboration.

Identify three skills you have learned in this unit. How will you use these in your future lesson planning?

5 Resources

Resource 1: Further reading

You may find the book *Who Sank the Boat?* by Pamela Allen useful to help you with your teaching. A reading of the book is available online.

If you are interested in the topic of things floating and sinking in water, you may find the following online resources useful as background information:

- 'Archimedes' principle' (Infoplease, undated)
- 'How objects float in fluids' (Kurtus, 2007)

6 Related units

- TDU 7, *Sorting and classifying*
- TDU 15, *Outdoor learning*

References

Infoplease (undated) ‘Archimedes’ principle’ (online). Available from: http://www.infoplease.com/encyclopedia/science/archimedes-principle.html#ixzz2PUNcQzbi (accessed 4 September 2013).

Jemima Luck [YouTube user] (2009) ‘Who sank the boat’ [sic] (online), YouTube, 30 September. Available from: http://www.youtube.com/watch?v=OsYb1YSYR34 (accessed 21 November 2013).

Kurtus, R. (2007) ‘How objects float in fluids’ (online), revised version, Ron Kurtus’ School for Champions. Available from: http://www.school-for-champions.com/science/fluid_floating.htm (accessed 4 September 2013).

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