Elementary Science

TESS India

Unit 11:

Making and using games to support learning: understanding electricity

Teacher Education through School-based Support in India
www.TESS-India.edu.in

The Open University

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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

Using games in the elementary science classroom can provide a range of educational benefits.

Games are highly effective in delivering and consolidating subject knowledge. By offering students the chance to learn by doing, games can be motivating and engaging. They encourage creativity, collaboration and communication. They can accommodate different skills and roles, and can provide students with immediate feedback about their performance. They offer teachers opportunities to observe and monitor their students and identify any difficulties and misconceptions they may have.

The games described in this unit are intended to be easy to organise and prepare, using readily available local materials. They can also be modified to suit the needs of most students.

This unit explores ways of using games to support your students' understanding of electricity. Understanding what electricity is, and how it works, is a fundamental part of everyday life. By using resources such as batteries, wires and bulbs, you can teach your students about electrical safety. You can also demonstrate simple ideas such as how a light bulb works and how to make electrical circuits.

Safety warning!

Students need to know the dangers of mains electricity and should never investigate mains sockets or electrical equipment, or high-capacity batteries such as car, mobile phone or computer batteries.

Learning outcomes

After studying this unit, you should be able to:

- use games to assess your students' progress and understanding and adapt your teaching accordingly
- adapt familiar games to different elementary science topic areas using limited materials.

1 Adapting simple games for use in the elementary science classroom

Pause for thought

- Do you use games in your teaching to engage your elementary science students?
- If so, what games do you play?
- If not, can you think of any games that might be suitable?

You may have thought of simple games like these:

- **Eye Spy:** A set of topic-related objects is placed at the front of the class or in the middle of a group of students. One student says the letter or sound that one of the objects begins with. If no one guesses the object after three attempts, then clues can be given to help identify what it is. Then the next student takes their turn. Pictures can be also used for this game as it may not be possible to bring all the items relating to a topic into a classroom.
- **Games such as Pictionary:** The teacher prepares one or more sets of cards, each with a scientific word or phrase written on it. The cards are stacked face down in a pile. One student picks the top card, and, keeping it secret, tries to draw a picture that suggests the word on the card. The picture is not allowed to contain letters or numbers. No additional clues must be given. The other students then guess what the word might be. Words such as ‘circuit’, ‘insulator’, ‘conductor’ or ‘amps’ could be used when studying electricity, but each topic will lend itself to a different set of words and phrases. The game can be played in small groups or as a whole class. (Pictionary is a proprietary board game format, and also a game show format; copyrights and trademarks may apply to various aspects of this game.)
- **Hangman:** The teacher, or a student, chooses a word or phrase relating to the topic of the current lesson. They use a dash to represent each letter of the word or phrase on the board. The other students try to suggest individual letters that match the dashes and so guess the word or phrase. If they get it right, the letter is written on the board. If not, a line is added to a ‘stick’ picture of a hanging man [Figure 1]. The aim is to guess the word or phrase before the picture is completed. This game can be played in small groups or as a whole class.

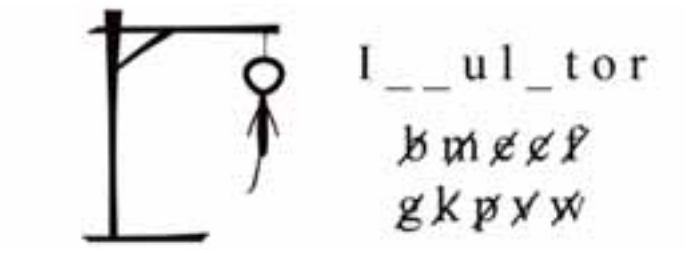

Figure 1 A game of hangman.

- **Quizzes:** Using quizzes is an easy way to engage students while testing their knowledge and understanding of science. Students can be organised into groups or work as individuals. When discussing the answers afterwards, they may mark their own work or that of another group or individual. Teachers can use quizzes to identify gaps in learning and identify any misconceptions a class may have, allowing time to discuss and address any difficulties and misunderstandings the students may have.
- **Matching games:** These games involve two sets of cards: one set composed of topic-related words, and the other composed of their scientific definitions. Working in groups, students can compete with other groups to match the words to the correct definitions. The game can be made more active by getting students to take turns to run to collect the matching cards.
- **Memory games:** A set of cards is put face down on a surface. Students take turns to turn over two cards at a time, placing them face up on the surface. If the cards match, the student takes them both. If not, they are turned over and left on the surface. The next student does the same, but can match one of their two cards with one of those that has been turned face down – if they can remember which one! The object of the game is for students to collect as many matching cards as they can.

  This game can be adapted to suit any science topic. Pairs of cards can consist of matching words and their definition, a corresponding picture or an equivalent scientific symbol. For example, a word like ‘battery’ can be matched to a picture or symbol for a battery component.
- **Puzzles:** Simple puzzles can be made of images, flowcharts, concept maps and words by copying an image and cutting it up into pieces. Students can simply be handed all the pieces of the puzzle to put together as a group. Alternatively, the separate pieces of the puzzle could be hidden in the classroom or an outdoor area to make a treasure hunt.

The following activity encourages you to use a simple memory game with your class.

Activity 1: Trying out a memory game with your class

Begin by reviewing the description of a memory game in the list above. Then copy the template provided in Figure 2 and cut out the ten ‘cards’.

Figure 2 A template for a set of cards to be used in a memory game.

Try playing the game yourself. How useful do you think this game would be to your students? How might they respond? How would you change it to suit their needs?

Now make your own memory game for your elementary science class. What topic would be most suitable? Consider how many sets you will need to make and how to organise your class. What will you do as a follow-up activity after the memory game?

Pause for thought

Did your students enjoy playing the game? How do you think it supported their learning?

Were there any challenges you faced when making or playing the game? How would you overcome them next time?

2 Using games to explore circuits

Case Study 1: Miss Sutapa uses a card game to teach electrical circuits

Miss Sutapa, a teacher in a small rural elementary school, was teaching her Class IV students about electricity. She had very limited resources and only enough equipment to demonstrate how to make a simple electrical circuit. She decided to try using a card game to develop her students' understanding of more complex electrical circuits. Here is her account of how she went about this.

At my local DIET centre I was introduced to a card game that enables students to develop a better understanding of more complex circuits.

In a previous lesson I had demonstrated how to make a simple series circuit and had introduced my students to its various components. I did this by explaining the circuit to small groups of students, while the rest of the class played a memory game – matching the symbols of electrical components with the correct word in small groups.

I felt confident by the end of this lesson that the students understood the correct symbol for each component and could say how to make a simple circuit.

I then wanted my students to understand the difference between parallel and series circuits. Using the idea I had been introduced to at the DIET centre, I prepared a card game.

On blank cards I carefully drew eight different circuits [Figure 3], using the symbols I had taught my students in the previous lesson. Some of the circuits would work and some of them would not. I drew lamp bulbs, switches, cells, batteries and an ammeter in the circuit drawings. I included a parallel circuit, in addition to the different types of series circuits. I replicated the set of cards to accommodate the size of my class.

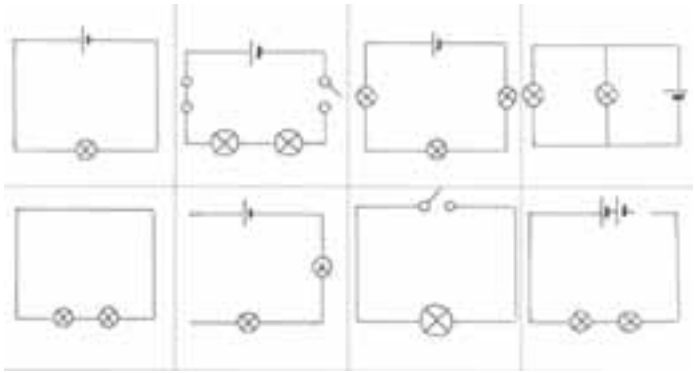

Figure 3 Set of circuit cards used by Miss Sutapa's students. This activity can be simplified for younger students by drawing simple series circuits or taking photos of real circuits.

I organised my students into groups of eight and gave them a set of cards each. Within each group I chose a leader to manage the discussion and ensure that every student had an opportunity to speak. I asked my students to discuss the circuits and decide if each circuit would work or not. I told them that they had eight minutes to complete the task.

I then walked around, listening to each group as they discussed the circuits on the cards. A few students needed support to identify particular component symbols.

I watched as my students began to organise the cards into two piles: one corresponding to circuits that worked, and one to circuits that did not work. As I listened to their discussions, I remarked that they clearly understood that electricity needed to flow around a circuit without a break. However, they seemed to be much less sure about the parallel circuit.

I brought the class back together and I asked each group to give an example of a circuit that would work and a circuit that would not, and to explain their reasoning behind this. I was impressed at the way they were able to explain why a circuit would or would not work. They gave reasons such as ‘the switch is closed so the circuit is complete’, ‘the circuit has a missing cell so it will not work’ and ‘there is a break in the circuit so the electricity cannot flow’.

Then I asked them about the parallel circuit. I drew the circuit on the blackboard and asked a volunteer from each group to explain why they thought it would or would not work.

I then made the circuit with the equipment I had at the front of the class. I asked each group to quickly come up in turn to look at the circuit. Some students were surprised to see it working. One of my students noted how both bulbs were bright, unlike a series circuit with two bulbs.

Next I asked my students what they thought would happen if I unscrewed one of the bulbs in the parallel circuit. I allowed them a few minutes to discuss their ideas and then asked a few students to explain their thinking to the rest of the class.

I unscrewed one bulb and carefully held up the circuit. My students were surprised to see the remaining light bulb still shining. I then asked them why the bulb was still working even though the circuit was essentially ‘broken’. We then discussed the explanation together.

The lesson concluded with each group saying how many circuits they had guessed correctly. I then reviewed with them what they felt they had learned by playing the game.

Finally, I asked them to focus on the circuits that did not work and to consider how this could be fixed, for example by adding the necessary component. They finished by drawing the amended circuits in their exercise books.

Miss Sutapa reflects on the card game

I was very pleased with the way I was able to achieve so much with quite limited resources.

Using the memory game to reinforce the component symbols worked well, while giving me the opportunity to show groups of children a working circuit.

The circuit card game allowed my students to discuss circuits without actually making them and made it possible for me to introduce the concept of parallel circuits in an interactive way rather than through the more usual demonstration.

Pause for thought

- How could you change and adapt Miss Sutapa's card game to suit the needs of younger students?
- How could you make the lesson even more interactive?

The card game that Miss Sutapa devised can be modified to make it more accessible for younger students by replacing the component symbols with simple images of a battery or a lamp, for example.

Children of all ages benefit from physical learning, using their bodies to sense, touch and experience the world around them. The card game could be taken outside, or in a large space within the school, where the students themselves can 'form' each circuit by holding hands and 'being' the different components, such as batteries, lamps and switches.

The students can then make the electricity 'flow' in the circuit by taking turns to squeeze the hand of the person next to them to pass on the electric charge. This will help them to understand that electric charge flows from the positive terminal to the negative one. They will see and feel where there is a break in the circuit, and can 'mend' it so that the electrical charge can flow freely again.

3 Using games to assess students' understanding of electricity

Continuous and comprehensive evaluation (CCE)

Students can show the full extent of their and knowledge and understanding of circuits through simple drawings. By asking your students to draw a circuit before beginning the unit of study on electricity and looking at a selection completed after they have played a circuit-related game, you will get a clear sense of their progress, while gaining insight into the next steps you need to take to improve their understanding.

What might you learn from Figures 4–6 regarding their understanding of circuits?

Figure 4 Student work.

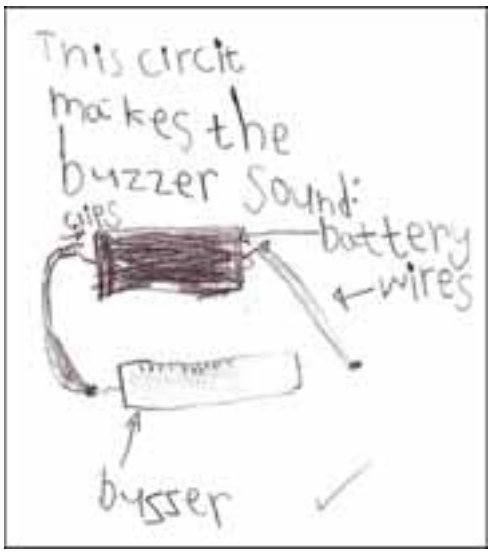

Figure 5 Student work.

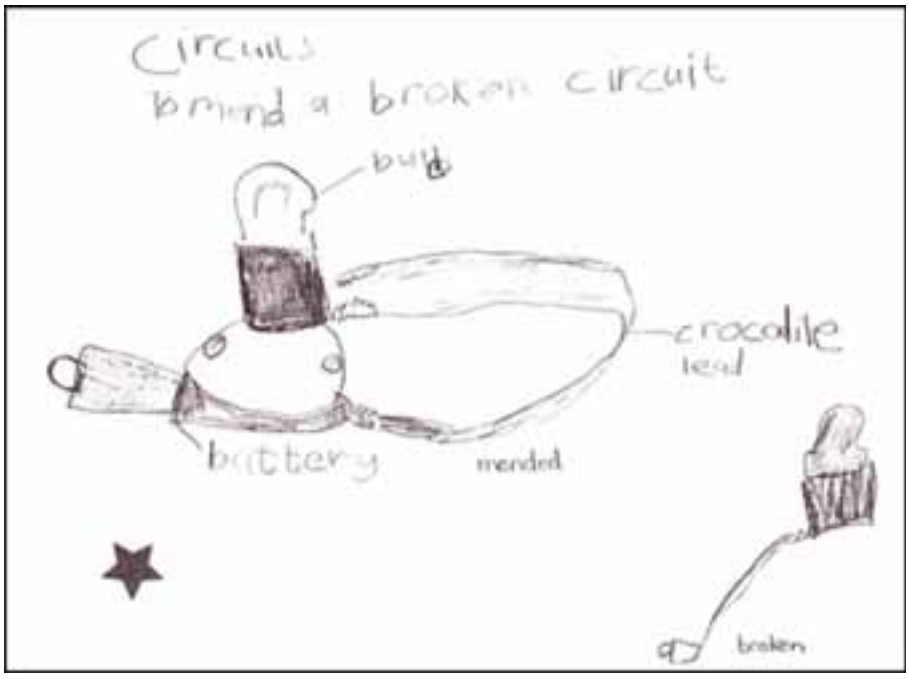

Figure 6 Student work.

The following activity asks you to devise a quiz to use with your elementary science students. The activity will help in consolidating your students' knowledge about electricity while they work collaboratively in small groups.

Activity 2: Using quizzes in the elementary science classroom

Adapting popular TV game shows or board games to create a class quiz can help engage all your students, especially if they are already familiar with its rules and format. *Who Wants to be a Millionaire?* is a popular TV game show that can be easily adapted for use in the classroom.

First, read through the rules of our version of the game below.

Who Wants to be a Millionaire? classroom game

- Students will earn points, not money!
- The points system is as follows:

  1,000

  2,000

  4,000

  8,000

  16,000

  32,000

  64,000

  1,25,000

  2,50,000

  5,00,000

  10,00,000
- For each correct answer students will progress through the points scale.
- Students will be given a question and four possible answers to choose from.
- If students reach **1,000** and **32,000** and they fail to answer the next question correctly, they will keep their points. However, if they are on any number that is not 1,000 or 32,000 and they give an incorrect answer, they will lose their points down to the value of 1,000 or 32,000, depending on where they are on the scale. For example, if a student's current score is 2,50,000 and they give an incorrect answer they will move down the scale to 32,000 and leave the game.
- Students will be given three 'lifelines' that they can use only once: '50/50', 'phone a friend', and 'ask the teacher'.
- For '50/50', the teacher or quizmaster takes away two of the incorrect answers, leaving the students with only two possible answers to choose from instead of four. For 'phone a friend', ask four students not to participate in the main game but instead to be 'on call' to help the students if they need to use this lifeline.
- A student can 'ask the teacher' the answer to one (and only one) of the questions, at any time. The teacher will need to think of a way to communicate the information to the student without the others hearing.
- The game can be modified to play as a whole class, in small groups, or as individuals.

(*Who Wants to be a Millionaire?* is a commercially available game format, and also a game show format; copyrights and trademarks may apply to aspects of this game.)

First decide how to organise the class, depending on whether the game is played as a whole class, in small groups, or as individuals.

Write down 11 quiz questions that relate to the topic that your class is studying and suit the age and learning needs of your students. For each

question, provide four possible answer options for your students to choose from, one of which is correct, and the other three are 'distractors'.

The questions should be easy to begin with and get progressively more difficult as the points increase. Here are a few example questions to get you started:

A circuit is a complete loop that allows _____ to pass through it.

(a) water
(b) heat
(c) electricity
(d) air

Which of these materials could not be used for electrical insulation?

(a) rubber
(b) copper
(c) wood
(d) plastic

Which one of these words describes a type of electricity?

(a) strong current
(b) dangerous current
(c) direct current
(d) through current

You should also write two or three sample questions and sets of answers to use with your class for practice purposes.

Before beginning the quiz, review the rules with your students and practise the game using a few sample questions.

Now try your quiz with your class.

Pause for thought

- Did your students enjoy participating in the quiz? What questions did they find challenging and why?
- What did the quiz reveal about your students' understanding of electricity? What will you do with this information?
- What other games from this unit will you try with your class?

4 Summary

This unit has shown how you can achieve higher levels of participation in your elementary science lessons, by using games in the classroom.

Games have many educational benefits, such as reinforcing learning, developing social skills and providing speaking and listening opportunities. Games enable students to explore their scientific knowledge in active, challenging and motivating ways. Team games encourage collaboration and support, ensuring the participation of students of all abilities and building confidence and a sense of belonging.

Classroom games do not have to be expensively produced and can be easily made (or invented) by you and your students.

The games suggested in this unit have focused on developing students' understanding of electricity. However, they are not difficult to modify for use with other science topics.

5 Related units

- **TDU 15, *Plants in their environment: using outdoor spaces*:** This unit explores how the outdoor environments can be used as an extension of the classroom. It provides suggestions for games and activities that can be played outside, making learning more engaging for all students.

Acknowledgements

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