Protecting the Border

by Paul Neveldsen

CONNECTED 3
SCIENCE • TECHNOLOGY • MATHEMATICS

Overview

This article describes the systems and technologies that have been developed to prevent unwanted pests, diseases, and goods coming into New Zealand and to prevent precious taonga such as native species being smuggled out of the country.

Curriculum context

TECHNOLOGY

NATURE OF TECHNOLOGY

Characteristics of technological outcomes

Achievement objectives

L3: Students will understand that technological outcomes are recognisable as fit for purpose by the relationship between their physical and functional natures.

L3: Students will understand how society and environments impact on and are influenced by technology in historical and contemporary contexts and that technological knowledge is validated by successful function.

Key ideas

- Technology involves people designing and making **things** to meet a need or opportunity.
- These **things** are called technological outcomes.
- Technological outcomes are produced because of social and/or environmental issues.
- Technological outcomes change how people do things.

Learning goals (to be shared with your students)

In this activity, we are learning:

- to identify a technological outcome
- to describe the issues that led to the technological outcomes used by border control
- to identify how border control technologies change how people do things.

TECHNOLOGICAL KNOWLEDGE

Technological systems

Achievement objectives

L2: Students will understand that there are relationships between the inputs, controlled transformations, and outputs occurring within simple technological systems.

L3: Students will understand that technological systems are represented by symbolic language tools and understand the role played by the "black box" in technological systems.

Key ideas

- Technological systems are technological outcomes that have interconnected components or parts that have to work together for the outcomes to be fit for purpose. For example, a mechanical pencil is a technological system; a standard pencil is not.
- Technological systems have inputs: a toaster's inputs are electricity, bread, and a person pushing the lever.
- Technological systems have outputs: a toaster's outputs are heat, smell, light, and toast.
- Every technological system involves a transformation of the inputs into outputs in a controlled way.
- The term "black box" is used to describe a transformation when you don't understand or can't explain it.

Learning goals (to be shared with your students)

In this activity, we are learning:

- to identify a technological system
- to explain that a technological system has inputs, controlled transformations, and outputs.

MATHEMATICS AND STATISTICS

STATISTICS

Statistical investigation; probability

Achievement objectives

- L4: Students will plan and conduct statistical investigations using the statistical enquiry cycle.
- L4: Students will investigate situations that involve elements of chance by comparing experimental distributions with expectations from models of the possible outcomes, acknowledging variation and independence.

Key ideas

- A 'population' is every individual or object in a group.
- A 'sample' is a selection (usually random) of individuals or objects in a group.
- When is it not practical to check every individual or object, sampling is used.

Learning goals (to be shared with your students)

In this activity, we are learning:

- to analyse a large population by studying a sample group
- to improve the accuracy of our research by taking care in selecting the sample group.

ENGLISH

READING

Ideas

Achievement objective

L4: Students will show an increasing understanding of ideas within, across, and beyond texts.

Indicators

- Makes meaning of increasingly complex texts by identifying main and subsidiary ideas in them.
- Starts to make connections by thinking about underlying ideas in and between texts.

The Literacy Learning Progressions

The relevant knowledge skills and attitudes for students at this level are described in the The Literacy Learning Progressions.

Suggestions for providing literacy support for the key ideas

The following strategies will support students to engage with the ideas and information as they use the text for particular curriculum purposes.

The *Connected* series includes a range of texts that provide opportunities for students to locate, evaluate, inergrate, and synthesise information and ideas.

It is expected that students will read across the range of texts in this *Connected* to develop their literacy skills and their understanding of the topic.

Text characteristics

- Non-continuous text
- Technical information and vocabulary related to the topic and supported by text and visual features
- A variety of sentence types, some with several clauses
- Subheadings, photographs, and a text box to supplement the text.

1. FINDING THE MAIN IDEAS

This article discusses the systems and technologies that are in place at our borders to prevent unwanted pests and diseases entering the country and to prevent rare plants and animals being smuggled out.

The main ideas in the text include:

- The number of people and the volume of imported goods and mail that come into New Zealand have increased a great deal.
- We have developed systems and technologies that check people and goods coming into and going out of the country.
- There are particular organisations responsible for patrolling New Zealand's borders (the Customs Service, MAF Biosecurity New Zealand, and the New Zealand Food Safety Authority).

MODEL the process of thinking aloud to show how to scan the headings, photographs, and map to gain an overview of the text.

I'm scanning the layout, subheadings and photos to work out what information is in this article. It looks like the first page is an introduction, and then on page 9, it's about who patrols the borders. On page 10, there's a subheading about smuggling goods in, and on page 13 the subheading is about smuggling goods out. It seems to me that this is an article about how we check the goods that are coming into and going out of the country. That explains the text box on page 11 about X-rays at airports. Look, the photos link up too.

2. DEALING WITH UNFAMILIAR OR TECHNICAL VOCABULARY

IDENTIFY any unfamiliar vocabulary. Record and discuss the customs vocabulary ("be declared", "amnesty", "smuggling", "black market") before the students read the article.

PROMPT students to use their prior scientific knowledge and their understanding of context to make meaning of the technical information in the text box about how X-ray machines work at airports.

MODEL the process of linking up the information in the text to reach an understanding of the technology being explained. *In the text box, it's explaining that although the X-rays at airports work in the same way that X-rays at hospitals work, at airports the information in the X-rays needs to be interpreted by computers. It says in the last paragraph that organic objects show up as orange in customs X-rays. I needed to think for a minute before I worked out why the shoes in the X-ray image showed up as orange.*

ASK QUESTIONS after the first reading to clarify the differences between systems and technologies.

It says on page 8 "… we have developed systems and technologies to protect our borders." Let's work out what's the difference between a "system" and a "technology".

What is a good way to keep track of these systems and technologies as we read?

Are sniffer dogs systems or technologies?

3. USING THE TEXT TO SUPPORT CRITICAL THINKING

PROMPT students to search Customs and MAFBNZ websites and download copies of the forms that travellers have to complete on arrival in New Zealand. They can then infer the purpose of the questions on the forms. (For example: *Why are travellers asked their country of embarkation?*)

Exploring the technology

The following activities and suggestions are designed as a guide for supporting students to develop understandings about technological outcomes and technological systems.

Key ideas

- Technology involves people designing and making **things** to meet a need or opportunity
- These **things** are called technological outcomes.
- Technological outcomes are produced because of social and/or environmental issues.
- Technological outcomes change how people do things.
- Technological systems are technological outcomes that have interconnected components or parts that have to work together for the outcomes to be fit for purpose. For example, a mechanical pencil is a technological system; a standard pencil is not.
- Technological systems have inputs and outputs.
- Every technological system involves a transformation of inputs into outputs in a controlled way.
- The term "black box" is used to describe a transformation when you don't understand or can't explain it.

Activity 1: *Identifying a technological outcome*

Before reading "Protecting the Border", have a class discussion about what a technological outcome is.

Technology is when people design and make things that make their lives easier, meet a need, or solve a problem. Introduce the term "technological outcome". The things created through technology are called technological outcomes.

Discuss how technological outcomes are different from natural objects (for example, grass, people, rocks).

After reading "Protecting the Border", have the students work in small groups to identify all the technological outcomes that were referred to in the article (for example, cars, containers, ships, food items, planes, bags).

Have a brainstorming session to list technological outcomes that are possibly used when patrolling the border, including those not listed in the article (for example, an X-ray machine, fungicides, a fishing rod, protective overalls, a body temperature scanner, CCTV, guns, traps, hutches, scales, herbicides, computers). Include items from the other articles in the book, assuming that your students have read these.

Have each group choose one technological outcome from the class list and determine:

- What was the need/opportunity/problem that led to it being developed?

Each group can then present its findings to the class.

Activity 2: *Recognising that technological outcomes change how people do things*

As a class discuss:

- How was New Zealand's border protected 50 years ago?
- What about 100 years ago?

Split the class into small groups. Allocate each group:

- a technological outcome that is a modern way to patrol our border (for example, a body temperature scanner, an X-ray machine, and a computer)
- a person who might be affected (for example, an immigrant, a border security officer, a smuggler).

The group then brainstorms the effects of that technological outcome on that person.

De Bono's thinking hats are a great way to encourage the students to consider different views.

Activity 3: *Identifying a technological system*

Have a class discussion about the meaning of the word "system".

- Discuss what a natural system is (for example, a digestive system).
- Discuss what an organisational/social system is (for example, the Dewey decimal system used in the school library).
- Ask the class to describe what they think a "technological system" might be.

Present the students with a collection of technological outcomes. It would be best to present actual technological outcomes, but photographs can work just as well. Make sure that some of the technological outcomes are technological systems and some are not. Make sure that the technological systems are a mix of electronic technological systems (for example, a mobile phone) and mechanical technological systems (for example, a stapler). Include at least two items that are very similar but where one is a technological system and one is not (for example, a pen and a pencil or an eggbeater and a whisk).

Explain to the students that you are going to organise the technological outcomes into two groups, one a group of technological systems and one a group of non-technological systems. Start with the two items that are very similar.

As you sort the items, ask the students:

What is the difference?

Why is a pen a technological system but a pencil is not?

Begin to discuss the definition of a technological system. A checklist is a good tool to help students identify a technological system.

Technological systems:

- have interconnected components or parts that have to work together
- have inputs
- have outputs
- involve a transformation of the inputs into outputs in a controlled way
- might be started by a human, but the system does the rest.

Return to the list of technological outcomes used for border security. Ask:

Which ones are technological systems?

Which ones aren't? (These are just called technological outcomes.)

On page 11, the article describes how an X-ray machine works. Use the information to identify the inputs, transformation, and outputs of an X-ray machine. Record the information on a whiteboard.

> Inputs = electricity, bags.
>
> Transformation = The electricity causes the X-ray machine to send electromagnetic rays towards the bags. These rays are picked up by two detectors. A computer circuit compares the two detectors and shows the image on a computer monitor.
>
> Outputs = X-rays (electromagnetic energy), images.

In groups, the students can then work together to identify the inputs, transformation, and outputs for everyday technological systems (for example, a bicycle, a toaster, a computer mouse, a hole punch).

Explain that it is OK if you don't understand the transformation that is happening in a technological system. This means that the transformation is a "black box" for you.

We use the term "black box" to describe the transformation when we don't understand it or can't explain it.

A transformation that is a "black box" for you might not be a "black box" for someone else. For example, the transformation in the technological system of a car won't be a "black box" to a mechanic.

MINISTRY OF EDUCATION RESOURCES

- http://www.techlink.org.nz/curriculum-support/papers/knowledge/tech-systems/index.htm

Exploring the mathematics

The following activities and suggestions are designed as a guide for supporting students to develop mathematical understanding as they explore mathematical ideas associated with scientific research.

Key ideas

- A 'population' is every individual or object in a group.
- A 'sample' is a selection (usually random) of individuals or objects in a group.
- When is it not practical to check every individual or object, sampling is used.

MATHEMATICAL IDEAS AND LANGUAGE

- Vocabulary (population, sample, average, mean, random, percentage)
- Units (hours, minutes, dollars).

FOCUS QUESTIONS

At the beginning of the article, we are told that millions of people cross the New Zealand border annually. Suppose it took 15 minutes to thoroughly search the luggage of a visitor arriving in New Zealand:

- How much time would it take one person to clear the passengers from a 747 if it had a full load of 350 passengers?
- How many staff would be needed if this number of people had to be cleared in one hour?
- Do you think it would be practical to do this?

Activity 1: *Projecting from a sample*

Explain to the students that in many situations, it is not possible to count every item or person in a population and to sort them according to some characteristic. This is where statistical sampling is used. We use a sample group that is chosen randomly to determine a statistic such as the number of people who ski or the number of people who keep rats as pets. Once we have that statistic (for example, a percentage), we then use it to estimate how many people in the population have that same characteristic.

In this activity, the students will use sampling to work out how many students in their class are left-handed.

- Each student writes their name on a piece of paper and all the names are placed in a jar.
- They then draw 10 names from the jar at random. The students whose names are drawn become the sample group for the class population.
- They then find out how many of those whose names have been drawn are left-handed and work out the percentage of the sample group that is left-handed.

Ask: *How many students are there in the class? How many of them are likely to be left-handed?*

The students can then repeat the experiment with another class and go on to repeat it another time with the two classes combined to make a bigger population. At this stage, they can double the size of the sample group.

Ask the students to compare the results of the bigger sample group with the results of the first experiment in their own class. (Generally, the bigger the sample group, the more accurate the estimation about the population will be.)

The students can then use the findings from the sample group to estimate the number of left-handed students in the school. They could compare their results with national results by visiting Census at School: www.censusatschool.org.nz/index.php.