FaSMEd

Raising Achievement through Formative Assessment in Science and Mathematics Education

Micro organisms
Prevent bacteria spreading

Subject:	Science
Age of students:	10-13 years
Hardware:	Whiteboard/Smartboard, PCs, Tablets (Ipads), Projector, Internet, Mini Whiteboards
Software:	Smartboard software–SMART Notebook, Socrative – Interactive clickers system (student response system), spreadsheet (Excel)
Functionalities:	Display and share, feedback to the teacher and class via ICT based student response systems
Time:	90 min (the experimental part or the teaching)
FaSMEd partner:	Norwegian University of Science and Technology
Short Abstract:	The subject of these lessons is science; the theme of the lessons is “microorganisms” and how to prevent the spreading of these organisms. Technology to be used is Smartboard, and this is combined with large paper sheets for plotting, analogue mini whiteboards for feedback, and spreadsheet (Excel) or large paper sheets for data handling and processing. A student response system (Socrative or Kahoot) is used for questioning.

1. Content

The lesson is about “microorganisms” and how to prevent the spreading of these organisms. The described session is about the spread of microorganisms through the air. What does it mean to ‘catch a cold’, or ‘give someone the flu’? Can we explore how far a sneeze is spread and if there is a way we can prevent it spreading?

2. Activity

2.1 Aims

Learning outcomes:

Content knowledge:

- Understand central scientific consepts about micro-organisms
- Know that micro-organisms can be spread through air
- Understand that steps can be taken to prevent the spread of micro-organisms
- Understand mathemetical concepts about data measurments and graph presentations

Process:

- Students will learn to collect data
- Students will learn to process data and produce graphical presentations

Skills:

- Get scientific inquiry skills
- Make accurate measurements and record results in a bar graph
- Collabaroate and work together with other students

The aim of this lesson is to promote students’ knowledge about spreading of microorganisms, and by using an inquiry approach students is supposed to find the best way to prevent spreading of the microorganisms and present their results mathematically in a graph.

At the beginning, the aim is to establish the students’ pre-knowledge on the concepts of microorganisms and related diseases before the lesson moves further towards investigation. Examples of teacher questions that could be asked is: “What are the three types of microorganisms?”, “What conditions do microorganisms like to live in?”, “How can viruses spread?”

By the moment the students starts the experiment, they have got an understanding on different types of microorganisms and how they can create diseases. In addition, they will have some ideas on how to prevent spreading, like shown on figure 1 below:

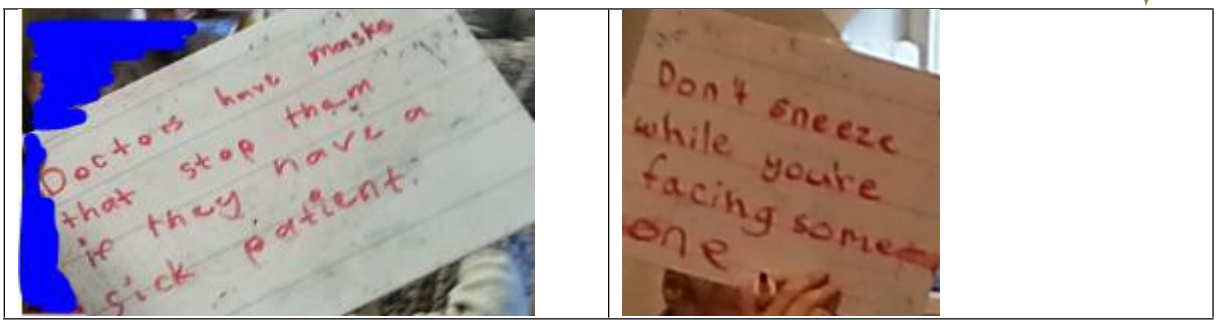

Figure 1: Examples of students' ideas on how to prevent spreading; written on mini whiteboard.

2.2 Structure / Methodology

This lesson could be a part of a 4 week period about micro-organisms, about useful and harmless organisms and what they need to live. Hereby knowledge about food hygiene and how to keep a kitchen clean and safe is needed. An alternative approach is three lessons of approx. 90 minutes, one to establish knowledge and prepare for the experimental second part, the second part is the practical part described in detail here, and the last part will concentrate on in-depth learning based on the results from the experimental part.

Time needed: Approx. 90 min.

Materials needed:

Hardware:

Whiteboard/Smartboard,
PCs, Tablets (Ipads),
Projector
Internet

Software:

Smartboard software–SMART Notebook,
Socrative – Interactive clickers system (student response system)
Spreadsheet (Excel)

Other resources:

Mini analogue whiteboards
Spray bottles
Paper towels/paper roll
Rulers and tape measures
Large graph paper
Food colouring

Figure 2: Equipment and different methods of preventing spreading: elbow, hand and paper towel (Above and left). Measuring distance (Below right).

Lesson plan:

The lesson can be divided into three parts; an introductory part which mainly concerned what microorganisms are, an experimental part where students carry out their experiments and make graph plots on large paper sheets, and a final part where results are collected and briefly presented. Towards the end of the lesson, the students are asked to answer some questions on the Socrative student feedback system. A full presentation and discussion of the results from the Socrative can be done the day after.

Starter:

The students are shown a letter addressed to them from a boy who has a cold and is worried about passing it on to his grandma. He asks them if there is anything he can do prevent his cold spreading.

Dear Year 6,

I heard you guys are great with Science - I need your help!

I have a bad cold and my Granny says she doesn't want me to give it to her. I don't know what she means, I usually give her flowers!

Anyway, I wondered if you can help? My Granny is certain that she will catch my cold. Is there anything I can do to stop this happening?

Yours sincerely,

Bob

Figure 3: The starter - "Letter from Bob", asking for help from the students

An alternative approach could be to ask the headmaster to send a letter to the class and ask for the students' advice to reduce the teachers' sick leave because of colds. Included in this assignment could be a question from the headmaster to the students if they could be helpful to test different methods to reduce the spread of cold microorganisms among the staff.

Class discussion (use concepts):

Class discussion about what it means to catch a cold. People say 'he gave me the flu' – what do they mean? What kind of things do we already do to help stop germs spreading?

Example of video to demonstrate how sneezes can spread viruses:
https://www.youtube.com/watch?v=NVXukm1lNOs

Hypothesis

What do we think is the most effective way to stop a sneeze travelling?

Post-it note hypothesis on the board.

Figure 4: example of students' post-it hypothesis

Questions to elaborate students' understanding

Suggestions for 4 questions to assess children's understanding:

- What's the best way to prevent a sneeze travelling?
- Why do we cough and sneeze?
- What kind of MOs travel in a sneeze?
- How fast do you think a sneeze can travel?

The questions could be use as initials and for further understanding later, and they can be answered on analogue whiteboards or through student response systems (SRS) as Kahoot or Socrative

Experiments

Students in work-groups - set an experiment to find out what is the most effective way to stop a sneeze spreading: Lay out a roll of paper and use a spray bottle filled with coloured water to simulate a sneeze. Measure how far the 'sneeze' travels by itself, using an open hand, an elbow and using a tissue.

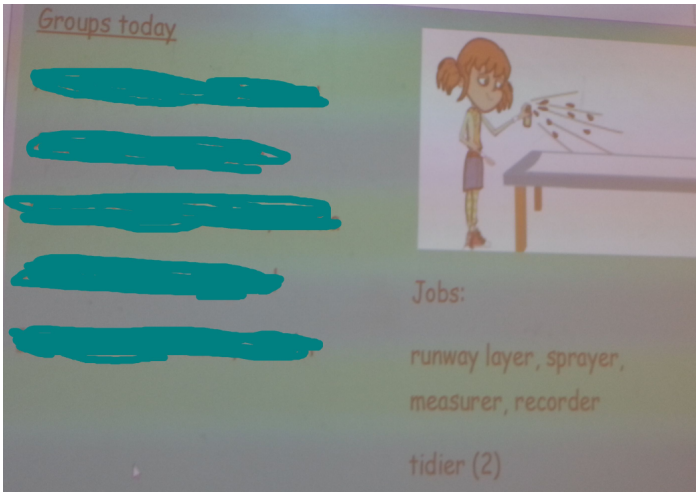

Figure 5: Illustration of the experiment layout

Group number	no protection	hand	tissue	elbow
1	140·5cm	102cm	98cm	86cm
2	1m 53	1m32cm	81	99cm
3	140	134	29	120
4	1m18	1m55	39cm	1m33
5	157cm	1.61m	1.39m	0.43m

Figure 5: Example of students data presented in a premade table template

Data handling and processing

The task is to put the record measurements into a table. Students work in groups, and are asked to turn the information in the table into a bar graph to show which sneeze travelled the furthest.

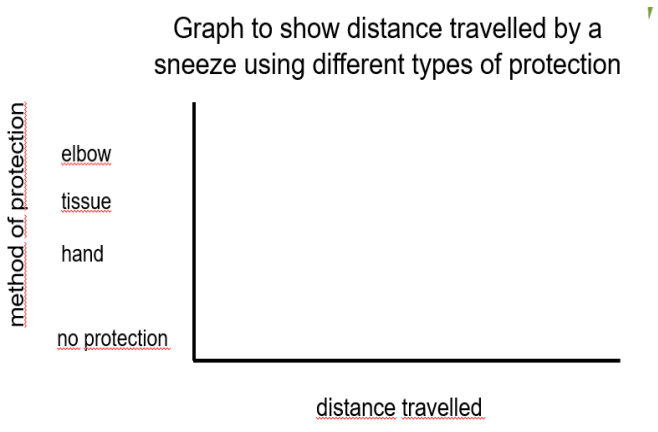

Figure 6: Template for making a bar graph (left) and an example of student results (right)

Conclusions

As a final task the students, as individuals, back to the boy to explain what is the best thing he could do to help stop his Grandma catching a cold and why they are sure about it.

2.3 Technology

The technology needed for this lesson is mix of analogue technology as small personal whiteboards and large papers, both for writing with marker pens; and digital technology as whiteboards, computers with several software as spreadsheet (Excel) and student response system (Socrative), and Smartboard notebook software.

Kahoot or Socrative feedback system can be used as part of the formative assessment. The students then have to access Internet, as they are both web based program.

Which digital tools to use could be adjusted according to the actual class situation: the pre-work can be done by analogue post-it stickers or digital whiteboards, the data handling can be done on paper or by spreadsheets like Excel, and the class discussion can be supported by analogue blackboard/whiteboards or student response systems like Socrative and Kahoot.

2.4 Aspects of Formative Assessment

The formative assessment is supposed to be done throughout the lessons, starting from questioning at the beginning, using i.e. mini whiteboard to establish the students' knowledge. The use of mini whiteboard (analogue), post-it stickers or digital whiteboard tool allows the teacher to get a quick glance of the answers. Yellow post-it stickers could also be useful to see what students were thinking in terms of the different hypotheses.

Through the experiment it is important to continually run dialog with students to find out where students did well, or when they needed some help. This is important whether it is the experimental part with the spray-bottles or the data handling and graph construction.

Recording on the Smartboard, student presentations, classroom discussions and the use of student response systems as Kahoot or Socrative are all considered as important parts of a formative assessment. Whether the hypotheses match the results or not doesn't matter. Good discussions about "why" are more important.

Besides, it is important that the teacher encourage peer-to-peer communication, e.g. by asking students to comment on each other's answer:

> "What do you think?"
>
> "Do you agree with..?"
>
> "Which statements do you agree most? Or least?"

Students' self-assessment is also important, and ongoing activities in the classroom could be supported by e.g. a kind of "traffic light system" where the students use colours, red if they don't feel they've got it, orange if they think they understand it, and green if they think they can do it.

Anyway, it is important to personalize the use of technology, to adjust the use to the available technology, to the actual school's technology support, and to the individual teacher's technology knowledge and skill.

3. Further Information

This lesson, inclusive templates for data collection and data processing, is developed with the ideas from the UK internet site:

http://www.e-bug.eu/junior_pack.aspx?cc=eng&ss=2&t=Respiratory.

Through the lesson it is possible to give special attention to different aspects of formative assessment, both digital and non-digital, and they are found to be useful in making students' thinking visible to teachers. The digital ones, such as interactive whiteboards (SmartBoard), Excel and Socrative were found to be convenient and effective as means for presenting (and recording) the results of students' work or answer to questions. There were concerns however, about the dependence on the Internet access and stability in using student response system such as Socrative or Kahoot.

4. References

Bell, B., & Cowie, B. (2001). The characteristics of formative assessment in science education. *Science Education*, 85(5), 536-533.

Black, P., & Wiliam, D. (1998). Assessment and classroom learning. *Assessment in education*, 5(1), 7-74.

Livingstone, S. (2012). Critical reflections on the benefits of ICT in education. *Oxford Review of Education, 38*(1), 9-24.

Scott, P., Ametller, J.,. Mercer, N., Kleine Staarman, J. & Dawes, L. (2007). An investigation of dialogic teaching in science classroom. Paper presented at NARST: New Orleans, April 2007.

Scott, P., Mortimer, E., & Ametller, J. (2011). Pedagogical link-making: a fundamental aspect of teaching and learning scientific conceptual knowledge. *Studies in Science Education, 47*(1), 3-36.

Smartboard. https://education.smarttech.com

Socrative. http://www.socrative.com

Templates and ideas: http://www.e-bug.eu/junior_pack.aspx?cc=eng&ss=2&t=Respiratory