Mathematics Case Study:

Berenice Jardine and her Grade 8 class

Context

Partner University	AIMSSEC
School name	South Peninsula School
Subject (Maths/physics/biology/chemistry)	Maths
Activities used	Three formative assessment lessons
Technology/tools used	Card sorts, mini whiteboards
Justification/rationale for the selected case study (interesting features/good example/complex example, etc.)	Good example of a teacher with some experience who wanted to do something different.
School Context	
School Roll (number of pupils)	1000
Staff Roll (number of teaching staff)	39
Geographical location (urban/rural, etc.)	Urban school in the Southern suburbs of Cape Town
Relationship to other schools (e.g. cluster/Feeder/Part of a group of schools)	Just another senior school
Age range	13 to 18
Single or mixed gender	Mixed
Ethnicity	Cape Coloured (mostly)
Mixed ability or selected (could include Special Educational Needs)	Top set
Socio-economic intake (with local contextual indicators, e.g. UK Free School Meals)	This is a fee-paying school in the top socio-economic quintile in the

	country. Most students are from lower middle class families.
How the school is judged to be performing in local context	Very good (this is one of the top performing schools in terms of value for money according to an analysis done by a local NGO, Saili)
Past experience of using formative assessment	Informal
Past experience of using technologies/tools	Display technologies, calculators. There is a computer room in the school and Computer Drawing is an optional subject for students in the last three years of school.
Previous experience of working within other research projects	No
Teacher demographic	
Subject area (science or mathematics)	Mathematics
Role (e.g. Head of Department/Teacher, etc.)	Teacher
Gender	Female
Age range (under 20; 21-30; 31-40; 41-50; 51-60; over 60)	41-50
How long has he/she been teaching	18 years
How long has/she been working at this school	15 years

Past experience of using formative assessment within lessons	In the course of normal teaching – questioning, tests, etc.
Past experience of using technologies/tools within lessons	Display technologies – data projector. Calculators.
Past experience of working in a research project	None
Class demographic	
Age range	13 to 14 years
Number of students in the class	37
Gender split within class (male/female)	19 girls, 16 boys
Ethnicity	Cape coloured mostly
Mixed ability or ability set	Top set
Any relevant contextual information	This class began at the school in January 2015, so were 'new' to one another and new to Berenice. She says they are easy to teach.
Intervention Data	
Teacher report of what happened in each case study lesson	See reports on the lessons
Teacher report of what happened pre and post each case study lesson	See reports on the lessons
Teacher reflective diaries or blogs (where possible)	Not available
HEI partner observations	See reports on the lessons

Video of extracts of lessons (where permission is granted to be used for research purposes)	These are available
Video of lessons and/or interviews to be used for dissemination and professional development. (where possible)	These are available
Interviews with participant teachers (see interview schedule below)	Details from the interviews are included in the narrative.
Interviews with participant students – to include focus group interviews (based on Q sorting) on their perceptions of how FA and technology/tool helped them in their learning. (see interview schedule below)	A questionnaire was administered.
Student questionnaire (cross-project, to be agreed)	A questionnaire was administered – analysis of the responses is included in the reports of the lessons
Students as researchers (possible gender focus for some groups) (where possible)	N/A
Parent forum (where possible)	N/A
Attainment data will be in line with individual schools usual attainment data collection. Where possible, there will be pre- and post- design study data. For comparison, data from an equivalent class/year will also be collected.	Still to be collected.

The school

South Peninsula School has five year groups, Grades 8 to 12 (aged about 13 to 18), with about 1000 students on roll. Thirty-nine regular teachers are employed at the school.

South African schools are classified into quintiles, by the socio-economic status of the surrounding area, and SPS is in the 5th quintile (i.e. top 20%). SPS is a government school, and it charges fees of about R7000 p.a. (about €500). It is generally seen as a very good school, and gaining a place at the school is highly competitive. To get into the school, students need to score well in examinations in the last years of primary school, they have an interview and they need to be able to pay the fees. The school is a 'Dinaledi' school, which means that it has been selected as one of 500 schools across South Africa for extra support in mathematics, science and technology, because it has been identified as having the potential to produce matriculants with 'good' passes in mathematics and science. In practice, according to teachers at these schools, it means that they are usually provided with an extra mathematics teacher and some extra equipment. They are expected to enter high numbers of students for mathematics, rather than mathematics literacy, which is seen as an easier option.

The school is equipped with computers in one computer room and this is mainly used for class teaching of Computer Aided Drawing (CAD). The teachers are provided with laptops and some classrooms have data projectors.

The medium of instruction is English at South Peninsula is English and the first additional language is Afrikaans. For prospective pupils, this means that they must have a pass in Afrikaans at primary school, which in effect excludes many Black children from entry.

The students at the school are mostly English speaking Cape Coloureds. Many, but not all, are Muslim. Most of the others are Christian. It is a mixed school in terms of gender and just over half the students are female.

South Peninsula School is unusual in that although it is by tradition a coloured school, it is situated in a previously (and still) white area. However most of the students live in coloured areas, and this means that all, or

almost all, students get 'transport' to school: most usually in buses provided by the school.

Figure 1: School entrance

Figure 2: Corridor inside school

The class

In mathematics the students are placed in sets, according to their prior attainment. Berenice's class, a Grade 8 class, is a top set. There are 37 students in the class with 20 girls and 17 boys. Grade 8 is the first year at secondary school, and the school year begins in January, so when the project began Berenice did not know the class and the class had not yet 'gelled'.

The teacher

A pen portrait of the teacher, Berenice Jardine, is provided below is Section 3. She is pictured here (Figure 3).

Figure 3: Berenice Jardine

1- Tasks and resources used

For us, a FaSMEd research lesson was usually based on one of the Mathematics Assessment Project (MAP) lessons developed by the University of Nottingham as formative assessment lessons. For many schools in South Africa, for students to use digital technology in the classroom is not possible, and we decided that all schools would use non-digital technology in our research lessons: small cards to be sorted or matched, big versions of the small cards for whole class work and mini whiteboards.

Research lesson 1 (Negative numbers in context)

Lesson 1: 8th March 2015

Activity 1: The students were given the questions shown in Figure 4 to answer individually.

Temperature Changes

1.

The temperature was +3°C at midday.
By evening, the temperature was −5°C.

(a) Some of the calculations below show how to figure out the temperature change.
Circle any that apply.

3 − 5	3 + (−5)	(−5) − 3	(−5) + 3

(b) What was the change in temperature? Explain your answer.

2.

The temperature was −7°C at midnight.
By the next day, the temperature had risen by 11°C.

(a) Some of these calculations show how to figure out the temperature the next day.
Circle any that apply.

7 − 11	11 + (−7)	(−11) − (−7)	(−7) + 11

(b) What was the temperature the next day? Explain your answer.

3. Here is a calculation:

5 − (−11)

(a) Figure out the answer to the calculation:

(b) Which of these story questions fits the calculation? Circle any that apply.

A	It was extremely cold at midnight. During the morning, the temperature rose by 5°C. By midday, it had reached -11°C. What was the temperature at midnight?
B	The temperature at midnight was −11°C. By midday, the temperature was 5°C. What was the temperature change?
C	At midday, the temperature was 5°C. The temperature then fell by 11°C. What was the final temperature?

Explain your answer:

.....

.....

.....

.....

.....

Figure 4: Pre-lesson assessment (Properties of exponents)

Lesson 2: 9th March 2015

Activity 2: Brief discussion of the pre-lesson assessment task.

Activity 3: Introduction with whole class

The teacher handed out big cards (Figure 5) to four volunteers and asked them to arrange themselves from lowest to highest temperature.

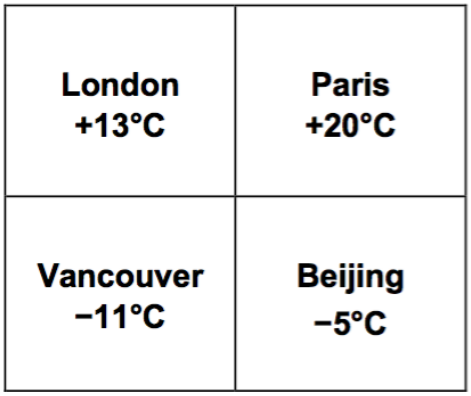


Figure 5: Big cards used for introduction

The teacher displayed the PowerPoint slide in Figure 6 on the board and led a discussion about the difference in temperature between the different cities.

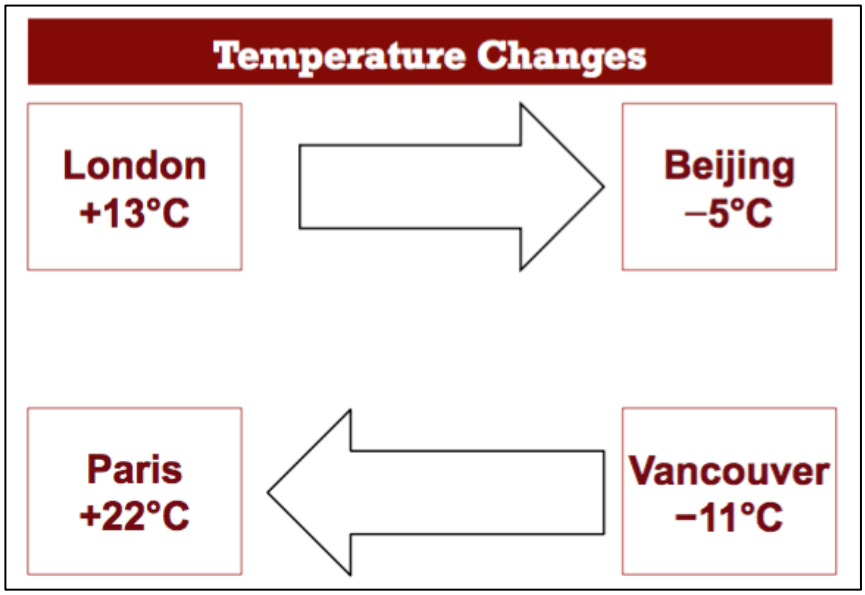


Figure 6: PowerPoint slide used in introduction

Activity 4: Pair work

The students were asked to work in pairs to use arrow cards (Figure 7) to indicate the difference in temperature between certain cities (Figure 8).

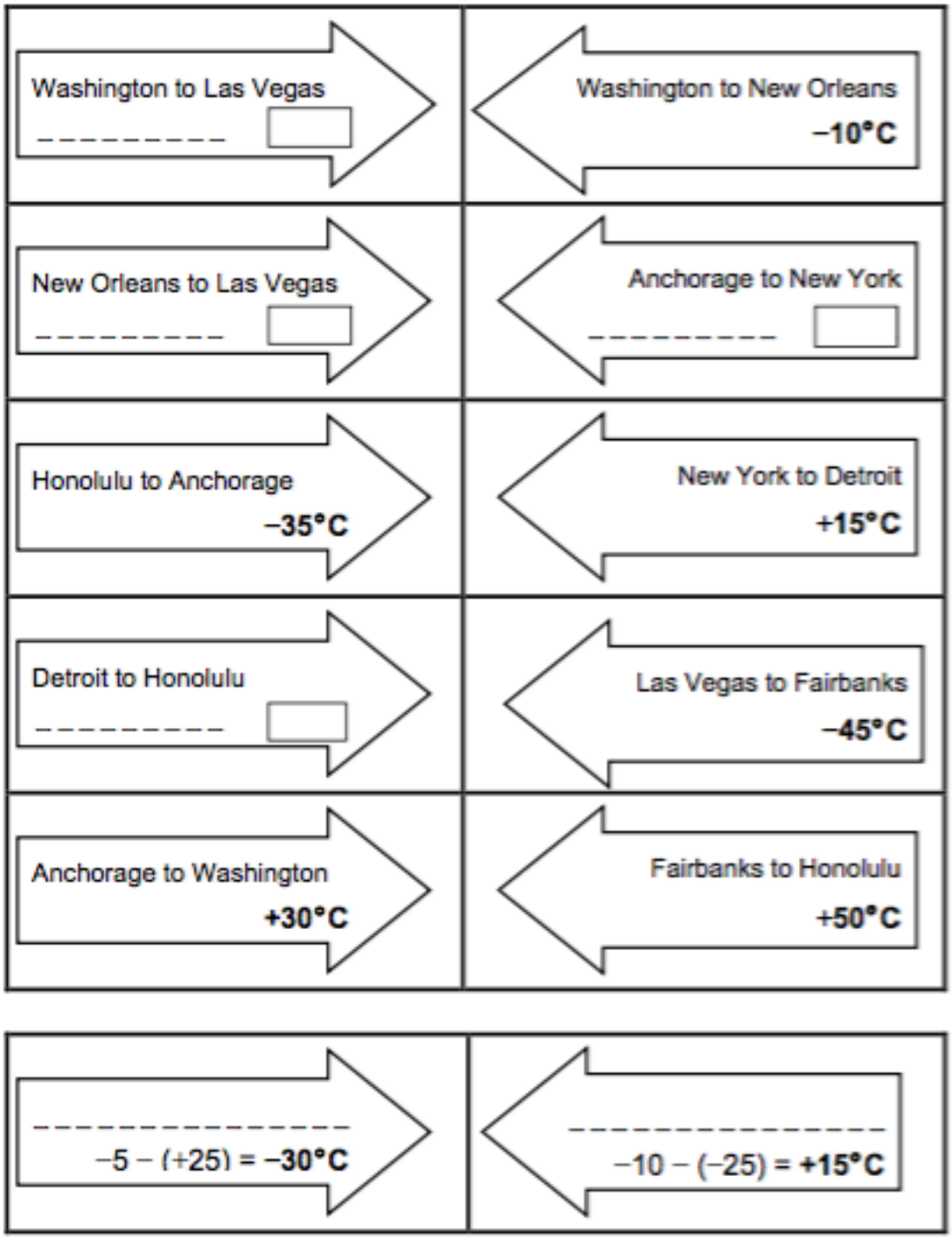


Figure 7: Arrow cards

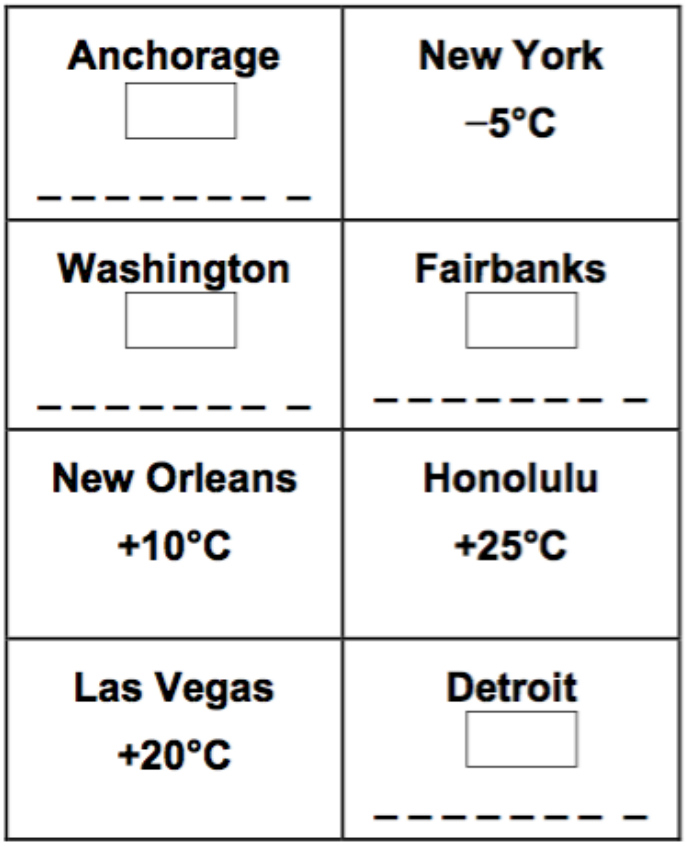


Figure 8: Cards for different cities

The instructions for what students should do are shown in Figure 9.

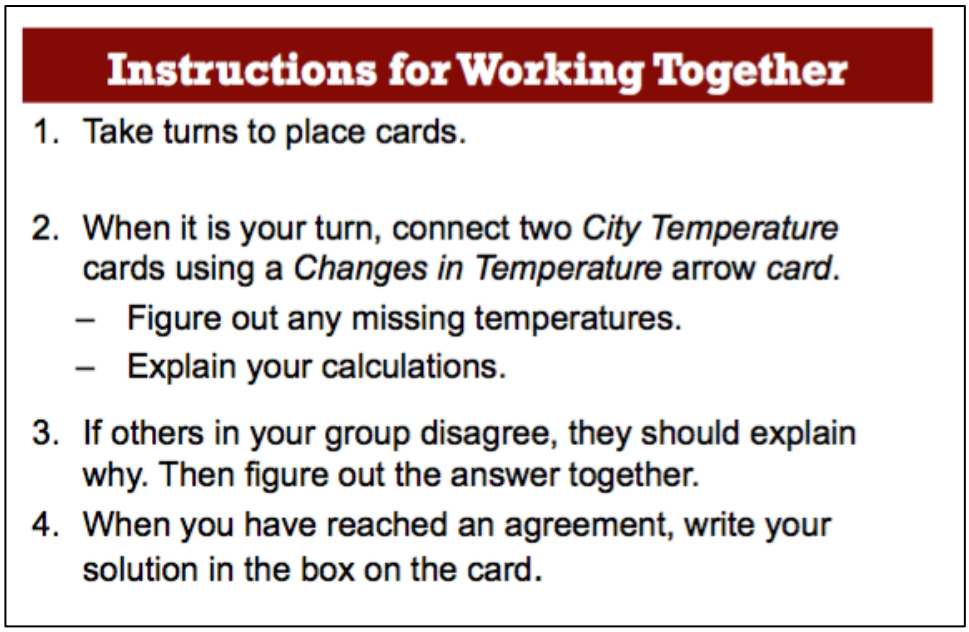


Figure 9: PowerPoint slide with instructions for working together

Lesson 3: 10th March 2015

Activity 4 continued: Students continued to work in pairs sticking the cards on the poster paper.

Activity 5: Whole class discussion: going through the answers on the board (Figure 10).

Figure 10: Discussing answer on the board

Activity 6: Whole class discussion

The teacher displayed a PowerPoint slide (Figure 11) with three more pairs of cities to compare and led the class in a discussion.

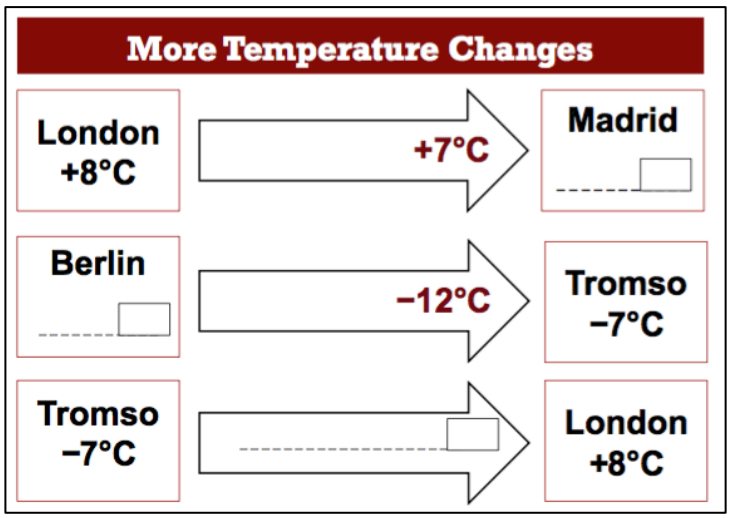
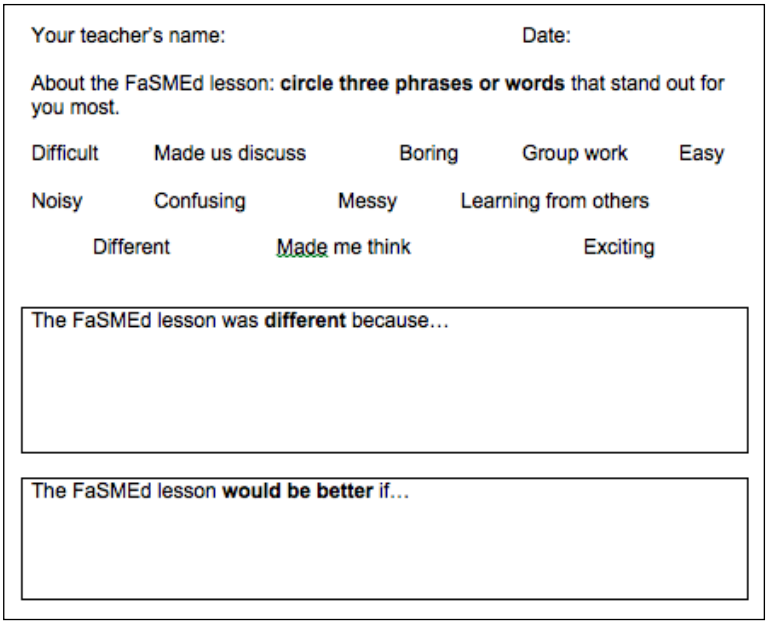


Figure 11: PowerPoint slide of cities to compare

Lesson 4: 11th March 2015

Activity 7: Students completed a questionnaire about the lesson (see Figure 12)


Your teacher's name: Date:

About the FaSMEd lesson: **circle three phrases or words** that stand out for you most.

Difficult Made us discuss Boring Group work Easy

Noisy Confusing Messy Learning from others

Different Made me think Exciting

The FaSMEd lesson was **different** because…

The FaSMEd lesson **would be better** if…

Figure 12: Student questionnaire

Research lesson 2 (Interpreting equations)

Lesson 1: 24th May 2015

Activity 1: Pre-lesson assessment, see Figure 13.

Real-life Equations

1. Suppose that there are some chairs in a room and that each chair has 4 legs.

x = the **number** of chairs.
y = the **total number** of legs on all the chairs.

Put a check mark in the box next to every equation below that you think is correct.

(a) $x = 4y$ ☐ (b) $y = 4x$ ☐ (c) $x = \frac{y}{4}$ ☐ (d) $y = \frac{x}{4}$ ☐

Explain your answer(s).

_____

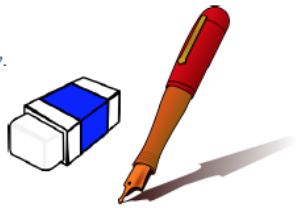
_____

_____

_____

2. Suppose that Max buys some pens and erasers.

The cost of a pen in dollars is x and the cost of an erasers in dollars is y.



p = the **number** of pens he buys
e = the **number** of erasers he buys.

The following two equations are true.

Write down the meaning of each equation in words.
(Refer to pens and erasers in your answers, don't just use letters).

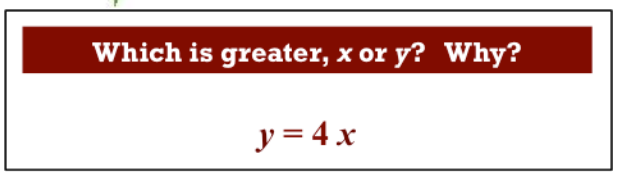
$p = 2e$	$x = 2y$
In everyday words this means:	In everyday words this means:

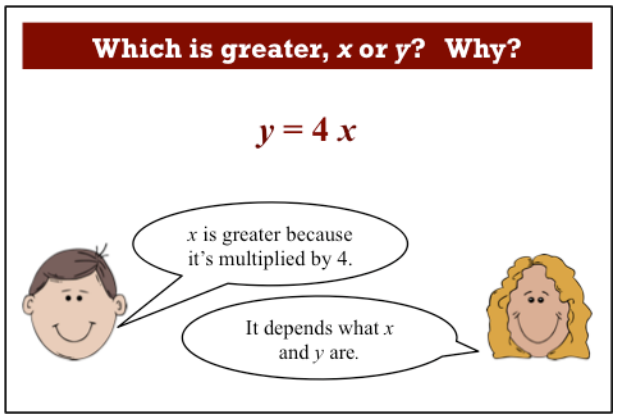
Figure 13: Pre-lesson assessment (time distance graphs)

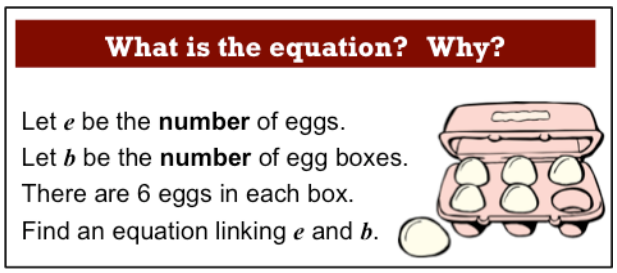
Lesson 2: 25th May 2015

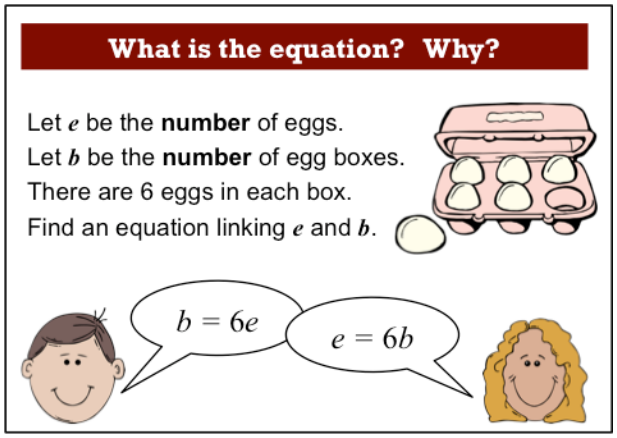
Activity 2: Class discussion: what's the right equation.

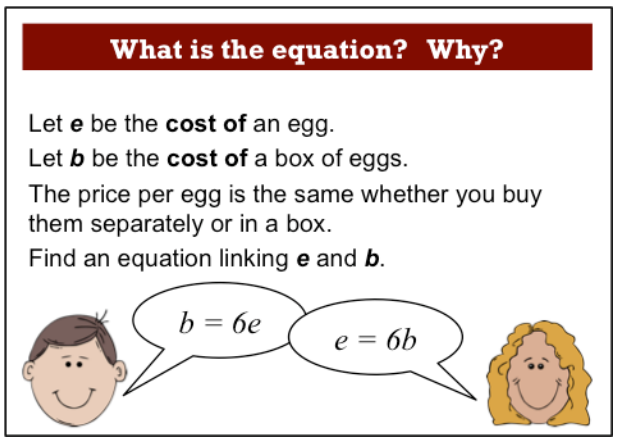
The teacher use a series of six PowerPoint slides (Figure 14) to lead the class in a discussion about using an equation to describe a statement and the importance of using the correct variables.











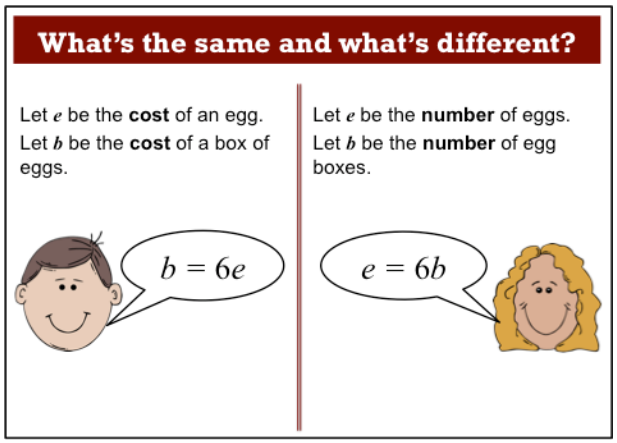


Figure 14: Choose the equation to match the statement

Activity 3: The students were asked to work in groups of three to match the cards shown in Figures 15 and 16.

E1 $y = 2x$	E7 $b = 2$
E2 $x = \frac{1}{2}y$	E8 $x = 2y$
E3 $b = 2a$	E9 $y = \frac{1}{2}x$
E4 $a = \frac{1}{2}b$	E10 $x = y$
E5 $b + a = 5$	E11 $y = 2$
E6 $ax = 25$	E12 $ax + by = 25$

Figure 15: Equation cards to match with statements

S1 Apples cost half as much as bananas.	S2 Bananas cost twice as much as apples.
S3 I bought twice as many bananas as apples.	S4 Altogether I bought 5 apples and bananas.
S5 Altogether the apples I bought cost R25.	S6 A banana costs R2.
S7 Apples and bananas cost the same.	S8 I paid R25 for all the apples and bananas I bought.
S9 Bananas cost half as much as apples.	S10 I bought 2 bananas.

Figure 16: Statement cards to match with equations

The teacher used a big version of two of the cards to explain to the students how to match the cards (Figure 17) and she also showed the class an example of a completed poster (Figure 18).

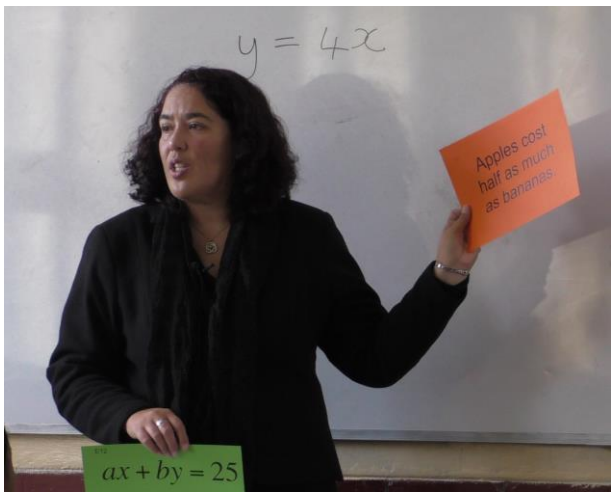


Figure 17: Demonstrating with big cards *Figure 18: Example of a poster*

The instructions for what they should do are shown in Figure 19.

Working Together

Take turns to:

1. Match an equation card with a sentence.
2. Explain your thinking to your partner.
3. Your partner must check and challenge your explanation if he or she disagrees.
4. Check if another card or another sentence matches as well.
5. Continue until you have matched all the cards.
6. Use the blank cards to write equations or sentences so that each card is grouped with at least one other card.

Figure 19: Instructions for working in groups

Activity 4: Institutionalisation

The teacher used big versions of the little cards to facilitate a class discussion about the correct answers. Figure 20 shows the correct answers on the board.

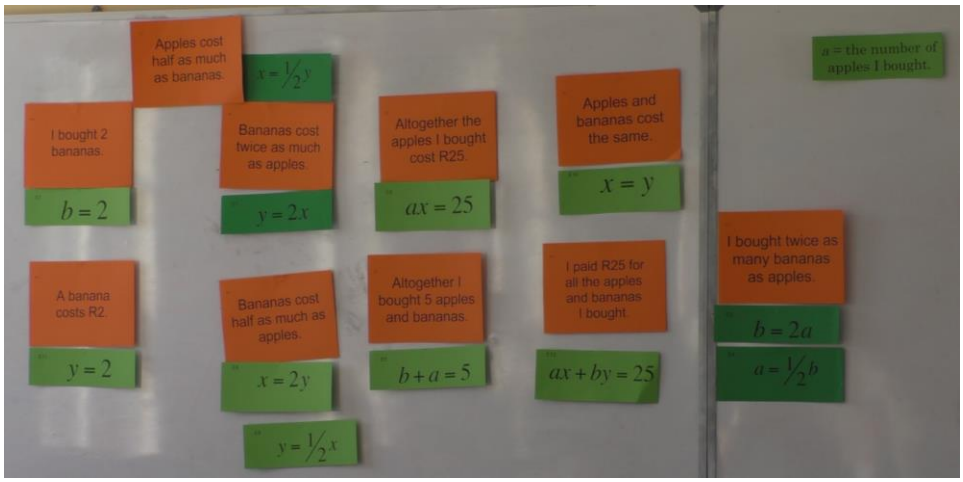


Figure 20: Correct matches on board

Students used a recording sheet to make a record of the correct answers to stick in their books (Figure 21).

Real life equations

a = the **number** of apples I bought	x = the **cost** of an apple in Rands
b = the **number** of bananas I bought	y = the **cost** of a banana in Rands

S1	Apples cost half as much as bananas.	
S2	Bananas cost twice as much as apples.	
S3	I bought twice as many bananas as apples.	
S4	Altogether I bought 5 apples and bananas.	
S5	Altogether the apples I bought cost R25.	
S6	A banana cost R2.	
S7	Apples and bananas cost the same.	
S8	I paid R25 for all the apples and bananas I bought.	
S9	Bananas cost half as much as apples.	
S10	I bought 2 bananas.	

Figure 21: Recording sheet

Lesson 3: 26th May 2015

Activity 5: Students completed a questionnaire about the FaSMEd lesson. This was almost the same as the one used previously, see Figure 12 above.

Research lesson 3 (Properties of quadrilaterals)

Lesson 1: 24th August 2015

Activity 1: Introduction

The topic was introduced by referring to the previous lesson and discussing the properties of squares and rectangles.

Activity 2: Working in small groups

Students were given six strips with properties of different quadrilaterals (Figure 22) and a piece of poster paper. They were told to take one strip at a time, put it in one of the parts of the poster paper, to decide *as a group* which quadrilateral the properties describe and then to draw and name it.

A1 The diagonals of the shape are congruent	A2 The shape has at least one side that is 5cm long	A3 The diagonals of the shape bisect each other at right angles	A4 The shape has 4 equal angles	A5 The shape has two pairs of parallel sides
B1 The shape has at least one side that is 4cm long	B2 The diagonals of the shape bisect each other	B3 The shape has 4 equal angles	B4 Opposite sides of the shape are congruent	B5 The shape has at least one side that is 6cm long
C1 The diagonals of the shape are not congruent	C2 The shape has at least one side that is 12cm long	C3 The shape has at least one side that is 7cm long	C4 The shape contains at least one 55° angle	C5 Opposite sides of the shape are parallel
D1 The diagonals of the shape bisect each other at right angles	D2 All four sides are congruent	D3 The shape contains at least one 70° angle	D4 Opposite sides of the shape are parallel	D5 The shape has at least one side that is 7cm long
E1 The shape has at least one side that is 5cm long	E2 One diagonal bisects the other diagonal into two 2cm segments	E3 The shape has two pairs of congruent sides	E4 The diagonals of the shape intersect each other at right angles	E5 The shape has at least one side that is 4cm long
F1 The shape contains exactly one pair of parallel sides	F2 The shape has more than one side that is 10cm long	F3 The shape contains at least one 60° angle	F4 The shape has a side that is 6cm long	F5 The shape contains a pair of opposite sides that are congruent

Figure 22: Six strips of properties describing six quadrilaterals

Lesson 2: 25th August 2015

Activity 3: Institutionalisation: Whole class discussion about correct answers.

Activity 4: Students completed a questionnaire about the FaSMEd lesson. This was almost the same as the one used previously, see Figure 12 above.

Technology used

Projective technologies

Sets of small cards for use by the students in group work

Big cards for modelling the activity

Sets of big cards for the institutionalisation phase

Mini whiteboards

Formative assessment

Teacher: Clarifying learning intentions and criteria for success

Teacher: Engineering discussions, questioning during whole class discussion

Teacher: Pre-lesson assessments (Research lessons 1 and 2); these allowed the teacher to assess prior understanding and plan accordingly.

Teacher: Gathering information from the card matching or sorting activities and intervening accordingly, usually with questions.

Teacher: Gathering information from what the students have written on the mini whiteboards and intervening accordingly, usually with questions.

Students: Gathering information about their peers' understanding from the card matching or sorting activities and acting accordingly, to explain their own reasoning, for example.

2- "Work with teachers"

How was the overall work/sessions with teachers conducted?

Overview

The work of FaSMEd in South Africa was organised by the researchers at AIMSSEC, Marie Joubert and Ingrid Mosert. The research team began working with teachers in the second half of 2014. We did not have research relationships prior to the FaSMEd project. We spent some months recruiting teachers, and made the

decision to involve any teachers who chose to take part. In the end we had 20 teachers in 10 schools. Most of these teachers taught three FaSMEd research lessons, one in each of the first three school terms of the academic year beginning in January 2015. For each lesson, we visited the teacher once or twice to plan the lesson, went to school to observe and video record the lesson (often over two days) and then interviewed the teacher. The work with the teachers focused on the planning of lessons and the resources to be used, and included discussion of how formative assessment could be used or was used, with a particular emphasis on the potential of the small and big cards and the mini whiteboards.

Most interactions with the individual teachers were face to face, and interviews were audio- or video-recorded. With some teachers, email was used to make arrangements and send proposed lessons or reports. Other teachers were not regular users of email, and arrangements were often made using WhatsApp.

After each phase of lessons, we held a cluster meeting. At the second and third cluster meetings we asked some teachers to make a short presentation to the group.

This case study is about Berenice Jardine and her Grade 8 class. Berenice teaches at South Peninsula High School and both she and her colleague, Adnaan Ederies, took part in the FaSMEd research.

In detail

We first met Berenice on 21st August 2014, when she attended workshop run by the AIMSSEC research team, which aimed to inform teachers about the project and to attract some of them to take part. Berenice expressed an interest in taking part and was invited to a meeting on 30th October 2014 in which the project was further discussed. At this meeting, teachers were told about what they would need to do to if they wanted to take part in the research and what the project team would do. Berenice said that she wanted to take part.

On 19th November 2014, the project researchers went to visit Berenice at her school. During the meeting the following were discussed: research ethics, the toolkit and the lessons Berenice might like to teach. At the meeting Berenice said that she was the only teacher at the school who wanted to take part but she would ask others if they were interested. Later her colleague, the Head of Department, also agreed to take part.

During the school year 2015, we met with Berenice as detailed below. In most cases the participants in the meeting were the two researchers, the teacher and, sometimes, his colleague.

- 20th January, to gather some early information about how she responded to a draft version of a proposed toolkit. She used the toolkit, with us observing, and then we interviewed her about her experience. This research is not relevant to the classroom interventions that followed, but is possibly important to mention as it demonstrates something of the relationship we were developing with her.
- 2nd March, to observe an 'ordinary' lesson and to plan for the research lesson. We asked to observe an ordinary lesson so that we could get a sense of Berenice as a teacher.
- 9th and 10th March, to observe and video-record the research lesson (Negative numbers in context) and to interview Berenice. This lesson was chosen to fit in with the work the class was doing at the time. Berenice did the pre-lesson assessments when we were not present.
- 12th May to plan the second research lesson (Real-life equations).
- 25th May to observe and video-record the second research lesson and to interview Berenice. She had done the pre-lesson assessment with the class the previous day.
- 13th August, to plan the third research lesson (Properties of quadrilaterals).
- 24th August, to observe and video-record the third research lesson and to interview Berenice.
- 15th September, to interview Berenice and Adnaan about their experiences of taking part in FaSMEd.
- 13th October, to discuss Berenice's contribution (Cameo slot) to the third cluster meeting
- 20th November, to do the Q-sort with six of her and Adnaan's students

Cluster meetings

Cluster meetings were held three times; at the end of a phase of research lessons. All teachers participating in the research (apart from those too far away: one college

with three teachers) were invited to attend the cluster meetings. Not all teachers were able to come to each of the cluster meetings, but many did come. Here, below, we provide more details of what happened in each cluster meeting.

Cluster meeting 1: 26th March

This meeting took place at the main AIMS building in Muizenberg, timed to take place after school (3:30 to 5 pm). Fourteen teachers, one visitor (observer) and four colleagues from AIMSSEC attended.

The researchers ran the meeting, first welcoming the teachers and explaining the purpose of the meeting: for teachers to get to know one another and begin to form a 'cluster'; to share what had happened so far, to talk about what happens next in the project and to discuss emerging issues.

Sharing what has happened so far:

- The researchers introduced each of the teachers and explained what they had done.
- The researchers showed a video montage taken from the video recordings of the research lessons from all teachers;
- We distributed a set of research reports to each teacher;
- We held a group discussion about what had happened.

What happens next:

- The teachers were told that we would be in touch about the next research lesson;
- We distributed two lesson ideas for teachers to look at (Properties of quadrilaterals and Real-life equations) and asked them to look at them briefly together with another teacher, with a view to considering if they would use it for their next research lesson.

Issues arising:

- Some teachers told us that they found it difficult to teach a lesson designed by someone else. We told the teachers that this had always been a concern for us, and encouraged them to adapt and re-design the lesson for their own contexts;

- One teacher asked us for a lesson on early algebra and we could not find one that was already tried and tested so we designed a new lesson together with him and he talked about his experience of this;
- Many teachers said that they wanted to find ways for students to keep a record of what had happened in the research lessons. We said that we would think about how to make a recording sheets;
- We discussed that we, and most teachers, wanted to have an understanding of the students' views on the lesson, and it was agreed that we would give students a short questionnaire in the next round of lessons.

Cluster meeting 2: 18th June

This meeting took place at the main AIMS building in Muizenberg, timed to take place after school (3:30 to 5 pm). Ten teachers and six colleagues from AIMSSEC attended.

The researchers ran the meeting, first welcoming the teachers as before.

Sharing what has happened so far:

- Marie introduced Greg and said that we had asked him to talk about his experience of the FaSMEd project so far. Greg explained that he had been asked to share some of his experiences of being part of the research project. He started by saying how much he had learnt from the experience so far. He explained that the first research lesson (on exponents) he had taught was to his Gr 8 class but that it had not been a good experience. Subsequently he taught two lessons to his Gr 10 class (Time-distance graphs and Different representations) and these lessons had been much more successful. He showed some video clips from the second and third lesson and pointed out a number of things he had noticed. He spoke about, for example, the different strategies he had seen learners using in terms of how to approach a card matching activity.
- We showed a video montage as before and we asked the teachers to consider the following things while watching the video: the role of the teacher, the role of the students, the design of the tasks and the use of cards.
- The teachers then worked in groups to share their experiences of teaching the same or similar lessons.

Issues arising this term:

- Time: we discussed the fact that the FaSMEd lessons tend to take more time than one class period and the need to take this into account;
- Guidance: we talked about the extensive guidance provided with many of the lessons and the teachers seemed to think it was useful but said also liked the abbreviated lesson plan (one page) we had begun to produce.
- Other points: we also talked about designing lessons from scratch, adapting other people's lessons and possibly video recording a pair of learners.
- Danny Parsons, who worked with us for three months, presented some ideas related to the use of geometry software in the mathematics classroom.

Cluster meeting 3: 15th October

The third cluster meeting was held at a local school. It is a school where two of the FaSMEd teachers work. As before, the researchers led the meeting.

Sharing what has happened so far:

- Marie gave a quick summary of the lessons taught that term.
- We showed a video-montage, as before, asking the teachers to consider the following things while watching the video: the use of big cards, learners' response to the lesson and the use of mini whiteboards.
- One of the teachers, Regis Magama, introduced the 'Revision Lesson' we had designed for his class. The teachers and AIMSSEC colleagues were then paired up and worked together on the revision lesson.
- The teachers then completed a questionnaire about their experience of taking part in FaSMEd

Issues arising this term:

- Use of big cards for modelling and to end off. We had intended that Jane and Severino lead the discussion on these, but both were unable to make it to the meeting;

- The development in the students: Berenice led a short discussion on her observations of how the students in her class had matured over the course of the three FaSMEd lessons;
- Regis talked about the use of mini whiteboards in his classrooms, explaining how they helped him gather the information he needed for formative assessment.

Did you appraise the session/s with teachers?

Appraisal of sessions with the individual teacher

We did a final interview with Berenice (video recorded) to ask her about the last lesson and the experience of all three lessons. This was not really an appraisal of the sessions as such but was rather an appraisal of the whole process. Berenice said that she had found the first lesson difficult, as it was the first time she had taught using a lesson plan devised by someone else, but in the second and third lessons she felt more comfortable adapting the lesson for her own environment. She added that the students had become more comfortable: 'it got noisier as well, but that was OK, they were mostly focused on the lesson… many of our lessons tend to be more formal and teacher-centred, and they need get more comfortable with it being more student-centred, where they come up with solutions and discuss why things are the way they are'.

We also asked all the teachers, Berenice included, to complete a questionnaire mainly about their experience of the different aspects of the research lessons, and Berenice's responses to the questions relevant to this section are given below:

Post-lesson discussion and interview: 'Helped me to reflect on my own teaching practice.'

Reading observation notes: 'Sometimes made me aware of aspects of interactions between myself and learners or of learners with each other that I might otherwise have missed.'

Sharing experiences with other teachers at the cluster meetings: 'I enjoyed sharing experiences of lessons with other teachers as it both validated my own practice and allowed me to find out about different approaches that other teachers use.'

Watching video of other teachers' lessons at cluster meetings: 'Gave interesting insight to different classroom experiences.'

Reading reports of other teachers' lessons: Allowed me to compare and contrast lessons I had taught with similar lessons taught by others.

Which tools and strategies, materials, techniques, … were supportive in terms of participants' work in school?

'Active learning' approaches and pair work, especially with the use of card matching strategies, were supportive. The researchers were supportive in preparing all the materials and bringing them along to school.

What were the constraints (mentioned or experienced by teachers) for teachers' work with FaSMEd tools and strategies?

The main constraints observed in Berenice's classroom were:

- Time, as it takes more than one class period to complete one of the FaSMEd lessons. However, Berenice was aware of this and scheduled the research lessons before assembly so that the lesson could continue for longer than one period;
- Teaching someone else's lesson; Berenice said that she found this difficult for the first lesson but that it had become easier later, as she became more confident;
- Curriculum; Berenice explained that the mathematics curriculum is full and it is sometimes difficult to fit everything in, and teaching a research lesson takes some of the precious time needed to cover the whole curriculum.

3- Classroom teaching (based on teacher interviews)

Berenice, who is a female mathematics teacher aged between 41 and 50, grew up in Cape Town, and went to school at a school which is similar in nature to South Peninsula, called Livingstone. She matriculated there and then studied at the University of Cape Town (UCT), where she gained a BSc in Life Sciences, majoring in zoology. She says there was 'lots of maths' in her degree course. She then did a Higher Diploma in Education at UCT, which qualified her to teach science and maths at secondary school level.

She says that her decision to teach came naturally as she had grown up in a teaching household; her father was a teacher. She had also been involved in church youth work from a young age and she realized that she enjoyed working with young people.

She has been teaching for 18 years, 15 of which have been at South Peninsula. She has taught both life sciences and mathematics, but currently she is teaching only mathematics. She explained that the school was short of mathematics teachers. She added that much of what she knows about teaching is from 'self learning', particularly in mathematics, as she was trained in life sciences and is a 'science person'.

When asked to describe herself as a teacher, she said that she enjoyed engaging with students, particularly the younger learners. She said that she tended to be very focused on the mathematics objectives in her lessons and she needed to keep reminding herself that her students liked to establish an emotional connection and that, for her, this was important. She said that many students arrive in her class with a negative perception of mathematics, and that she liked to 'put a human face on maths' for them and that she tried to use materials that would engage the students. She likes using colour and tries to use practical activities in class, and she particularly enjoys teaching geometry which she tells the students is 'maths with pictures'.

In her classroom, Berenice supports learners who are struggling by re-explaining and giving them extra assistance. She says that they know they can come and ask for help in the daily breaks in the school day and that she also runs two formal extra maths classes a week. She says the quick students sometimes present a challenge, as she does not want them to get bored. Sometimes she groups a quick

learner with one who struggles more and then the stronger student can help the weaker one. She added, however, that the students needed some training to be able to do this effectively.

Ideally, Berenice would like to have smaller classes as she would then be able to spend more time with individual students. She would also be able to spend more time on the 'kind of thing we have been trying' [FaSMEd activities]. She said that she school maths too 'curriculum bound' and would like to explore other ways of teaching.

Berenice said she sees all mathematics as important, but if she were to choose what is particularly important, it would be arithmetic. She added that the value of learning mathematics is in developing logical thinking in a structured way, and that engaging with mathematics helped learners move from the concrete to the abstract.

Berenice said that she has had some experience of using formative assessment, which she described as 'an informal type of assessment used by teachers and learners to gauge the learners' understanding'. She went on the say that once she knew something about what they understood, she could decide what to do next: either she would repeat the teaching or assist with gaps in their knowledge or, if they seemed to have 'got it' she would move on. In terms of deliberate, planned formative assessment, her only experience had been that of FaSMEd. She said that she thought the 'technology' used for formative assessment in FaSMEd had worked well as it gave her 'a chance to walk around and see how they changed their thinking as they discussed things'. She added that 'it gives me an insight into their patterns of thinking, and then you also pick up if you've, maybe, umm, not emphasised something that needed to be emphasised: we did that a few times in the lesson where I had to stop them and say 'this is what I mean by … whatever…'.

In terms of digital technology, Berenice said that she mainly used the data projector with her laptop. However, she explained that she had only had the data projector for three years and she was still exploring the best ways to use it. She said she would like to try using technology in different ways in her lessons, but she had no experience of this yet.

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