St Cecilia's College

Assessing Using Mathematics and Geography Knowledge and Understanding

Introduction

St Cecilia's College is a non-selective girls' school with around 900 pupils. This case study outlines the school's assessment policy and practice and its approach to planning and developing assessment at Key Stage 3. This provides a background for considering how geography teachers, in collaboration with colleagues from the mathematics department, have developed tasks to assess Using Mathematics alongside geography subject knowledge and understanding in Year 8. This case study provides an insight into how an assessment task can be used to serve both summative and formative purposes.

School Policy and Practice

Assessment is seen as an important part of the teaching and learning process and as a way of improving pupil learning outcomes. School assessment policy and practice is developed through a collaborative approach, led by the vice principal and the Senior Leadership Team, and involves all teaching staff. The key features of the school's assessment policy and practice are:

- The main aim of assessment is to improve learning.
- Assessment is aligned to the Northern Ireland Curriculum.
- Assessment is an integral part of teaching and learning with assessment opportunities identified within subject schemes of work.
- A range of assessment approaches are used and take into account:
  - the pupil's individual learning needs;
  - the pupil's ability;
  - the pupil's learning experience;
  - statutory requirements; and
  - subject content and the need to assess skills and capabilities.
- Diagnostic assessment is used to identify particular areas of learning that are problematic for pupils. Assessment information is used to put in place learning support strategies.
- Formative assessment is an integral part of classroom teaching and learning. A range of Assessment for Learning (AfL) strategies are used to support pupils to improve their learning, including setting personal learning targets.
- Summative assessment is used by all departments to assess pupils four times per year, including winter and summer examinations.
- Using assessment for summative and formative purposes; assessments that are used to provide summative data are also intended to be used in formative ways to improve learning, these include:
  - sharing success criteria;
  - providing quality teacher feedback;
  - effective questioning;
  - scaffolding reflection; and
  - peer and self-assessment.
- Evaluative assessment, the end of Key Stage 3 results for English and Mathematics are used for accountability purposes and to inform curriculum planning. The school is currently developing assessment arrangements for incoming statutory assessment of Communication, Using Mathematics and Using ICT.
- Key Stage 3 assessment data is used for:
  - benchmarking and target setting;
  - monitoring and tracking pupil progress;
  - identifying underperformance and low achievement and underachievement; and
  - informing assessment and curriculum planning.

- Assessment policy and practice is regularly monitored and reviewed as part of its school self-evaluation and school development planning.

Assessment for Learning (AfL) strategies are being developed and trialled throughout the school. At Key Stage 3 there is a focus on developing assessment tasks to assess the Cross-Curricular Skills, Thinking Skills and Personal Capabilities (TSPC) and subject knowledge and understanding.

Planning and Developing Assessment

As part of assessment planning, the school conducted a curriculum audit to identify and plan which subjects were best placed to assess and report on the Cross-Curricular Skills and TSPC. This helped to ensure that the school's assessment arrangements at Key Stage 3 were manageable and avoided unnecessary repetition of the assessment of skills/capabilities.

It was decided that, while the assessment of Using Mathematics would be led by the mathematics department, assessment would involve other departments in Years 8 and 9. One of the main reasons for this was to emphasise to pupils the relevance and importance of mathematics in other subjects.

The geography department agreed to contribute to the assessment of Using Mathematics in Year 8. Geography teachers enlisted their mathematics colleagues, including the co-ordinator for Using Mathematics, to support them to develop assessment tasks. Inter-departmental discussion initially focused on the teaching and learning of Using Mathematics in geography and what progression in Using Mathematics might look like.

Teachers considered geography activities that provided opportunities for pupils to acquire and develop these skills and examined the Using Mathematics Levels of Progression to find out what levels these activities might cover in relation to the Using Mathematics requirements and knowledge and understanding. This discussion was also an opportunity to discuss the pupils' learning in mathematics and whether they would have developed the Using Mathematics skills necessary for successfully performing these activities in geography.

Microclimate Investigation Task

One of the geography activities identified as a possible assessment opportunity for Using Mathematics was an investigation of microclimate (Appendix A). During discussion the geography teachers thought that it could also be used to assess pupils' subject knowledge, understanding, and enquiry and fieldwork skills. This would enable pupils to make the connection between learning about microclimate and Using Mathematics as the enquiry and fieldwork skills require pupils to use mathematics in a practical context.

Teacher discusses the microclimate tasks with pupils

In consultation with their colleagues from the mathematics department, geography teachers developed a task to assess Using Mathematics skills and geography subject knowledge and understanding (Appendix A). The task is in two parts. The first part is designed to assess Using Mathematics and covers two of the requirements in the Levels of Progression:

R1 choose the appropriate materials, equipment and mathematics to use in a particular situation;

R1 identify and collect information; and

R2 read, interpret, organise and present information in mathematical formats.

Pupils discuss what measurements they need to take.

It also covers aspects of knowledge and understanding for Measures, Handling Data, and Shape and Space at Levels 3, 4 and 5. Teachers used the CCEA Using Mathematics task writing tool to help create an assessment grid (Appendix B).

The second part of the task consists of questions to assess aspects of pupils' knowledge and understanding about microclimate.

Using the task

The activity takes two weeks (8 hours during class) to complete. All Year 8 pupils complete the task during the same two weeks. In the first week, each Year 8 class collects data on temperature, rainfall, wind speed and wind direction at three locations on the days that they have geography. The data from each class is then shared so that all pupils have a data set for five days to work with.

Pupils work in groups of three or four to plan the activity. They are given prompt questions and asked to think about how they will carry out the investigation (Appendix A). This approach gives pupils flexibility to make decisions. For example, pupils have to think about what measurements to take, which measuring instruments to select, and how they will record, present, and interpret their results. Pupils are given the choice of using templates for result tables, bar charts, pictograms and data collection sheets or to create and use their own.

When carrying out the Using Mathematics part of the task, pupil works in pairs to collect data. As data is collected at three locations for four variables, all pupils must collect their own data for at least one location.

Pupils sharing information

Once the data is collected, the teacher gives pupils the results collected by the other classes. Pupils work individually to produce their own data set for five days. Pupils use this data to perform calculations to find, for example, the maximum and minimum temperature, the temperature range and mean temperature for different locations. Pupils choose how they will present and interpret their results, using tables, bar charts or pictograms.

The teacher observes the pupils as they conduct the investigation. This helps to inform their judgement about what level a pupil is working at in Using Mathematics. The teacher uses the Using Mathematics assessment grid to judge each pupil's performance against the Levels of Progression assessment criteria and records a numerical level for each pupil, that is not shared with pupils, alongside comments in their mark book.

The second part of the task requires pupils to demonstrate their knowledge and understanding by answering questions related to the investigation and drawing on their previous learning about microclimate. Questions are marked out of 20 with reference to a mark scheme (Appendix A).

Using an Assessment Task for Summative and Formative Purposes

The Microclimate Investigation is one of the four assessments that are used for summative purposes. Teachers record in their mark book a numerical level for pupils in Using Mathematics. Marks from the second part of the assessment are also recorded in Assessment Manager. The assessment task is also intended for use in formative ways that enable pupils to make progress in their learning. These include:

Effective questioning

Throughout the activity, the teacher used effective questioning strategies to encourage pupils to think about their learning. These included asking open-ended questions, prompting responses, giving pupils time to think between questions, and encouraging them to explain their thinking.

Agreeing success criteria

Before giving pupils the task, teachers explained and discussed the learning that pupils needed to demonstrate to complete it successfully. Pupils agreed success criteria for the Using Mathematics part of the task (Appendix C).

Pupils after successfully collecting their data

Reviewing previous pupil work

Although this was the first time the task was being used to assess Using Mathematics, the teacher gave pupils examples of 'good' microclimate investigations that had been completed by other students. These were accompanied by class discussion and an evaluation of the samples. Pupils were asked to list three 'good' points and one area for improvement for each sample of work. Pupils had to justify their reasoning and suggest ways to make the improvements. This exercise allowed pupils to gain a sense of the expected standards.

Peer and self-assessment

After completing the task, pupils reviewed and assessed each other's work against their success criteria as part of a peer assessment activity. Pupils also discussed their learning experience and what they found challenging, and identified what they could do differently to improve their work.

Pupils were then given time for self-assessment. Pupils had to review their work, take on board peer comments and prepare for a discussion with the teacher about how they might improve their learning and set personal learning targets.

Quality teacher feedback

Pupils were encouraged to work on the task independently. The teacher provided support to pupils who needed it. The teacher took this into account when making their summative judgement about the level pupils were working at in Using Mathematics.

The teacher marked the pupils' work after the peer and self-assessment activities. When marking pupil work, the teacher gave constructive written comments that highlighted areas of weakness and suggested what pupils could do to make improvements. For the Using Mathematics section of the task, this included useful comments that would support pupils to progress towards the next level.

The earlier self-assessment activity gave pupils a chance to prepare for a discussion with the teacher about their learning and to set personal learning targets.

Ensuring Consistency

By working collaboratively on developing the task, geography and mathematics teachers gained a common understanding of what might be expected from pupils and expected standards. After assessment criteria were agreed with pupils, teachers met again to work through the task and agree on applying assessment criteria.

Geography teachers made summative judgements about pupil performance in Using Mathematics. They awarded provisional levels and marks out of 20 for geography knowledge and understanding. They then met to discuss a range of samples of pupil work and to agree standards. After reaching common agreement about marking and standards, they met with mathematics teachers to discuss and reach agreement about the levels awarded for Using Mathematics.

Monitoring, Recording and Reporting Progress

The marks for the microclimate task and other assessments are recorded as percentages in Assessment Manager. This, along with the class teacher's other assessment information, allows pupil progress to be tracked and monitored over time and compared with the performance of others in the class, band, and year group.

Target Setting

This assessment data is used for whole school, class and individual target setting across all subjects. Once recorded in Assessment Manager, the pupil's performance in the microclimate task will be flagged using a traffic light colour code to show their progress against a set target. Green indicates a mark above average, amber is average and red is below average.

Future Assessment Development in Geography

The collaborative work between teachers from the mathematics and geography departments was recognised as a valuable way of sharing assessment practice. Work to develop other Using Mathematics assessment tasks will build on this collaborative approach.

For the geography teachers, one of the main outcomes of developing the Using Mathematics task was an increased understanding of how subject knowledge, skills and capabilities are interconnected and interdependent and the need to develop a more integrated approach to their assessment. The Using Mathematics assessment task is the first attempt to assess Using Mathematics skills and geography knowledge and understanding. The next step is to develop a task to integrate the assessment of TSPC alongside subject knowledge and understanding. For example, the nature of the task would allow it to be adapted to assess the Thinking, Problem Solving and Decision Making or Managing Information strands of the TSPC.

Appendix A

Year 8 Geography Department School Microclimate Investigation

Microclimate

In this task you will investigate some of the factors that affect the microclimate of your school grounds.

The microclimate of the school grounds depends on temperature, rainfall, radiation of light and heat, shade, humidity, wind, slope, position of nearby structures and ground cover and position.

Your task

This part of the task assesses your Using Mathematics skills.

In this investigation you will examine **temperature, rainfall, wind speed** and **wind direction** at three locations in the school grounds.

The three places that you will visit are:

- the netball courts;
- the courtyard; and
- the bus stops.

During the investigation you will have to take measurements and collect data for **temperature, rainfall, wind speed and wind direction.**

Your class will collect this data over one week during your Geography classes. Other Year 8 classes will also collect microclimate data. This will be shared so that each class will have a set of data that covers five days.

Getting Started

Plan how you will conduct your investigation.

Think about what you want to find out.

Think about what measurements you need to take.

Think about what equipment you will use to collect your data.

Think about the number of measurements you will take.

How will you know if your measurements are accurate?

How will you record your results?

Next Steps

Collect and record measurements for temperature, rainfall, wind speed and wind direction.

Use your data (including other class data) to present your findings.

Think about how you will present your findings?

For example, will you use tables, pictograms or bar charts or other graphs?

Use your data to calculate a value for the total rainfall for the month.

Conclusion – review your findings

Explain what your findings show.

What have you learned about microclimate?

1. Explain what microclimate means (4 marks)

2. How are nearby school buildings likely to affect:

   (a) the temperature at the three locations you investigated? (2 marks)

   (b) the rainfall at the three locations you investigated? (2 marks)

   (c) the wind speed at the three locations you investigated? (2 marks)

3. How would you investigate how different types of surface might affect the microclimate? (4 marks)

4. Explain which of the three sites would be the best one to locate a wind turbine. (2 marks)

5. How might your results be different if you performed the investigation in August? (2 marks)

6. How is the geographical location of the school related to its microclimate? (2 marks)

Appendix B

Year 8 Microclimate Investigation (UM Task)

Requirements for Using Mathematics *Across the curriculum, at a level appropriate to their ability, pupils should be enabled to:*	**Level 3** *In structured activities in familiar and accessible contexts, pupils can:*	**Level 4** *In activities with some structure, in familiar and some unfamiliar contexts and situations, pupils can:*	**Level 5** *In activities with some structure, in familiar and some unfamiliar contexts and situations, pupils can:*
• **choose the appropriate materials, equipment and mathematics to use in a particular situation;**	• **suggest different ways an activity might be approached;** *suggest different ways of doing the investigation, for example suggest a different sequence for data collection; and* *number of results taken, time to take them.*	• **decide how an activity might be approached and compare their approaches with others;** *consider different ways of doing the investigation and make comparisons between approaches, for example take into account the need for a fair test – time taken to record results, time when results are recorded, for example the same time every day compared with taking results at different times.*	• **plan and decide how an activity might be approached;** *decide and plan a practical approach to investigation;* *decide what they need to do to complete the task and discuss their approach, giving suggestions; and plan order of locations to investigate and sequences of measurements to be taken.*
	• **select and use the appropriate materials, equipment and mathematics required;** *choose and use the most appropriate equipment for measuring temperature, rainfall, wind speed; and choose and use the appropriate mathematics to record and present data, for example frequency tables, pictograms or bar charts.*	• **identify and use appropriately the materials, equipment and mathematics required;** *select and use a thermometer, rain gauge, anemometer and compass appropriately to measure temperature, rainfall, wind speed and direction using four compass points; and decide how they will gather and present the information.*	• **identify and use efficiently the materials, equipment, mathematics and strategies required;** *use a thermometer, rain gauge, anemometer and compass efficiently to measure temperature rainfall, and wind speed to a given degree of accuracy;* *break their task into smaller steps; decide and plan what measurements they will take and how they will record them, for example identify what measurements and how many results they will take and when they will take them; and* *identify appropriate ways to present and interpret their data and draw conclusions from their results.*

Requirements for Using Mathematics *Across the curriculum, at a level appropriate to their ability, pupils should be enabled to:*	**Level 3** *In structured activities in familiar and accessible contexts, pupils can:*	**Level 4** *In activities with some structure, in familiar and some unfamiliar contexts and situations, pupils can:*	**Level 5** *In activities with some structure, in familiar and some unfamiliar contexts and situations, pupils can:*
• **identify and collect information;**	• **identify, collect and record the information required;** *identify and record measurements by completing data collection sheets for rainfall, temperature, and wind speed.*	• **find, organise and interpret relevant information;** *use selected resources to find, gather and organise and record a range of data by taking appropriate measurements of rainfall, temperature, wind speed and wind direction with reference to four compass points; and* *read and interpret their measurements and charts.*	• **identify, obtain, process and interpret information appropriate and sufficient for the activity;** *decide what information is required for the investigation, for example temperature, rainfall, wind speed and direction and bearings;* *design and use a data collection sheet; where appropriate repeat measurements three times and calculate the mean;* *decide if sufficient data has been collected to provide accurate valid results; and* *interpret the data in a meaningful way.*
• **read, interpret, organise and present information in mathematical formats;**	• **present their findings clearly using a range of appropriate mathematical formats;** *present their findings by completing frequency tables and bar charts or pictograms; and label results in correct units, for example rainfall in mm, temperature in °C.*	• **present information clearly;** *use and present data in frequency tables and pictograms or bar charts and accurately label diagrams.*	• **present information accurately and appropriately including the use of mathematical language, symbols and diagrams;** *decide how to present information/ findings and give reasons for their choice;* *show working out for their calculation of ranges and means for temperature and rainfall; and* *choose and use appropriate scales, tables and titles for line graphs/dual bar charts.*

Requirements for Using Mathematics *Across the curriculum, at a level appropriate to their ability, pupils should be enabled to:*	**Level 3** *In structured activities in familiar and accessible contexts, pupils can:*	**Level 4** *In activities with some structure, in familiar and some unfamiliar contexts and situations, pupils can:*	**Level 5** *In activities with some structure, in familiar and some unfamiliar contexts and situations, pupils can:*
	• **explain their findings;** *answer questions about what they have found out, for example which day had most rainfall? which day was the warmest/coldest? and draw basic conclusions from their findings.*	• **compare methods of presentation;** *compare their results given in a table or bar chart for different measurements of microclimate with those taken at different locations, and at the same location at different times.*	
Knowledge and Understanding **Shape and Space and Measures**	• **choose and use appropriate standards units to estimate, measure and record length, capacity, volume, weight, time and temperature;** *measure and record rainfall in mm, temperature in °C and wind speed in km/h (units for speed will be given to pupils).* • **read simple measuring instruments with an appropriate degree of accuracy;** *read a thermometer, ruler, anemometer gauge to within + or - two units.* • **use grid references in practical situations.** *use grid references to locate three positions on school grounds where microclimate measurements will be taken; and use grid references to locate these positions on map of school grounds.*	• **estimate and measure length, 'weight', mass, time and temperature, working to an appropriate degree of accuracy;** *measure and record rainfall in mm, temperature in °C, and wind speed in Km/h to within + or - 1 unit.* • **understand the relationships between metric units;** *understand that 10 mm = 1 cm and that 100 cm = 1 m relevant to measuring rainfall;* • **add and subtract common measures;** *add and subtract measurements for rainfall, temperature and wind speed.* • **know eight points of a compass.** *use a compass and eight compass points to determine wind direction.*	• **use the four operations to solve problems related to measures.** *use four operations, for example use subtraction when calculating temperature range; use addition when calculating total rainfall and temperature; use division when calculating the mean for a measurement; and use multiplication when calculating the total rainfall for the month using the mean daily value.*

	Level 3	Level 4	Level 5
Knowledge and Understanding **Data Handling**	• **collect and record relevant data for a given activity;** *collect and record measurements for wind speed, rainfall and temperature.* *use their data to complete bar charts and pictograms for wind speed, rainfall and temperature over four weeks.* • **read and interpret information from tables, pictograms, diagrams, lists, bar charts, simple pie charts and databases.** *use and interpret their data from bar charts or pictograms to comment on, for example days with most and least rainfall or highest and lowest temperature.*	• **collect, group, record and present data with given class intervals;** *collect group and record and data for wind speed, rainfall and temperature; present data using class intervals.* • **present and interpret data using a range of graphs, tables, diagrams, spreadsheets and databases.** *use tables, bar charts, or pictograms that contain more than one symbol when presenting data.*	• **collect, organise, record and represent data;** *pupils decide on appropriate class intervals to organise data for wind speed, rainfall and temperature and represent the data graphically.* • **design and use a data collection sheet;** *create and use data collection to record a suitable number of measurements of wind speed, rainfall and temperature over a four week period.* • **construct tables and interpret a range of graphs, tables, diagrams, spreadsheets and databases;** *draw and interpret dual bar charts for rainfall and temperature over one week.* • **understand, calculate and use mean and range.** *show understanding of what the mean represents in data;* *calculate and use the mean to make comparisons between rainfall and temperature over different weeks; and calculate and use the range for rainfall and temperature to illustrate variations over time.*

Appendix C

Success Criteria for Using Mathematics

I can:

- suggest different ways to perform an investigation;
- choose and use 'right' equipment to take measurements of rainfall, temperature, wind speed and wind direction;
- use the correct units of measurement;
- collect and record measurements using data collection sheets;
- present my findings in tables pictograms or bar charts; and
- interpret my data and draw some conclusions.

I can:

- compare different ways of performing the investigation;
- choose one way to perform the investigation and give reasons for my choice;
- use appropriate instruments to accurately measure rainfall, temperature, wind speed and wind direction;
- suggest different ways to perform an investigation;
- choose and use 'right' equipment to take measurements of rainfall, temperature, wind speed and wind direction;
- use the correct units of measurement;
- collect and record measurements using data collection sheets;
- present my findings in tables pictograms or bar charts; and
- interpret my data and draw some conclusions about temperature, wind speed and wind direction at different locations.

I can:

- plan and decide how to perform my investigation and give reasons for my choice;
- plan and perform a series of activities to complete the task and give reasons for my choice;
- design and use my own data collection sheets;
- when taking measurements, take more than one set for temperature, wind direction and wind speed;
- calculate the range and mean for temperature, rainfall and wind speed;
- show my calculations and working out;
- decide how to show my findings; and
- interpret and make comparisons of data to draw conclusions.