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VIRTUE, KATE (PGT)

Sustainability Education in Mathematics

KS3 Interpreting Data - Collation, Display and Analysis

1. Key Information

Mathematics Group Members

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Subject

Sustainability in the local community - with a focus on school related practices
Mathematics - Data collation, display and analysis

Focus Group

KS3

Material can be adapted across Year 7 - Year 9

Materials can be used for a Off Timetable/Themed Day or for a sequence of lessons

Learning Objectives

Sustainability:

To engage students in the societal issues of sustainability.

To promote social justice by investigating how students everyday lives are connected.

Mathematics:

To explore statistical analysis, including real-world applications and career paths.

To reinforce mathematical methods of data collation and displaying data.

2. Context

Group of 30 students, higher attaining year 8.

Lesson series directly following a sequence of lessons of sampling and using data.

This sequence of lessons is designed to reinforce data sampling techniques recently studied. It will allow students to pick a topic that is meaningful to them e.g. how students travel to school that has bearing on the environment.

Students will have studied data collection without necessarily having an opportunity to see how it applies to the real world. This will allow them to connect mathematics with the real world.

Sensitivity

We are aware that some investigations students may be sensitive. It will be important to emphasise to students that this is not a matter of making right and wrong choices, but thinking through how we can all work to make choices which can offset the impact of climate change. For example students who have to come a long way to school may feel bad because they **have** to drive, this should not be understood as an accusation. Rather we are trying to help students to think through how in future they can seek to take more climate friendly actions where possible.

Optional context

Schools could combine this with local community projects/charities/governing bodies to relate to other events happening in the community.

Schools could combine with local amenities such as museums or galleries that correlate with the sustainability topics

Option to include intergenerational collaboration - work with charities or care facilities in the wider community and compare data from the past to the present, then use this to speculate on the future.

The school could take part in pop-up events in the community, displaying posters and presenting/discussing findings and the actions that can be taken going forward.

3. Learning

General learning

Students will learn how to design and conduct a survey that has real bearing on the world.
Students will learn how information found in an investigation can be analysed, presented, and used to enact change.
Students will learn how mathematics can be used to investigate real life problems.
Students will learn how mathematics can point us towards solutions to these real life problems.
Students will learn how existing practices, for example driving to school, can contribute towards climate change.

Key skills

Students will practice designing a survey they can use on other members of the school or the general public that collects meaningful data related to climate change. E.g. making a questionnaire. This will give opportunity for students to explore ideas such as representative samples and bias.

Students will develop their skills in collecting this data.

Students will learn how to analyse this data, finding means, medians, and modes where appropriate, as well as interpreting these to find their real life applications.

Students will learn how to present this data in appropriate charts and graphs. This will give them practice thinking through which graphs will be most appropriate, which graphs will give the most impact, and students will also be able to look at how to draw each graph.

Students will learn how to present this data to the class, in a presentation to their peers, developing their ability to talk about and discuss the significance of the maths they are learning.

Students will learn how to study their data for its implications on climate change, and learn to draw from it useful recommendations for those around them.

Climate Change Awareness

This activity will show students the significance of their everyday choices on the climate. It will show them how lifestyle changes may be able to help mitigate the effects of climate change. It will also provide an opportunity for students to explore the immense power mathematics has as a tool for tackling climate change, and other societal problems

Key Skills

Creating Questionnaires: Children will learn how to create clear and relevant questions based on specific topics. This involves understanding the purpose of the questionnaire and considering the target audience.

Gathering Data: Children will learn how to collect both qualitative and quantitative data.

Converting Data into Visual Representations: Children can learn how to represent data visually using tools like bar charts, pie charts and frequency tables.

Comparing Data and Identifying Trends and Averages: Children will learn how to analyse data by comparing different sets of data, identifying patterns, trends, and relationships between variables.

Considering Potential Impacts of Anomalies: Children can learn to recognise outliers or anomalies in data and understand their potential impact on the overall analysis.

Drawing Conclusions and Making Recommendations: Children can learn how to draw conclusions from their data analysis, make evidence based claims or recommendations, and consider potential implications or next steps based on their findings.

4. Activities

Sequence of Activites

Group discussion: Exploring what climate change means to our class, where do we see its effects and peoples responces to climate change in our everyday lives, what do we think the opinions of pupils at our school (and people outside of school) are? (15 minutes)

Teacher led: Explaination of task, students will collect data regarding an aspect of climate change they are interested in (recycling, forms of transport, fast fashion etc) by designing a questionnaire to ask students around the school. Pointing out different types of data (primary vs secondary, discrete vs continuous), and ways they could collect data, what is needed for a good questionnaire etc, different sampling methods, giving example of what climate scientist do (30 min)

Group activity: Students split into groups of 4, pick topic and have to decide 3 questions as a group to include in their questionnaire. Teacher checking in with groups and asking what students predict data might be, and providing help with design, chosing sampling methods (15 min)

Data collection: Individually students must collect information for their surveys by asking around classes and as a homework task.

Data Repesentation, Teacher Explaination: recapping the different methods they can use to represent their findings such as bar chart and pie chart. Discussion of what is suitable for different types (15 mins)

Data Repesentation, Practice the methodlogy: Individually student decided on appropriate method of displaying the data and produce graphics (30 mins)

Small Group Discussion: Come back into original groups, compare data collected and displayed. (all did same questionnarie but should have collected different data)
Discussion which representation methods are better, was there any difference or similarity in trends. Can they come up with reasons for why that might be? (5 min)

Presentation: In groups students combine their findings and create a short presentation or poster. Should include the different representations, highlight and trends, give possible explainations for difference, ideas for what could be done to improve climate change in context of the questionnaire. All groups to present and feedback for class. (45 mins)

Questionnaire design examples

KS3 Questionnaires & Analysis (Year8 - Unit 20)

worksheets, activities and lesson plans. The topic of Questionnaires and Analysis fr...

tes.com

Sampling method information

Types of Sampling Methods

Sampling Method	Description	Example
Random Sampling	• Gathering a representative sample from a population where each member in the population has an **equal chance** of being selected.	• Using a **random number generator** to select students in a class to complete a task.
Stratified Sampling	• Smaller groups or **strata** within the sample are represented **proportionally** to the population.	• Finding out a favourite soap opera from different age **categories** of people in a year group.
Systematic Sampling	• Every member in the population is given a **number**. After the first member is chosen at random, the remaining members are chosen from a given **interval**.	• A **list of people** with their first names in alphabetical order are numbered. The 5th person is **chosen randomly**, followed by every subsequent 8th person.
Non Random Sampling	• **Convenience** sampling is used for **ease** of data collection. **Volunteers** usually collect data.	• Asking people at a given location about how long their commute to work is.
Capture Recapture	• **Collecting** a sample of data from **one location** at **different points in time, marking** the individuals to estimate a population size.	• A sample of woodlice were **captured, marked and released**. Another sample of woodlice was captured 5 days later and the number of marked woodlice was counted.

Types of sampling methods

One to one maths interventions built for KS4 success Weekly online one to one GC...

thirdspacelearning.com

Types of data representation

Statistics: Representation of Data

CIE 9709/06 - Statistics Representation of Data. Slides on, Whiskers plot, standard ...

tes.com

Quiz: How Green are you?

This is a really interesting quiz that will help children to assess how 'green' and 'environmentall...
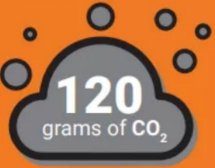
twinkl.co.uk

Poster example

https://headsup.warwickshire.gov.uk/heads-up-9-june-2023/celebrating-warwickshires-family-of-schools/climate-change-posters-for-your-school

5. Pedagogy

CMT (critical Mathematical Thinking)

Applying Mathematics to real-world problems such as engagement with societal issues:

https://www.frontiersin.org/articles/10.3389/feduc.2024.1363566/full

https://link.springer.com/article/10.1007/s11858-023-01521-3
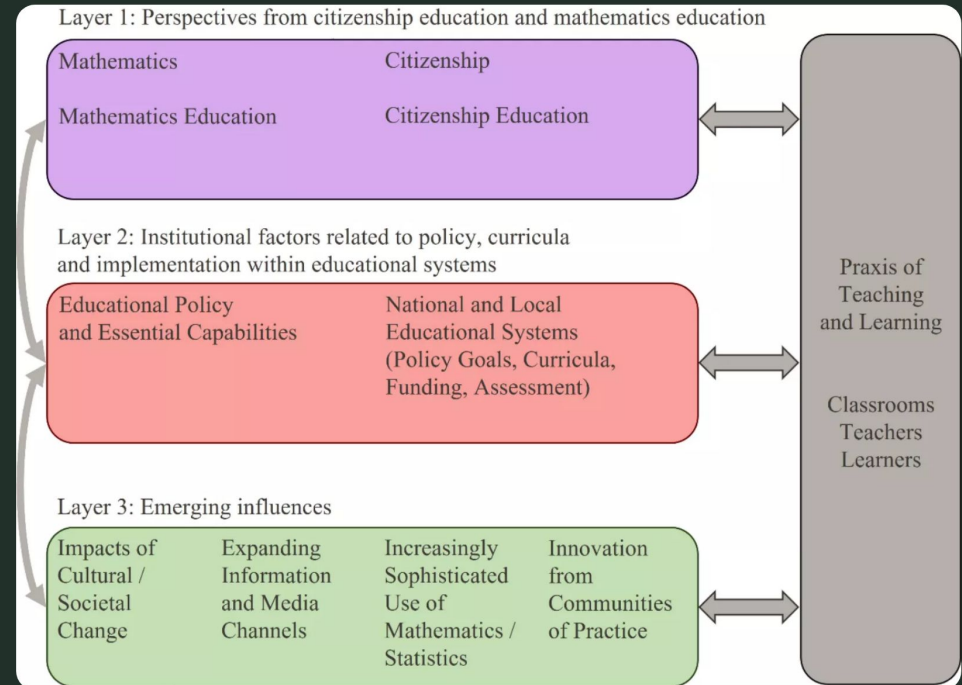
The connections between citizenship education and mathematics education - ZDM - Mathematics Education

The connections between citizenship education and mathematics education have ...

link.springer.com

Integrating Foundational Skills

KS3 incorporating a wide range of student ages and abilities, this task can be adapted to suit multiple needs:

- Skillset: Building on foundational skills which students should have had exposure to during primary education. Expectations of finished work can be based on a specific class, or year group and can run parallel to "normal" lesson content.

- Cross-curricular: Builds on mathematical knowledge but with plenty of opportunity to tie into cross curricular lessons e.g. historical context within the school and society, local demographic and how this links to findings, future planning for the school to be more sustainable, developing vocabulary, opportunities to tie this in with career prospects for the future

- Group work: Can be allocated teams for a mixture of confidences and abilities. Can be chosen by students. Can have a competitive edge if desired to motivate results. Groups can be scaffolded to different needs (like a sports handicap).
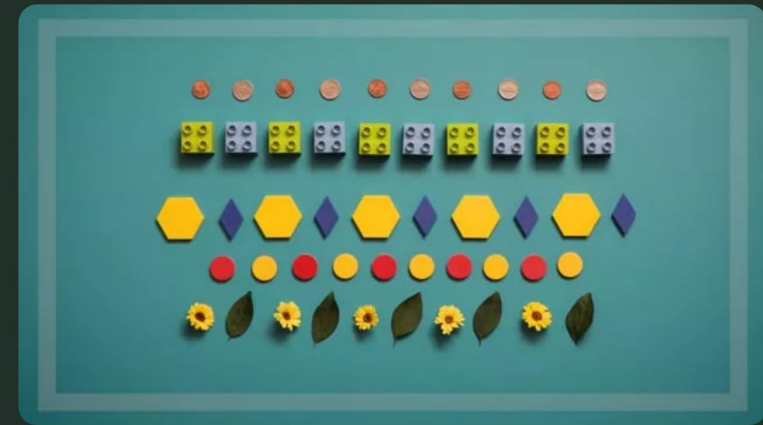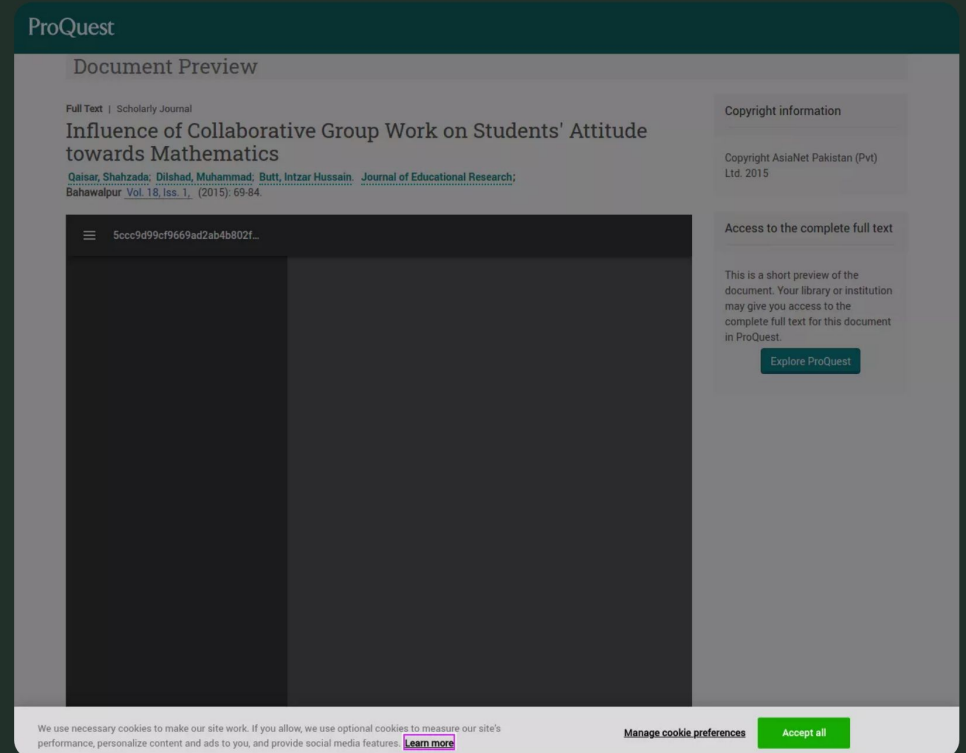

Data Collection and Analysis - Young Mathematicians

Data Collection and Analysis When children collect and analyze data, they're integr...

youngmathematicians.edc.org

Student-Centered Working

Looking at how collaboration can have a positive impact on students attitudes to mathematics.

## Influence of Collaborative Group Work on Students' Attitude towards Mathematics

Explore millions of resources from scholarly journals, books, newspapers, videos an...

proquest.com

Real-World and the Mathematics Classroom

How does context affect students learning?

What are the benefits to teaching practice if real-world connections are made in subjects?
https://link.springer.com/article/10.1007/s10857-007-9070-8
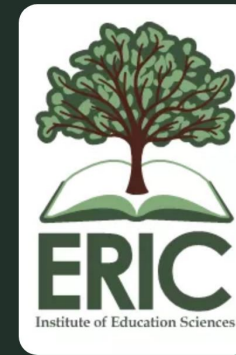
ERIC - EJ991857 - A Lesson Based on the Use of Contexts: An Example of Effective Practice in Secondary School Mathematics, Mathematics Teacher Education and Development, 2012

The importance of using real-life contexts in teaching mathematics is emphasised i...

eric.ed.gov

Open-Ended Tasks

Allowing students to make their own choices within the project in both their focus on sustainability in school and the mathematical approaches they choose to build on.

The teacher is on-hand to inform and assist as needed but is only leading the project in a broad sense, allowing the students flexibility in how they approach the tasks.

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Asia Pacific Education Review

Springer

Education Research Institute
Seoul National University

Included in Social Sciences Citation Index®

Cultivating divergent thinking in mathematics through an open-ended approach - Asia Pacific Education Review

The purpose of this study was to develop a program to help cultivate divergent thin...

link.springer.com

6. Resources

Materials needed

Data collection resources

- Pens and paper to record data within school or the local area

- Students can use tally charts if appropriate for their question
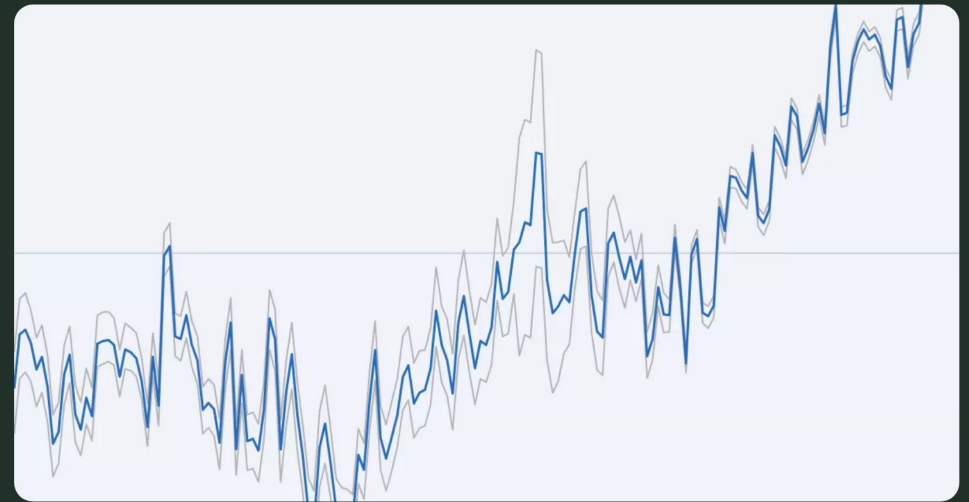
Data representation resources

- Pencils, rulers, protractors and compasses to draw charts/graphs

- Access to laptops/tablets to draw graphs on excel and for further research

Poster resources

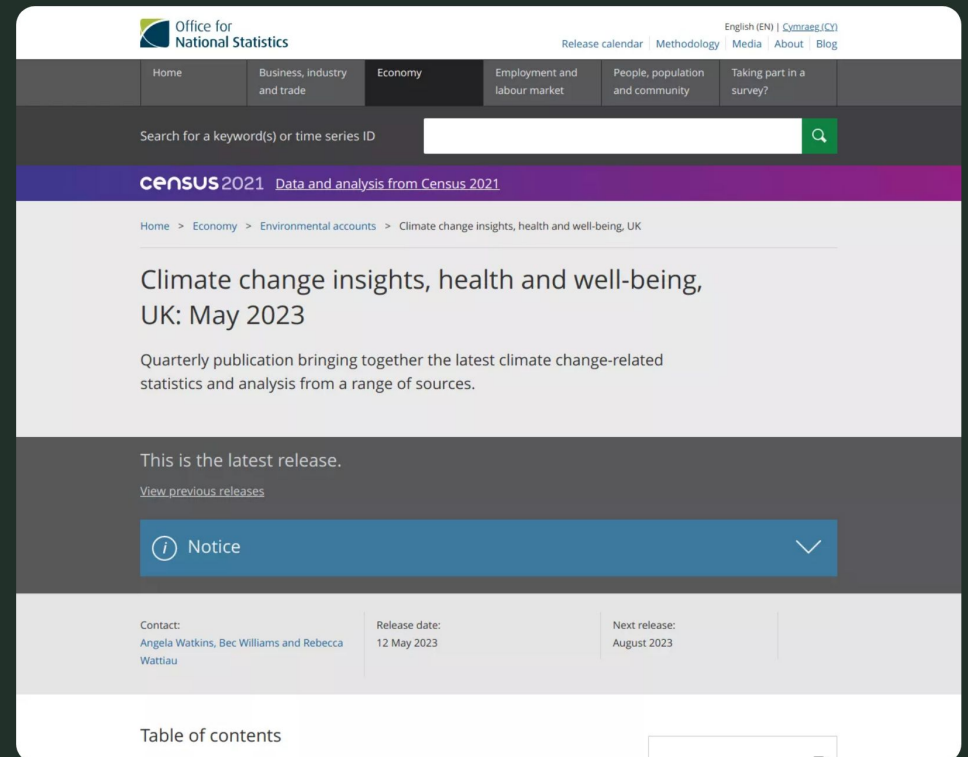- Big sugar paper (A2/A3)

- Lots on marker pens in different colours

Examples of data representation relevant to climate change

Climate Change

How are global temperatures changing, and what are the impacts on sea level rise, …

ourworldindata.org

UK climate change data - causes, impact, attitudes, behaviours...

Climate change insights, health and well-being, UK - Office for National Statistics

Quarterly publication bringing together the latest climate change-related statistics ...

ons.gov.uk

7. Learning Outcomes

Sustainability

Have connections between the data and effect on the environment been shown?

Has reasonable suggestions for how to implement changes to better the climate been made?

Students have engaged in a variety of issues, work being completed is varied in specific sustainability issues.
Students have successfully linked wider sustainability issues with their school or local community.

Mathematics

Are there accurate representations of the data?

Are the methods selected for sampling suitable?

Was the questionnaire design suitable?

Was the method of representation suitable?

Poster/Presentation

Option to run as a competition - prize for the best poster.

Posters could be used in school to raise awareness - not just a throwaway activity.

Findings/suggestions may go forward to school councils meetings/ SLT/ school governors and the school can revisit anything that is implemented successfully as school policy/practice