Project in Citizenship and Mathematics
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THE FACE OF A COUNTRY IN FRACTIONS
Exploring land use with mathematics

Description

The students discuss the distribution of land use patterns in different countries and, at the same time, get into the topic of ratios. The climatic and geographical differences in terms of land use are also addressed. They work with data and get to know advantages and disadvantages of simplification and modelling processes.

Global citizenship competences addressed

- capacity to examine global issues
- analytical & critical thinking skills
- communication & co-operation skills
- conflict resolution skills

Global citizenship content

Consider the world as a whole; get to know living conditions in different countries; consciously perceive one's own living environment; solve tasks in teams with equal rights

Mathematical approaches

- asking yourself questions
- conjecturing and checking things out
- using representation and symbolism
- modelling and dealing with uncertainty
- using argumentation and reasoning
- questioning the use of mathematics in structuring experience of the world

Mathematical content

Estimating, rounding, summarising and simplifying; analysing data; interpreting and comparing proportions and fractions

Resources required

For the whole class: a bag filled with different foods (mango, potato, coffee bean, lentils, olives), a globe, an empty poster, pencils, magnets, coloured paper, chalk
For each student: worksheet with the empty grid (two copies)
For each learning group: Statement cards (choice between two templates), ten country sets (Argentina, Bolivia, Finland, Georgia, India, Ireland, Japan, Kenia), research sheets about Greece, Rumania, Portugal, England and Germany

Time needed (in and out of the classroom)

Approximately four hours curriculum time

Organization and practical issues

The class starts by working in a circle. Later the students work individually and eventually they work in small groups.

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Suggested plan for teaching

Task 1: Getting to know different kinds of land use (approx. 1 hour)

For the introduction to the topic, the students sit in a circle. This ensures that all students have the chance to participate equally in the activity and can easily be in contact with each other. Additionally, a globe, which will be used in the first activity, is positioned in the middle of the circle. Now, a bag filled with different kinds of food is passed around. Ideally, the food comes from different countries. For example a mango (India), a potato (Germany), coffee beans (Kenya), olives (Greece) and lentils (Argentina). Each student takes a .piece of food out of the bag in turn.

What is this? Do you know its name?
Have you ever eaten it?
Do you know where it is grown?

☺+☺ When answering the question about the food's origin, the students are asked to look for the country on the globe and examine what it looks like. One after another, the students will talk about each piece of food in the bag.

After the first activity, the class stays seated in a circle. Now the students shall take a closer look at the globe.

What else can be seen on the globe apart from shape and position of the countries?

The students may mention the different colours on the globe. Possibly, they describe oceans, rivers, ice or mountains which may be marked in different colours.

Which parts of the countries are not marked on the globe? Can you see forests, grasslands, etc.?

This question provides the first step for getting to know the different kinds of land use.

There are different possibilities how to use land. Often they are not marked on the globe. I would like to talk through the biggest and most important classifications.

A big poster is laid in the middle of the circle of chairs to create a "legend" for the different kinds of land use. Later, the poster can be hung up in the classroom so that the students can look at it while working. The symbols and the matching colours for the different kinds of land use should be on the poster in advance.

Here you can see the colour brown and a symbol for wheat. Can you imagine which kind of land use this might symbolise?

By using this question technique, all other kinds of land use are clarified. As an explanation, some notes are made on a poster.

The posters could look like this:

		farmland	cultivation of food
		grassland	meadows for grazing and cutting
		settlements and infrastructure	villages, cities, streets
		forests	trees, natural resources
		water and wetlands	rivers, lakes, marshes and bogs
		other	

Discuss with the children what might the category "other" represent. Possibilities are mountains, deserts, ice, wasteland and snow. You may like to discuss which countries will have a lot of land like this and which will have only a little. What else might they notice about such land? Draw out that the others are much more likely to be used to produce food. Explain that "other" will also include any land use type of which there is very little

The students can copy the legend into their exercise books. However, it would also suffice to have the legend on the poster.

If there is enough time, the bag can be passed around again, this time filled with different items such as corn, wood, cars or houses. Then, the students can discuss which category the items belong to.

Task 2: Working with the 10-piece sets (approx. 1 hour)

Before the start of this phase, prepare large squares (preferably 10 cm x 10 cm) of cardboard in the respective colours. You can provide blu-tac or magnets to pin the squares onto the board or lay out the squares on the floor in the centre of the circle if you'd rather not use magnets at all. Make sure you have enough squares of each colour to be able to put all sorts of country sets on the board.

The pupils are still in the circle.
To see the different types of land use in the world, imagine the entire landscape of the world would fit on a big rectangle.
For this purpose, a large rectangle is drawn on the board or made on the floor. It is important that the 10 squares fit on the rectangle (2 x 5 squares). Therefore, it is recommended to draw the rectangle in advance.
To divide the world into its different kinds of land use, we might divide the rectangle into 10 squares.
For this purpose, 10 squares are put on the rectangle, for example only coloured in light green.

Now the whole world appears to be only grassland. In other words, the world would be 100% grassland. Is this correct?
Then, one of the squares is exchanged by a blue one.
What fraction is the part of the grasslands now? Or: What fraction is the area of water and wetlands?
The students might answer that one out of ten squares is water and wetlands and nine out of ten are grassland. At this point, introduce percentages:

If the whole rectangle, that is all 10 squares, is made of grassland and this is 100%, then one square stands for 10%. So, all land in the world now consists of 10% of water and wetlands. What percentage is still available on grassland? - 90%.
Then 4 more light green squares are replaced by 4 blue ones.
Of what proportion of water and wetlands and of grassland does the world consist now?
The children may say at this point that this is half or 5 out of 10 squares of water and wetlands or grasslands. Tell them that this equals 50%. Keep going on in this manner for a while.
For example: *The world consists of 30% forests and 70% farmland*. The students can fill the rectangle with the fitting squares. Or the teacher puts some squares into the rectangle: *What percentage of forest land is now on the world map?*
During this task, mathematical terms should be used, e.g. proportion, percent, one tenth, etc. This exercise may be performed as previously described. However, variations are possible at any time; for example, you can start with different colours.

After that, the students should put the real global proportions of land use on the board. For this the students get the following information: 20% forests, 10% farmland, 30% grassland, 40% other.
Take a look at the globe. What is missing on the board?
The teacher explains that 70% of the world's surface is covered in seas and 30% of the world is land. Right now, the class is going to focus on the land area. That is why the whole land area stands for 100%.
Why are there so many violet squares?
Thereby, the proportion of glaciers (11%) and unusable wastelands (19%) should be noted. In addition, discuss with the pupils that "other" also includes the land use types already mentioned, if their share is so small that they cannot fill their own square. Refer to the world set on the board while explaining this.

You can now see the land use of our world on the blackboard. Not all types of land use we talked about can be found. Which types can't you see? - Settlements and infrastructure, water and wetlands.
Can you imagine why these colours do not appear? – Their proportion is too small to fill a square.
Nevertheless, there are water and wetlands as well as many human settlements on the world. Where are they? – They are summarised in the category "other".
Whenever some of the types of land use we have talked about do not appear as having their own square because they are too small, they will belong to the category "other". This is very important, as we are going to look at some countries in more detail now.

The students may then copy the distribution of the world into their exercise book. To further consolidate this development, provide learners with a 2x5 square grid. Use the data in the box below and write the rounded percentages for the types of land use in the children's home country only on the board, asking students to colour the squares correctly to represent this data. This is then checked by placing the squares on the board.

LAND USE PROPORTIONS

Germany
→ 30 % farmland, 20 % grassland, 30 % forests, 20 % other

Romania
→ 40 % farmland, 20% grassland, 30 % forests, 10 % other

Portugal
→ 40 % forests, 10 % farmland, 20 % grassland, 30 % other

UK
→ 10 % forests, 20 % farmland, 50 % grassland, 20 % other

Greece
→ 30 % forests, 30 % farmland, 30 % grassland, 10 % other

If there is not enough time to complete the last exercise, the students can do it as homework.

Task 3: Statement cards (approx. 1 hour)

At the beginning of this phase, it is important to clarify that the countries have different sizes and that the information relates only to the *proportion* of land use. Show the LAND USE PROPORTIONS table of information above.

Germany and Portugal both have 20% of grassland. But Germany has approximately 71 000 km^2 of forest and Portugal has only approximately 18 000 km^2. How is this possible?

COUNTRY SIZE	
Germany	357 386 km^2
Romania	238 397 km^2
Portugal	92 212 km^2
UK	242 495 km^2
Greece	131 957 km^2

Allow time for the children to discuss this difficult idea. Germany and Portugal are not the same size, but both have the same proportion of grassland in relation to their total area. This does not mean that the grassland area of Portugal is just as large as the grassland area of Germany.

If appropriate, ask the children to consider other similar problems and use the information about country size (with rounding) to find out which country has more of the chosen category.

There are two different variants of the *Statement cards*. First variant: Bolivia, Finland, Georgia and Kenya. Second variant: Argentina, India, Ireland and Japan. The teacher can choose one of the variations for the children. The other variant could be used for groups that have processed their first variant quickly and completely.

The children split into small groups - five is the ideal size -and receive worksheets with the land use information for the four countries they are working with plus a set of *Statement cards*. These cards contain information about the four different countries.

> *Some of the information is correct, some is false. Some statement cards can't be identified as true or false without some additional research, as the land use information sheets do not contain enough information.*

Discuss this idea with the class. Refer back to the LAND USE PROPORTIONS table and ask, on the basis of this information, for a statement that is true, a statement that is false and one for which there is not enough information to decide.

Each set of Statement cards contains four that are correct, four that are false and four for which there isn't enough information to decide. The task is to sort out which is which.

The children share out the cards without showing each other what their cards say. They read their cards to their group one at a time in as many rounds as it takes to read out all cards. They have to listen to each other very carefully and have to try to remember the information. In this first round, the statements must not be commented on and no questions asked. This should foster the students' ability to listen to each other. They should value each other's contribution and be able to work together as a group in which each member has a special role. Afterwards, there is a second round in which the cards are read out again. This time questions may be asked, and statements commented. The children sort the cards in a "yes", "no" and "we do not know" pile.

If time allows, the groups can do some research about the statements on the "we do not know" pile. Later, the class can talk about difficulties and problems which occurred during the task. In this activity, the children learn to reach logical conclusions and learn to decide which statements they can verify with the information they possess, and which not. They gain some experience and self-efficacy in working with temporary uncertainties ("we do not know" pile).

Task 4: Create your own country set (around 1 hour)

Four new small groups are formed and each group gets a different research sheet with information about one of the partner countries (without the native country). Based on the information on the research sheet, the students create their own set of 10 squares. On the sheet there are pie charts with percentages, information about the land area, the number of inhabitants and other information. It is important to notice that not all facts and background information are needed for the exercise. Some of the information about the types of land use is divided into smaller or larger categories than the students need. It is the students' job to put them into useful categories, for example by deciding where they want to place permanent crops. In addition, the children must round the numbers to include very small entries e.g. water and wetlands or farmland into "other". There will often be no optimal solution. Pupils should be aware of the benefits of this simplification (focus on the essentials, clarity), especially when they realise during their work that simplification means that information becomes inaccurate or is lost completely. They have to make their own decisions, which

categories they summarise, whether they need an "other" category and what is included in it. Remind the students that they're going to be asked to explain their decisions later. They should write down exactly what they have summarised or rounded for what reasons. In the following round of introductions with the aid of the magnetic squares on the board, the children should present their decisions and the corresponding reasons.

At the end of this task, the students compare their results. Therefore, they should take some notes about the other groups' strategies during the presentation. Afterwards, in a whole class discussion they try to identify similarities and differences in what the groups did. In doing so, the following questions should be raised and answered: *What did we summarise? What was rounded? Are there any good arguments for the strategy of a particular group? If we could start the activity again from the beginning, would we do anything different? Why? Is it possible to compare the countries with each other with our country sets, as it was possible with the statement cards? Why/why not? Has everyone decided on the same/similar categories?*

☺+☺ If eTwinning is occurring, an additional task at this point is for each partner to share pictures or videos about their country to complement the research sheet information.

The country sets we have looked at before have been created by using the same criteria. That is why they can be directly compared.

Display the sets of ten squares the four groups have created and include a copy of the set for the native country. Recapitulate what can be read out of the boxes and what not, e.g. the quality of the farmland, the biodiversity of the forests, the favourable or unfavourable climatic conditions, etc. Ask each small group to write down three statements using the information for these five countries - one true, one false and on for which there is not enough information to decide. The groups pass on the questions to one of the other group who sort out which is which. Each group shares the results of their discussion with the rest of the class.

Extending the learning

If there is sufficient time to conduct a P4C enquiry with the children, the final benchmarking activity of comparing the countries may be placed at the beginning of a fifth hour. In the course of this, identify questions that the children find particularly intriguing.

To extend the activity from fractions to percentages you could gradually go towards finer units. Smaller squares might first represent five and then just one percent. Find a suitable way to represent your units if you're going up to 100 percent. Use the opportunity to also have a closer look at the "other" category. What does it consist of in which country? How big is the percentage of rural and urban housing areas? The sources on the research sheets can help, but please note that they're generally less detailed on non-European countries.

To get to know the face of a country better, children could also learn more about rural and urban areas and the amount of people living there, the distribution of land-ownership (and wealth in general) in the countries' population and the countries' efforts to protect their nature and landscape. The understanding of land use is also the basis for many global issues such as erosion, desertification, global food and hunger, land grabbing and many more.

A further important discussion and investigation relates to finding out who owns the land (the sea, the air) including comparing private and public space.

Other resources (material and human resources)

If the children want to do some research on their own, the source https://knoema.com/atlas is recommended (especially in respect of eTwinning) because it is available in different languages. Thus, all students can work on the same basis.

Ethical issues or dilemmas

We are used to look for differences in quality when doing comparisons. However, it should be avoided to link farmland, for example, with “good” and barren land with “bad”. (With reference to ecological value, it is often the other way round).

It is even more important not to classify a whole country as good or bad because of the fact that it has more or less of a particular kind of land use. Still, the children should learn that environmental conditions may be a challenge for people in different countries. Europeans are privileged because of the favourable environmental conditions in Europe. The field of tension which originates out of these challenges should be handled sensitively.