Projekt współfinansowany w ramach programu Unii Europejskiej Erasmus+

Mathematics
Cycle I Upper primary school
Understanding graphs and relationships

The scenario includes a description of adjustments for pupils with special educational needs (A, ASD, ID)

Topic 2	**We describe motion using graphs**
Duration	2 lessons (90 minutes)
Class/Age	The teaching cycle is intended for pupils in the final years of primary school who are not familiar with the concept of functions, and we do not introduce this concept during the cycle (years 7-8).
Type of adjustments	- aphasia (A), - autism spectrum disorder (ASD) - mild intellectual disabilities (ID)
Objective	*The aim of this module is to develop an **intuitive** understanding of types of relationships and their graphs.* 1) Creating and interpreting graphs in the context of movement analysis at the intuitive level 2) Developing an understanding of graphs 3) Developing an intuitive understanding of unambiguous relationships between variables 4) Developing co-variation reasoning
Description	Students create and examine graphs describing changes in distance over time using embodied experiments. During the lesson, students use the EMPE sensor together with the EMPE software. The sensor measures the distance to the nearest obstacle, and the software shows a real-time graph of changes in this distance over time. Students are involved in embodiment experiments by walking with the sensor and analysing the graphical interpretation of their movement. They have the opportunity to create and observe multiple graphs of different shapes, and they also perform reverse activities – they move in such a way as to reflect the movement shown in the graphs provided, and they interpret and analyse different movement graphs.

Teaching aids	- EMPE sensor with software - desktop computer or laptop with a web browser - projector screen - projector - work sheets for students

During the lesson, the teacher and students use the EMPE sensor with EMPE software developed as part of the EMPE project. Instructions for using the sensor can be found on the project website (https://empe.uken.krakow.pl).

The scenario includes a description of adjustments for pupils with special educational needs, highlighted in green. Adjustments have been made for working with pupils with **aphasia (A)**, **autism spectrum disorder (ASD)** and **mild intellectual disability (ID)**.

TOPIC 2. We describe movement using graphs

LESSON PLAN

This lesson is experimental in nature, and the measurements in the first part are to be carried out outside the classroom (on the stairs).

We continue the numbering of activities from Cycle I, Part 1.

Activity 6 Task about the stairs

Activity 6a)

Individual work. We ask students to solve the task about the stairs (Fig. 7) from Worksheet 3 on their own. The task is designed to test their intuition in understanding graphs.

The font and drawings are enlarged to facilitate the students' visual perception of both the image and the verbal content. Some of the content is written in bold, while other parts are underlined to draw the student's attention to the most important content.

Possible difficulties during work;

- autism spectrum disorder (ASD):
  - in order to follow instructions, the student may need more time than other students to complete tasks,
  - the student may ask additional questions,
- aphasia (A):
  - the student may have difficulty reading and understanding the content of the tasks on their own and will therefore need the teacher's help,

- the student may have difficulty formulating their thoughts in writing independently and will need the teacher's support if necessary,
- working slowly, the student may need more time than other students to complete tasks,

- mild intellectual disability (ID):
  - expressing movement in the form of a graph is based on thought processes, which in the case of this pupil are at a significantly lower level of functioning, and the pupil may need considerable help from the teacher, e.g. in the form of leading questions,
  - the student may have difficulty reading and understanding independently and will need the teacher's support if necessary,
  - the student may have difficulty formulating thoughts independently in writing and will need the teacher's support if necessary,
  - control questions must be used to ensure that the pupil understands the content of the task to be performed,
  - the necessary assistance from the teacher will require additional time.

***The task about stairs**:*

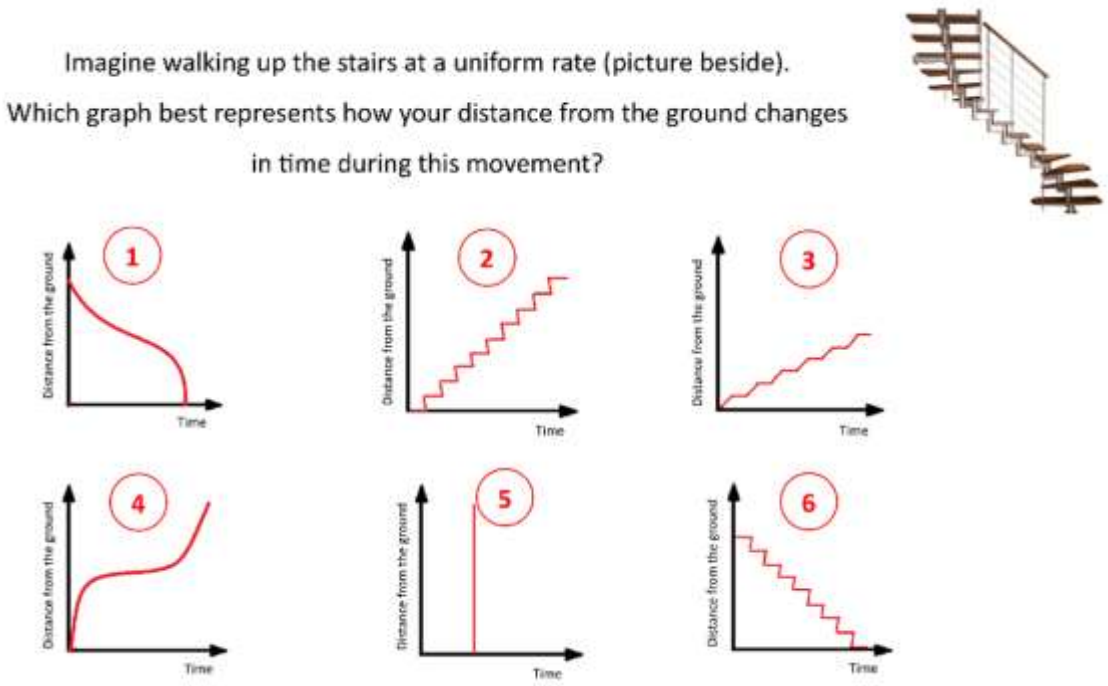


Figure1. Worksheet 3, Activity 6, Task about stairs.

Activity 6b)

We conduct an experiment of walking up stairs while measuring the distance from the ground with a sensor. A laptop will be required. We record the course of the experiment.

> *Comment. During the experiment, walk up the stairs very slowly and at a steady pace. Depending on the construction of the stairs, it is sometimes easier to measure the distance from the ceiling. In this case, discuss with the pupils how the distance from the ground and from the ceiling will change when climbing the stairs and when descending them.*
>
> *Students should discover that the graph of the distance from the floor when walking up the stairs will be similar to the graph of the distance from the ceiling when walking down the stairs.*

It is worth involving pupils with special educational needs in this task so that they have a chance to practise this movement.

Possible difficulties during the activity:

- autism spectrum disorder (ASD):
  - in order to perform the instructions precisely, they may expect (e.g. by asking questions) additional instruction on how to hold the sensor correctly or at what pace they should walk,
- aphasia (A):
  - the student may have difficulty understanding the instructions and will therefore need the teacher's help (additional instruction; how to hold the sensor, determining the pace of walking up the stairs),
- mild intellectual disability (ID):
  - similar to a student with aphasia, they may have difficulty understanding instructions and will therefore need the teacher's help (additional instruction; how to hold the sensor, determining the pace of walking up the stairs).

When performing the task included in the worksheet (activity 6b):

If possible, for students with autism spectrum disorder (ASD), aphasia and mild intellectual disability, it would be a good idea to print out the graph created during the experiment so that they can paste it into their notebooks.

Possible difficulties during the task:

- autism spectrum disorder (ASD):
  - if the student does not have graphomotor difficulties, they should not have any major difficulties redrawing the graph on the worksheet,
  - if graphomotor difficulties occur, the teacher's help will be necessary,
- Aphasia (A):
  - as the student may make significant mistakes when redrawing the graph, it is necessary for the teacher to monitor their actions and provide assistance if necessary,
- mild intellectual disability (ID):
  - similar to a student with aphasia, they may make significant mistakes when redrawing the graph, and supervision and assistance from the teacher is necessary.

When providing written answers, help should be given to pupils with aphasia and mild intellectual disability who may not be able to answer the question independently.

Activity 6c) Analysis of walking up stairs

Students analyse the shape of the graph in the classroom. They give the correct answer to the staircase task. They explain why answer 3 is correct and why answer 4 can also be considered correct if we analyse the process of climbing only one step of the stairs.

During the discussion, the teacher should encourage (but not force) pupils with autism spectrum disorder (ASD), aphasia and mild intellectual disabilities to participate actively. Conditions should be created for pupils to speak and present their ideas: give them more time to speak, and ensure that they are not interrupted by other students. This will not only allow them to be actively involved in the lesson, but also enable the teacher to ensure that students understand the content being taught and to correct any mistakes.

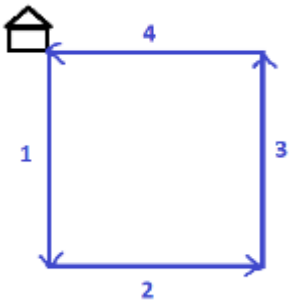
Possible difficulties during work;

- autism spectrum disorder (ASD):
  - if a student has difficulty thinking in terms of cause and effect, they will be a passive participant in the discussion,
  - by making specific mental associations, they may express themselves in an unconventional and surprising way,
  - the student may ask a series of additional questions,
- aphasia (A):
  - the student may have difficulty verbalising their thoughts correctly and should be helped, e.g. by suggesting appropriate words,
  - having problems drawing conclusions, their statements may differ so significantly from what is expected that, in order to properly guide the student's train of thought, it will be necessary to calmly but firmly correct their statements,
- mild intellectual disability (ID):
  - expressing movement in the form of a graph is based on thought processes, which in the case of this student are at a significantly lower level of functioning, and his statements may be completely inadequate to the topic being discussed, which will necessitate a similar approach as in the case of a student with aphasia; calm but firm correction of his statements.
  - the student may have difficulty formulating his thoughts independently and orally and, if necessary, will need the teacher's support in the form of, for example, prompting words.

Activity 7. Task about Mr Novak

Activity 7.1

Individual work. We display the task about Mr Novak on the screen. We ask the students to answer question a) from Worksheet 3.



Mr Nowak left his house and walked around his square-shaped property at a steady pace, as shown in the picture: Solve the following tasks.

a) How did his distance from the house change at each stage of the walk? Describe as accurately as possible.

1.....

2.....

3.....

4.....

b) Sketch a graph that illustrates, in your opinion, Mr Novak's distance from his house during the time of the walk.

c) Design and conduct an experiment illustrating Mr Novak's movement and draw the graph created using the sensor.

Students with autism spectrum disorder (ASD), aphasia, and mild intellectual disabilities may have difficulty interpreting the graph on their own. They will need help and guidance.

Students with aphasia and students with mild intellectual disabilities should try to complete this task on their own. However, they may find that the sheet is blank because they are unable to analyse the graph without the teacher's help.

Possible difficulties during the task:

- students with aphasia may have difficulty expressing their thoughts in writing,
- for pupils with mild intellectual disabilities, the task is difficult because it requires them to perform a series of mental operations and formulate oral statements at the same time.

Ensure that students with autism spectrum disorder (ASD), aphasia and mild intellectual disabilities perform sub-tasks b and c (graphs) well through ongoing monitoring and additional instruction.

Activity 7.2

Students present their designs and we carry out the one that is easiest to implement.

Comment. For example, you can draw a square on the floor in the classroom (or use the graphics on the school floor in the classroom, corridor or gym). One of the pupils stands on a corner holding an object (in the photo, a cushion – Figure 8), from which we measure the distance by moving along the sides of the square.

Figure2. Taking a measurement – Mr Novak's walk.

The graph that the pupils should receive is shown in Figure 9.

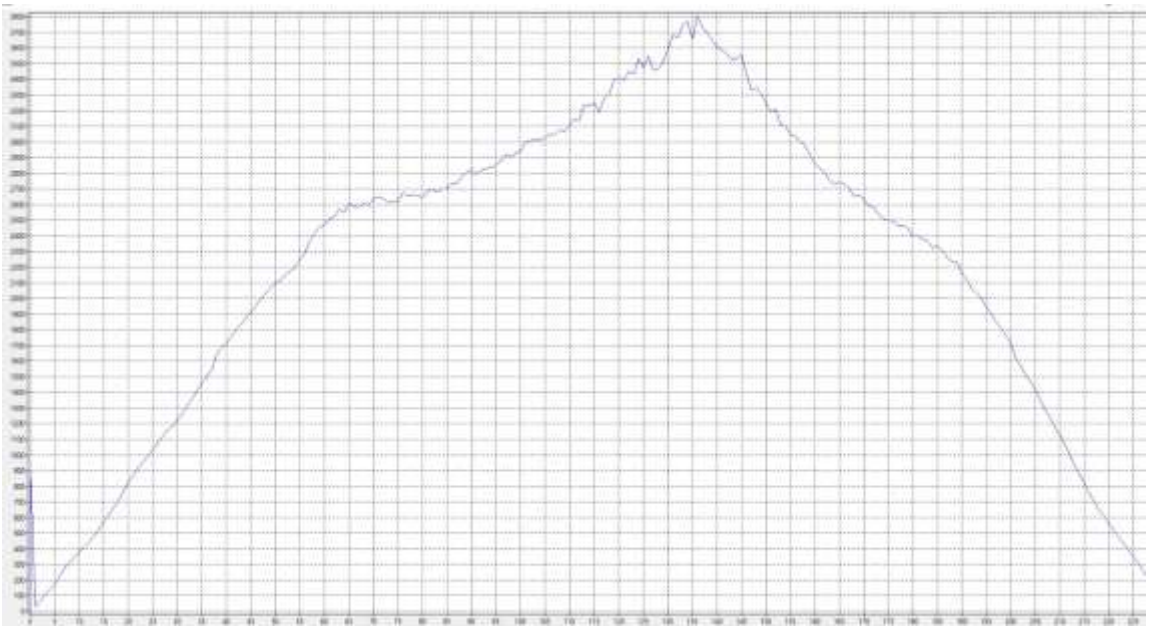


Figure3. Graph – Mr Novak's walk along the edge of the square

The pupils redraw the graph on their worksheets.

Comment: At secondary school level or in gifted primary school classes, you can continue the discussion by pointing out why the graph representing changes in distance during movement along sections 2 and 3 is not linear (see scenario for secondary school, cycle I, version B).