FaSMEd

Raising Achievement through Formative Assessment in Science and Mathematics Education

Time-distance graphs – Part 4

Subject:	Maths
Age of students:	10-14 years
Hardware:	Tablets, pc, IWB or data-projector
Software:	IDM-TClass
Functionalities:	Sending and displaying
Time:	1-2 hours
FaSMEd partner:	University of Turin
Short Abstract:	This activity is focused on **time-distance graphs**. It involves the construction of a graph that represents a story.

Premises: theoretical tools

In presenting our methodology and the way of developing this activity we refer to two main theoretical tools.

The first theoretical tools are the Formative Assessment (FA) strategies proposed by Wiliam and Thompson (2007):

1) Clarifying/ Understanding/ Sharing learning intentions and criteria for success,
2) Engineering effective classroom discussions and other learning tasks that elicit evidence of student understanding,
3) Providing feedback that moves learners forward,
4) Activating students as instructional resources for one another,
5) Activating students as owners of their own learning.

The second theoretical tools are the Functionalities of Technology (FT) introduced within the FaSMEd Project (see the complete description on FaSMEd website https://microsites.ncl.ac.uk/fasmedtoolkit/theory-for-fa/the-fasmed-framework/):

(a) sending & displaying,
(b) processing & analysing,
(c) providing an interactive environment.

1. Content

The activities "Time-distance graphs_part 1", "Time-distance graphs_part 2" and "Time-distance graphs_part 3" are propaedeutic to this one. It focuses on the construction of a graph that represents a given story. This requires the ability to be able to efficiently activate conversions from verbal to the graphical register (Duval, 2006).

2. Activity

This activity, which is not an adaptation from other activities, can be developed referring to a set of *two worksheets*.

2.1 The worksheets: focus and aims

Worksheet 8 introduces a story, describing the way in which a boy, Samuele, travelled along the road from home to the gym. Students are asked to draw the corresponding time-distance graph. We created it with the aim of making students consolidate the competences developed thanks to the previous activities.

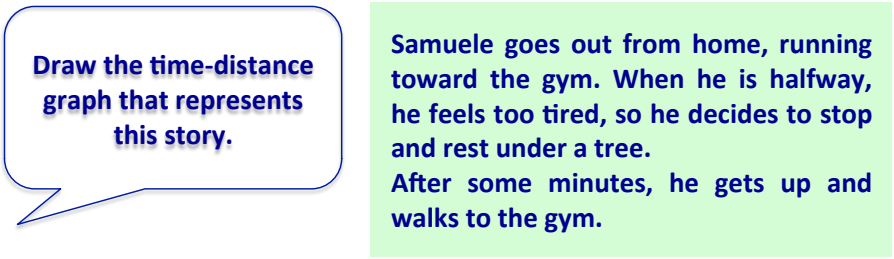

Fig. 1: Worksheet 8

When drawing the time-distance graph required on *worksheet 8*, students have to focus on specific key-words we have inserted within the story. Specifically, a correct interpretation of the word "halfway" should lead them to observe that a horizontal line should be drawn at a

distance that is half the one from home to the gym. Other key-words are "running" and "walks": a correct construction of the graph requires the ability to draw two ascending lines (separated by an horizontal one) with different slopes (the slope of the first ascending line should be greater than the slope of the second one).
Worksheet 8A is a helping worksheet. It could be sent to the students that face difficulties in in facing worksheet 8.

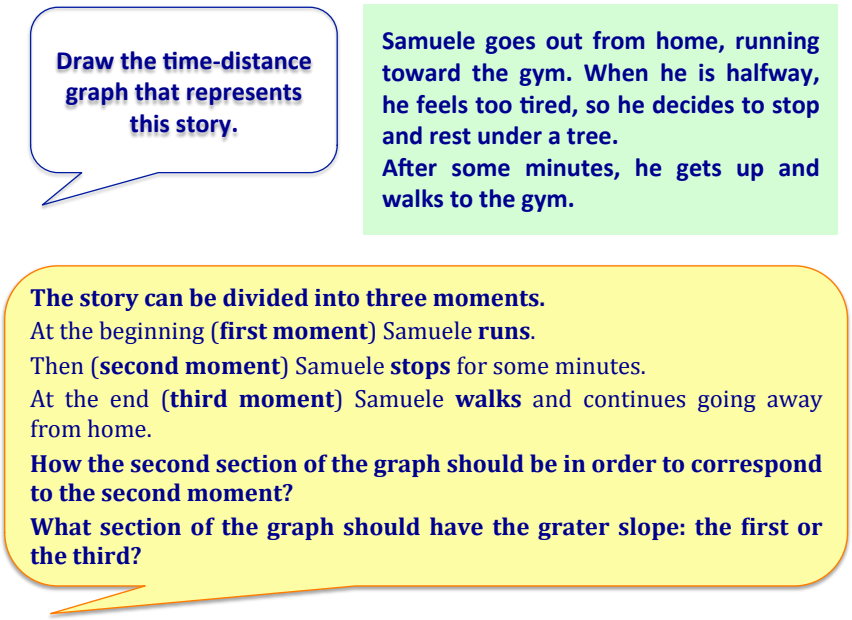

Fig. 2: Worksheet 8A

The suggestions and the guiding questions within *worksheet 8A* are aimed at:

- introducing the strategy of dividing the story in three main moments (corresponding to three sections in the time-distance graph);

- highlighting important key-words (in bold) that could help students to correctly draw the sections of the graph corresponding to the three main moments within the story;

- making students recall the role played by ascending/descending/horizontal lines within a graph and how the variation of speed could be represented in terms of different slopes.

2.2 Methodology

Our hypothesis is that, in order to raise students' achievement, Formative Assessment (FA) has to focus not only on basic competences, but also on metacognitive factors (Schoenfeld, 1992). Accordingly, we planned and developed class activities with the aim of: (a) fostering students' development of ongoing reflections on the teaching-learning processes; (b) focusing on making thinking visible (Collins, Brown & Newmann, 1989), through the sharing of their ideas with the teacher and the classmates.

For this reason, we suggest that, during the activities, the teacher guides the students to focus on the analysis and comparison of not only their *products* but also the *processes* that led to these products. In particular, the class should be led to discuss, on one side, the written productions and, on the other side, the strategies developed to carry out the tasks.

As regards the collective analysis of the students' written productions and the developed strategies, in particular, we refer to *argumentation* as a possible FA tool in the interaction between teacher and students. Specifically, argumentation is promoted to support the development of effective class discussions, starting from questions such as: "Explain what

you did", "Explain why your approach is effective", and to guide students in assessing the correctness, the clearness and the completeness of given explanations (their own or others).

The methodology adopted is in tune with these hypotheses. It will be clarified in section 2.4, after the introduction of the technology used (section 2.3).

2.3 Technology

In tune with the hypotheses presented in the previous section, we explored the use of a CCT, which connects the students' tablets with the teachers' laptop and allows the students to share their productions, and the teacher to easily collect the students' opinions and reflections during or at the end of an activity: IDM-TClass.

In the use of IDM-TClass to support FA processes, we in particular focused on the following three main functions of this software:

- the possibility of distributing documents to students and collecting documents from the students' tablets (related to the functionality *Sending and Displaying*);
- the possibility of creating instant polls and immediately showing their results to the whole class (related to the functionality *Processing and Analysing*);
- the possibility of displaying the students' written productions through the data projector or the interactive whiteboard (related to the functionality *Sending and Displaying*).

Each school was provided with tablets for the students and computers for the teachers, linked to IWB or data projector. In order to foster collaboration and sharing of ideas, students were asked to work in pairs or in small groups on the same tablet.

2.4 Structure of a typical lesson and Aspects of Formative Assessment

In the following, we present the typical structure of a lesson developed during the teaching experiments carried out in Italy, in this case with specific reference to worksheets **8** and **8A**.

The activity starts with a worksheet focused on one or more questions (in this case **worksheet 8**), sent from the teacher's laptop to the students' tablets (functionality *Sending and Displaying*). Students work in pairs or small groups of three.

After facing the task and answering the questions, the pairs/groups send back their written productions (functionality *Sending and Displaying*) to the teacher. The teacher can decide to send helping worksheets (*FA strategy 3*, aimed at the activation of *FA strategy 5*) to some groups, or the groups can ask for them. In this case, the helping worksheet **8A** could be sent to support the students in focusing on the three main moments in which the story could be subdivided and in drawing the corresponding sections of the graph.

After all groups have sent back their answers, the teacher sets up a classroom discussion (*FA strategy 2*) in which the students' written productions are shown (functionality *Sending and Displaying*) and feedbacks are given by the teacher and by classmates (*FA strategies 3 and 4*, aimed at the activation of *FA strategy 5*). The discussion is engineered starting from the teacher's selection of some of the received written answers, shown on the IWB. The discussion aims at highlighting (*FA strategy 3*): (a) typical mistakes; (b) effective ways of processing the tasks; (c) the comparison between the different ways of justifying claims. In this, the criteria for success could be clarified through the analysis and comparison of the different written productions (*FA strategy 1*).

Polls (functionality *Processing and Analysing*) could also be used to prompt the discussion (*FA strategy 2*, that could lead to the activation of other FA strategies, such as 3, 4, 5) during

different parts of the lessons. In this case no worksheets aimed at prompting polls were constructed, but it is possible to organize instant polls. For example, a poll could be constructed, to make students compare some of the drawings produced by their mates in order to identify the most complete one.

3. Further Information

We recommend that, when the teacher introduces the worksheets that are going to be sent to the students, she stresses some aspects. This is especially crucial with younger students (grade IV and V).

As regards **worksheet 8**, it is important to stress that the story should be read carefully in order to construct a graph that fits completely with the story. The discussion on the different drawings produced by the students should focus on aspects such as:

- the position of the horizontal line (the distance from home, when Samuele stops, is the same from the gym);

- the inclination of the two ascending lines representing the moment in which Samuele is moving;

- in case some students choose to invent data in order to construct the graph, the choice of this data (for example, are they realistic?).

Another important focus of the discussion should be the role played by the helping worksheet (**8A**) in supporting an effective drawing of the graph.

4. References

Collins, A., Brown, J.S., & Newman, S.E. (1989). Cognitive Apprenticeship: Teaching the Crafts of Reading, Writing and Mathematics! In L.B. Resnick (Ed.), *Knowing, Learning, and Instruction: Essays in Honor of Robert Glaser* (pp. 453-494). Hillsdale, NJ: Lawrence Erlbaum Associates.

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Further information about the software IDM-TClass can be found on the webpage
http://www.tecnilabedu.com/prodotto05EN.html