ENHANCING FORMATIVE ASSESSMENT STRATEGIES IN MATHEMATICS THROUGH CLASSROOM CONNECTED TECHNOLOGY

Annalisa Cusi*, Francesca Morselli**, Cristina Sabena*
* University of Torino, Italy **University of Genova, Italy

Szeged, 6th August 2016

European Project FP7
Action: Science in Society
Collaborative Project (n.612337)

Improving Progress for Lower Achievers through

Formative Assessment in Science and Mathematics Education

"**The project aims** at researching the use of **technology** in **formative assessment** classroom practices, in ways that allow teachers to **raise students'achievement** in mathematics and science"
(FaSMEd Document of Work)

THE FASMED PROJECT IN ITALY

The technology

Connected classroom technology

IDM Tclass

-**Tablets** for the students, who work in **pairs**;

-**Computers** for the teachers;

-**Interactive whiteboard** or **data projector**.

The activities carried out in the classes

Argumentation as a FA tool

Content:
Relations and functions, through their different representations (verbal, symbolic, graphic, tabular).

- **Integration** of the use of **connected classroom technologies** within a set of activities coming from **different sources**.

ArAl

MARS Mathematics Assessment Resource Service

THE FASMED PROJECT IN ITALY

Typical structure of a lesson

Three main **categories of *different worksheets***:

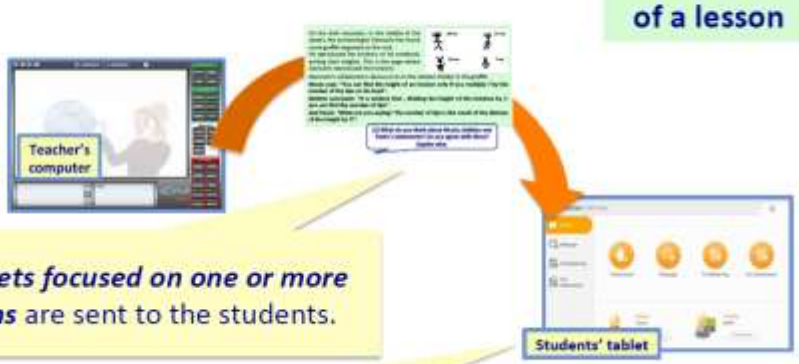
(1) *Worksheets focused on one or more questions*;

(2) *Helping worksheets*;

(3) *Worksheets prompting a poll.*

THE FASMED PROJECT IN ITALY

Typical structure of a lesson

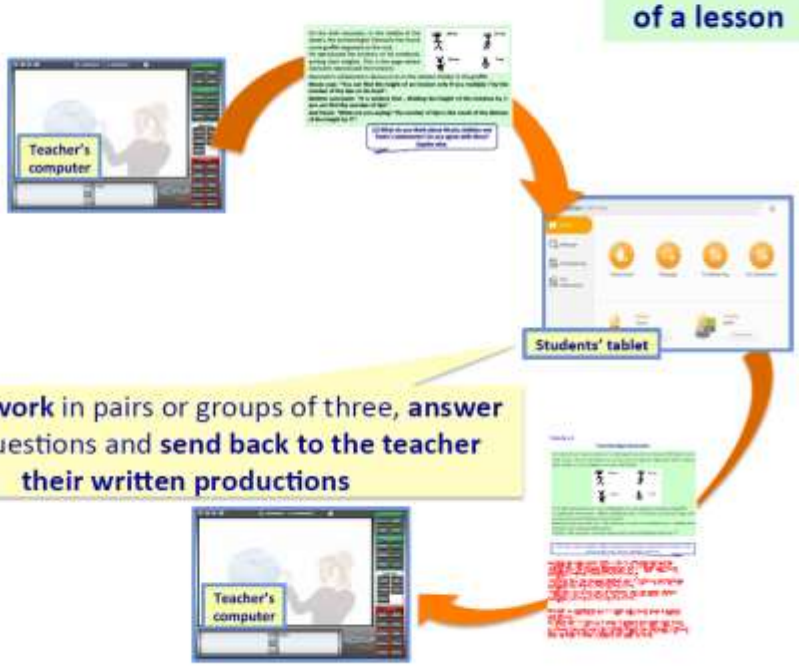


Worksheets focused on one or more questions are sent to the students.

Students **work** in pairs or groups of three, **answer** to the questions and **send back to the teacher their written productions**

THE FASMED PROJECT IN ITALY

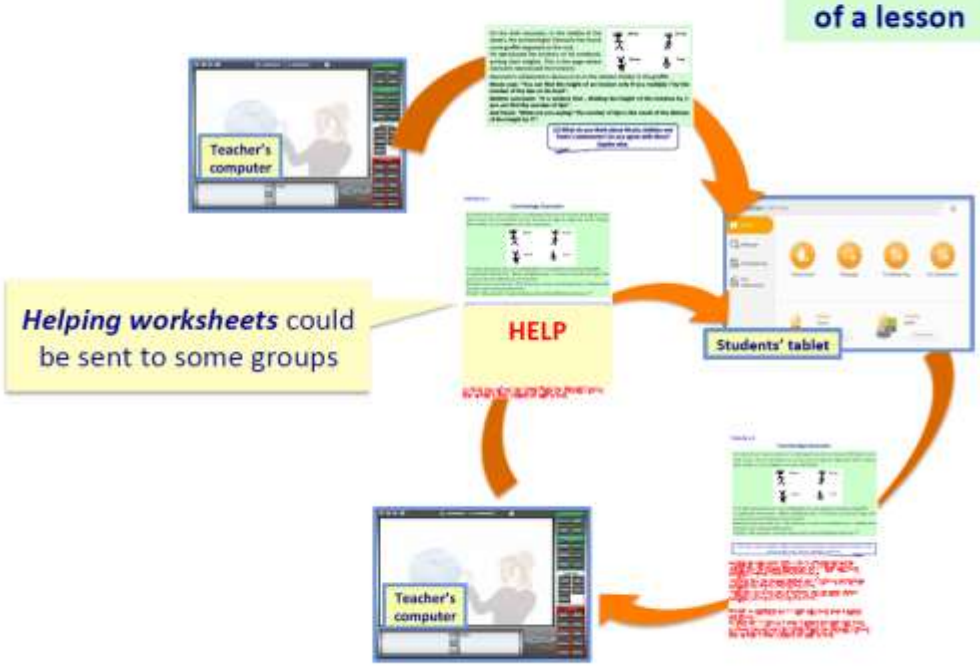
Typical structure of a lesson



Students **work** in pairs or groups of three, **answer** to the questions and **send back to the teacher their written productions**

THE FASMED PROJECT IN ITALY

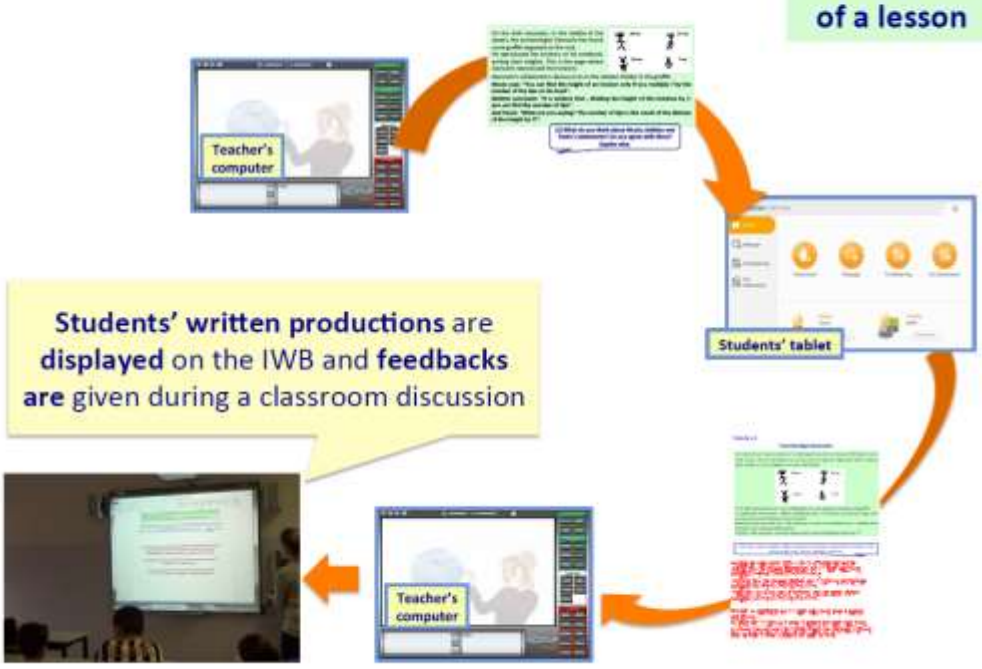
Typical structure of a lesson



Helping worksheets could be sent to some groups

THE FASMED PROJECT IN ITALY

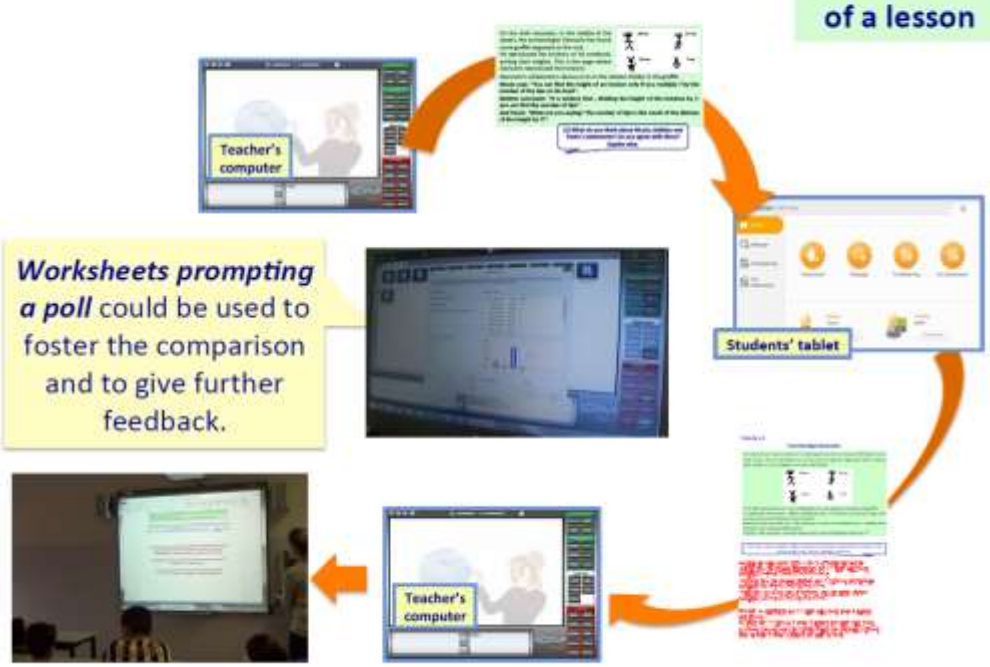
Typical structure of a lesson



Students' written productions are **displayed** on the IWB and **feedbacks are** given during a classroom discussion

THE FASMED PROJECT IN ITALY

Typical structure of a lesson



Worksheets prompting a poll could be used to foster the comparison and to give further feedback.

RESEARCH AIMS

FaSMEd

➔ to investigate the **FA processes** that take place in the mathematics classroom context, thanks to the **support provided by technology** and to the teacher's choices

➔ to **highlight the complex dynamical development** between the different **FA strategies** activated by the agents involved

THEORETICAL FRAMEWORK

1) FaSMEd three-dimensional framework

It extends Black and Wiliam's (2009) model to include the use of technology in FA processes.

THEORETICAL FRAMEWORK

1) FaSMEd three-dimensional framework

	Where the learner is going	Where the learner is right now	How to get there
Teacher	**1** Clarifying learning intentions and criteria for success	**2** Engineering effective class-room discussions and other learning tasks that elicit evidence of student understanding	**3** Providing feedback that moves learners forward
Peer	Understanding and sharing learning intentions and criteria for success	**4** Activating students as instructional resources for one another	
Learner	Understanding learning intentions and criteria for success	**5** Activating students as the owners of their own learning	

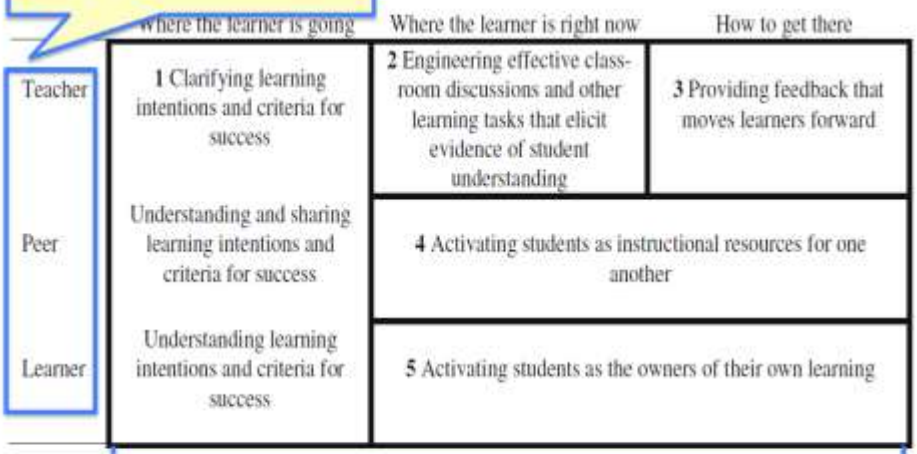
The five key-strategies that could be activated

THEORETICAL FRAMEWORK

FaSMEd

The three main agents in FA processes

nsional framework



The five key-strategies that could be activated

THEORETICAL FRAMEWORK

FaSMEd

1) FaSMEd three-dimensional framework

The **functionalities through which technology can support** the three agents in developing the FA strategies

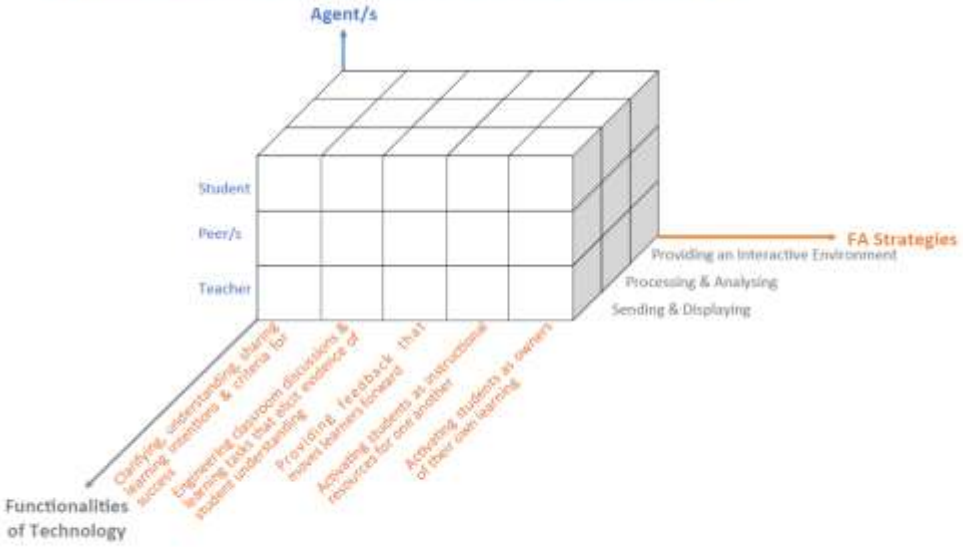
(a) ***Sending and sharing***: when technology is used **to support communication** among the agents of FA processes and to activate fruitful discussions.

(b) ***Processing and analysing***: includes all the functionalities that **support the processing and the analysis of the data collected during the lessons.**

(c) *Providing an interactive environment*: those functionalities of technology that **enable to create a shared interactive environment within which students can work individually or collaboratively** on a task or a learning environment where mathematical/scientific contents could be explored.

THEORETICAL FRAMEWORK

1) FaSMEd three-dimensional framework



THEORETICAL FRAMEWORK

2) Hattie & Timperley's levels of feedback (2007):

1) **Feedback about the task (FT)**

is about a task or product, such as whether work is correct or not

2) **Feedback about the processing of the task (FP)** aimed at the process used to create a product/complete a task

3) **Feedback about self-regulation (FR)** including greater skill in self-evaluation/confidence to engage further on a task

4) **Feedback about the self as a person (FS)** concerns issues of personal evaluation and affect

ANALYSIS OF AN EPISODE: THE ACTIVITY

Worksheet 1

Every morning Tom walks along a straight road from his home to a bus stop, a distance of 160 meters. The graph shows his journey on one particular day.

What happens in the period of time between 50s and 70s? How did you establish it?

- Grade 5
- Focus on **time-distance graphs**
- **Discussion on** 4 different answers selected and displayed on the IWB.

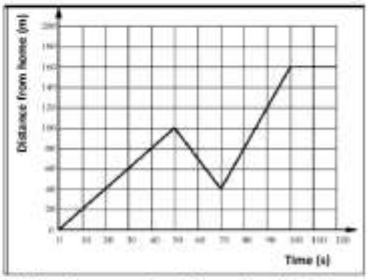
Researcher present as a **participant observer**, supporting the teacher in managing the **discussion.**

ANALYSIS OF AN EPISODE: THE DISCUSSION

FIRST PART OF THE DISCUSSION:

- **Most of the students think that the answer is not correct** and state that Tommaso walked for 40m, not for 60m
- Vincenzo and Mirco (the authors of the answer) declare that they were convinced by their classmates that their answer is not right
- **Only one student, Arturo, declares that, in his opinion, the written answer is correct.**

➔ **The teacher asks Arturo to explain why.**



What happens in the period of time between 50s and 70s? How did you establish it?

The discussion starts focusing on this answer:

"Tommaso, in 20 seconds, was able to walk for 60 metres. We know that in 20 seconds he walked for 60 metres because we took 50s away from 70s, obtaining 20s, then we subtracted 60m from 100m and we obtained 40 metres".

ANALYSIS OF AN EPISODE: THE DISCUSSION

145. Arturo: … if we look at the graph, he (*Tommaso*) arrives at 100m, then he goes back.

146. Teacher: Do we all agree that he goes back? (*A chorus of students answer "yes")*

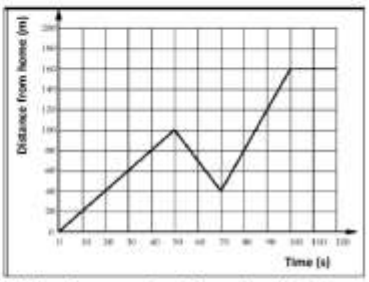
147. Teacher: Who doesn't agree on the fact that he goes back? (*None of the pupils raises his/her hand*)

148. Arturo: However, he goes back to 40m, not for 40m (*stressing on the words 'to' and 'for'*). So we have to do the subtraction 100 minus 40. And the result is 60, not 40. So it is correct.

149. Teacher: So is it (*the answer*) correct? Do you agree with Arturo? (*to the class*)

Silence.

150. Researcher: Please repeat the words you used (*speaking with Arturo*), since they are very precise. Listen to them (*speaking with the other students*).



What happens in the period of time between 50s and 70s? How did you establish it?

The discussion starts focusing on this answer:

"Tommaso, in 20 seconds, was able to walk for 60 metres. We know that in 20 seconds he walked for 60 metres because we took 50s away from 70s, obtaining 20s, then we subtracted 60m from 100m and we obtained 40 metres".

ANALYSIS OF AN EPISODE: THE

145. Arturo: … if we look at the graph, he (*Tommaso*) arrives at 100m, then he goes back.

146. Teacher: Do we all agree that he goes back? (*A chorus of students answer "yes")*

147. Teacher: Who doesn't agree on the fact that he goes back? (*None of the pupils raises his/her hand*)

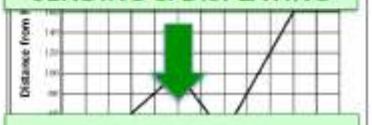
148. Arturo: However, he goes back to 40m, not for 40m (*stressing on the words 'to' and 'for'*). So we have to do the subtraction 100 minus 40. And the result is 60, not 40. So it is correct.

149. Teacher: So is it (*the answer*) correct? Do you agree with Arturo? (*to the class*)

Silence.

150. Researcher: Please repeat the words you used (*speaking with Arturo*), since they are very precise. Listen to them (*speaking with the other students*).

The functionality of technology: SENDING & DISPLAYING



FA STRATEGY 2: ***Engineering effective classroom discussions and other learning tasks that elicit evidence of student understanding***

on this answer:

"Tommaso, in 20 seconds, was able to walk for 60 metres. We know that in 20 seconds he walked for 60 metres because we took 50s away from 70s, obtaining 20s, then we subtracted 60m from 100m and we obtained 40 metres".

ANALYSIS OF AN EPISODE: THE DISCUSSION

145. Arturo: … if we look at the graph, he (*Tommaso*) arrives at 100m, then he goes back.

146. Teacher: Do we all agree that he goes back? (*A chorus of students answer "yes"*)

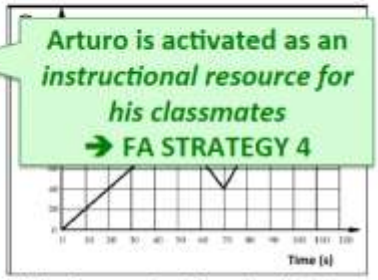
147. Teacher: Who doesn't agree on the fact that he goes back? (*None of the pupils raises his/her hand*)

148. Arturo: However, he goes back to 40m, not for 40m (*stressing on the words 'to' and 'for'*). So we have to do the subtraction 100 minus 40. And the result is 60, not 40. So it is correct.

149. Teacher: So is it (*the answer*) correct? Do you agree with Arturo? (*to the class*)

Silence.

150. Researcher: Please repeat the words you used (*speaking with Arturo*), since they are very precise. Listen to them (*speaking with the other students*).



What happens in the period of time

Arturo is activated as an *instructional resource for his classmates*
➔ FA STRATEGY 4

FA STRATEGY 3 AT THE PEERS' LEVEL:
Arturo's explanation represents both a feedback about the task and a feedback about the processing of the task

took 50s away from 70s, obtaining 20s, then we subtracted 60m from 100m and we obtained 40 metres".

ANALYSIS OF AN EPISODE: THE DISCUSSION

145. Arturo: … if we look at the graph, he (*Tommaso*) arrives at 100m, then he goes back.

146. Teacher: Do we all agree that he goes back? (*A chorus of students answer "yes"*)

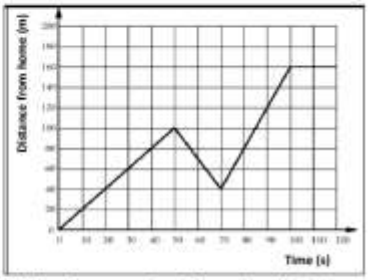
147. Teacher: Who doesn't agree on the fact that he goes back? (*None of the pupils raises his/her hand*)

148. Arturo: However, he goes back to 40m, not for 40m (*stressing on the words 'to' and 'for'*). So we have to do the subtraction 100 minus 40. And the result is 60, not 40. So it is correct.

149. Teacher: So is it (*the answer*) correct? Do you agree with Arturo? (*to the class*)

Silence.

150. Researcher: Please repeat the words you used (*speaking with Arturo*), since they are very precise. Listen to them (*speaking with the other students*).

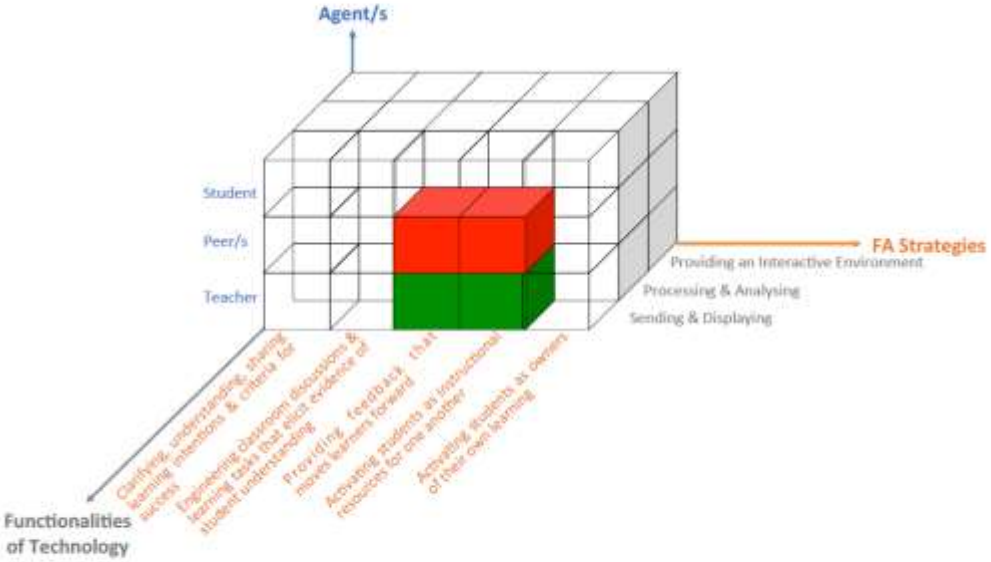


What happens in the period of time

FA STRATEGY 3 AT THE TEACHER'S LEVEL:
the Researcher recognizes that the student has provided a correct argument.
➔ Feedback about the processing of the task

obtaining 20s, then we subtracted 60m from 100m and we obtained 40 metres".

ANALYSIS OF AN EPISODE: THE DISCUSSION



ANALYSIS OF AN EPISODE: THE DISCUSSION

Arturo repeats his reasoning, stating it slower and stressing the most important words, as asked. In particular, he explains that 60m is the result of the difference between 100m and 40m.

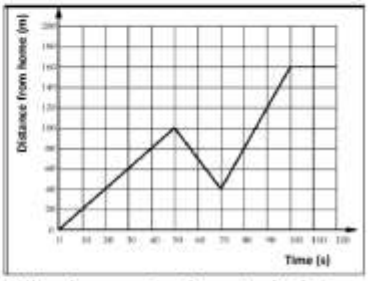
166. Researcher: You (*speaking to Vincenzo and Mirco*) said that you wanted to change your answer. Would you still change it or would you keep it as it is?

167. Mirco: We would keep our first answer.

168. Researcher: Ok. I have one question for all of you (*speaking to the whole class*): what is missing in this answer?

169. Mirco: That Tommaso went back! We did not write it.

170. Researcher: You did not say that Tommaso went back.



What happens in the period of time between 50s and 70s? How did you establish it?

The discussion starts focusing on this answer:

"Tommaso, in 20 seconds, was able to walk for 60 metres. We know that in 20 seconds he walked for 60 metres because we took 50s away from 70s, obtaining 20s, then we subtracted 60m from 100m and we obtained 40 metres".

ANALYSIS OF AN EPISODE: THE DISCUSSION

Arturo repeats his reasoning, stating it slower and stressing the most important words, as asked. In particular, he explains that 60m is the result of the difference between 100m and 40m.

166. Researcher: You (*speaking to Vincenzo and Mirco*) said that you wanted to change your answer. Would you still change it or would you keep it as it is?

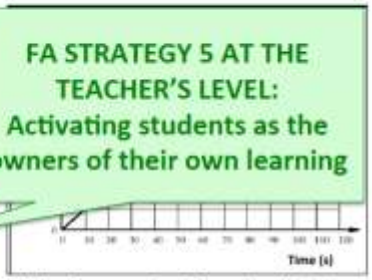
167. Mirco: We would keep our first answer.

168. Researcher: Ok. I have one question for all of you (*speaking to the whole class*): what is missing in this answer?

169. Mirco: That Tommaso went back! We did not write it.

170. Researcher: You did not say that Tommaso went back.

FA STRATEGY 5 AT THE TEACHER'S LEVEL: Activating students as the owners of their own learning



What happens in the period of time between 50s and 70s? How did you establish it?

The discussion starts focusing on this answer:

"Tommaso, in 20 seconds, was able to walk for 60 metres. We know that in 20 seconds he walked for 60 metres because we took 50s away from 70s, obtaining 20s, then we subtracted 60m from 100m and we obtained 40 metres".

ANALYSIS OF AN EPISODE: THE DISCUSSION

Arturo repeats his reasoning, stating it slower and stressing the most important words, as asked. In particular, he explains that 60m is the result of the difference between 100m and 40m.

166. Researcher: You (*speaking to Vincenzo and Mirco*) said that you wanted to change your answer. Would you still change it or would you keep it as it is?

167. Mirco: We would keep our first answer.

168. Researcher: Ok. I have one question for all of you (*speaking to the whole class*): what is missing in this answer?

169. Mirco: That Tommaso went back! We did not write it.

170. Researcher: You did not say that Tommaso went back.

FA STRATEGY 3 AT THE TEACHER'S LEVEL:

The researcher accepts Mirco's answer without further questioning it
➔ Feedback on the task

She prompts students to focus on the same answer and look for something that is missing
➔ Feedback on the task

Tommaso, in 20 seconds, was able to walk for 60 metres. We know that in 20 seconds he walked for 60 metres because we took 50s away from 70s, obtaining 20s, then we subtracted 60m from 100m and we obtained 40 metres".

ANALYSIS OF AN EPISODE: THE DISCUSSION

Arturo repeats his reasoning, stating it slower and stressing the most important words, as asked. In particular, he explains that 60m is the result of the difference between 100m and 40m.

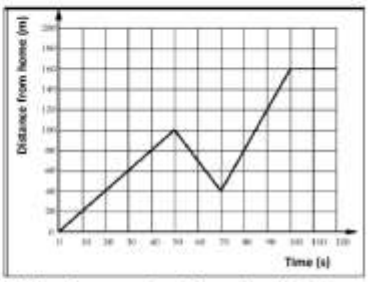
166. Researcher: You (*speaking to Vincenzo and Mirco*) said that you wanted to change your answer. Would you still change it or would you keep it as it is?

167. Mirco: We would keep our first answer.

168. Researcher: Ok. I have one question for all of you (*speaking to the whole class*): what is missing in this answer?

169. Mirco: That Tommaso went back! We did not write it.

170. Researcher: You did not say that Tommaso went back.



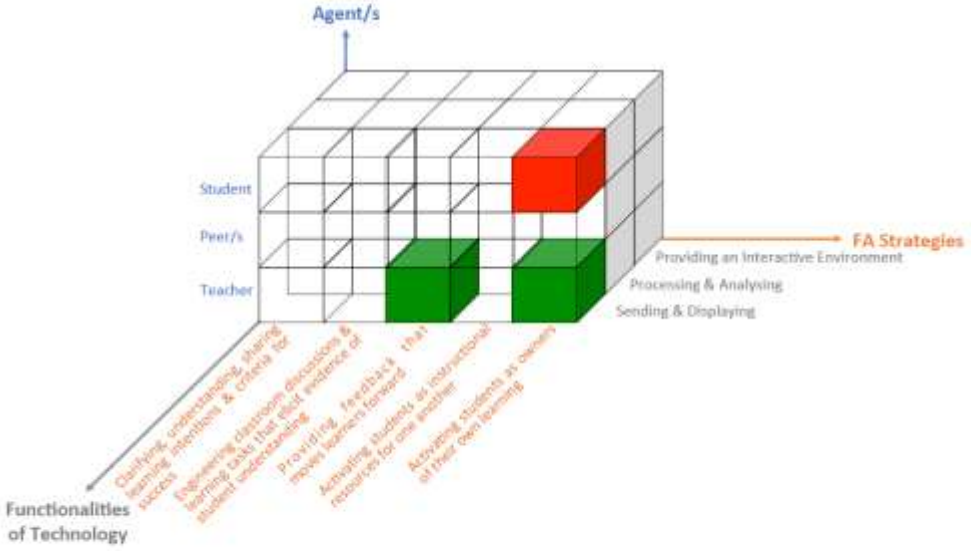
What happens in the period of time between 50s and 70s? How did you

FA STRATEGY 5 AT THE LEARNER'S LEVEL:

Mirco shows that he really has activated himself as the *owner of his own learning*

took 50s away from 70s, obtaining 20s, then we subtracted 60m from 100m and we obtained 40 metres".

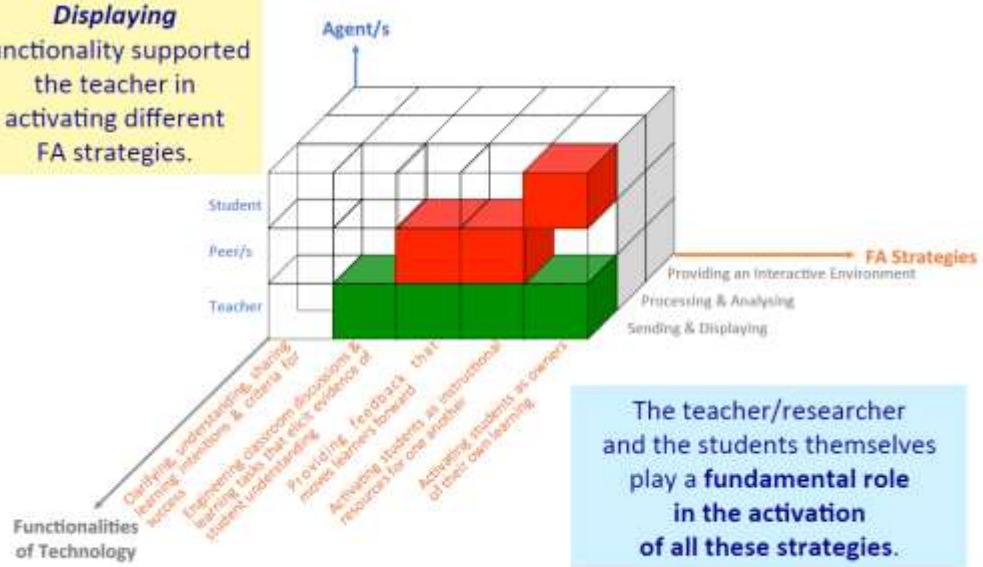
ANALYSIS OF AN EPISODE: THE DISCUSSION



GLOBAL LECTURE OF THE EPISODE

The **FA processes** that take place

The ***Sending and Displaying*** functionality supported the teacher in activating different FA strategies.



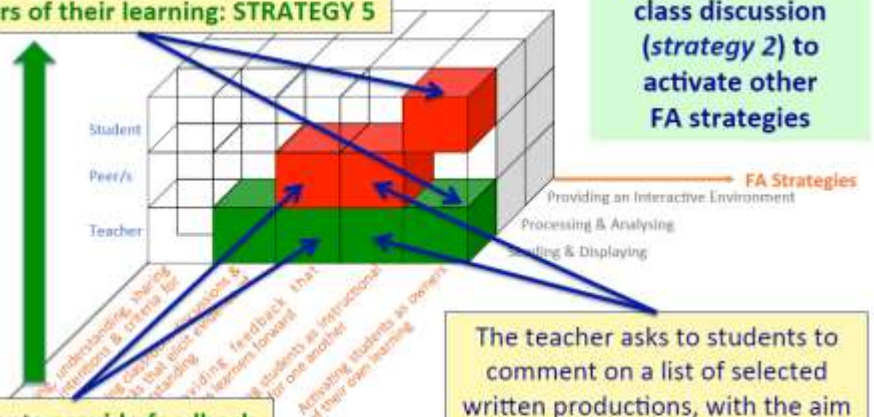
The teacher/researcher and the students themselves play a **fundamental role in the activation of all these strategies.**

GLOBAL LECTURE OF THE EPISODE

…en the activated FA strategies

The students, thanks also to the support provided by the teacher, exploit the provided feedback, **activating themselves as owners of their learning: STRATEGY 5**

Engineering of the class discussion (*strategy 2*) to activate other FA strategies

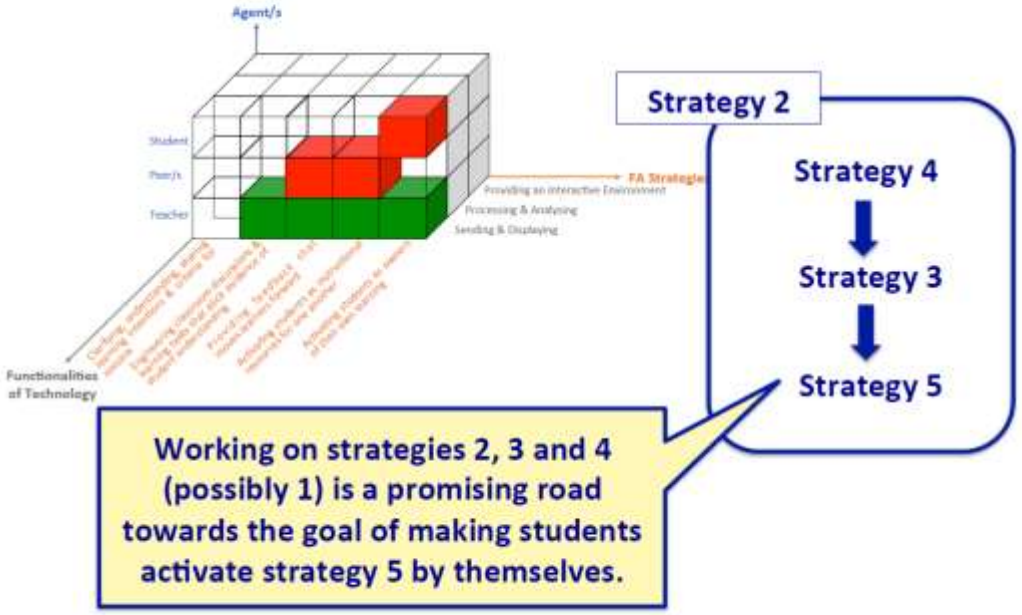


The teacher asks to students to comment on a list of selected written productions, with the aim of **activating the students as instructional resources for one another: *STRATEGY 4***

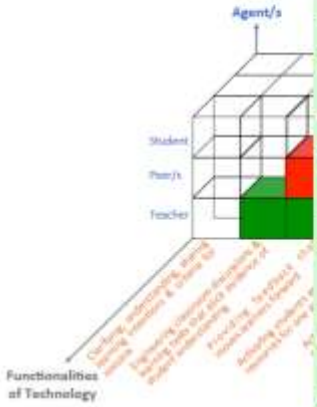
The students **provide feedback to each others** and the teacher, too, comments, providing further feedback: **STRATEGY 3**

GLOBAL LECTURE OF THE EPISODE

Dynamical development between the activated FA strategies



PRESENT DEVELPMENTS OF THIS RESEARCH



- Identification of **sub-levels of feedback,** more focused on the **mathematical aspects** discussed;
- Analysis of the **feedback strategies** activated by the teacher;
- Study of the **role of argumentation** as a tool to support FA processes;
- Identification of the **different ways in which the worksheets are used to support** the students' learning through a FA perspective in the CCT environment.

THANK YOU!