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Which support technology can give to mathematics formative assessment?
The FaSMEd project in Italy and France

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Abstract: This workshop is focused on the role technology may play in supporting the formative assessment process. Different examples from the case studies developed in France and Italy within the European Project FaSMEd will be analysed and discussed. In order to highlight the choices we made in relation to the aim of the project, before discussing the examples we will introduce the methodology adopted in each country and the theoretical frameworks to which we refer for the planning and analysis of the activities.

Resumé: Le but de cet atelier est d'examiner le rôle que la technologie peut jouer dans un processus d'évaluation formative. Des exemples provenant d'études de cas réalisées en France et en Italie dans le cadre du projet européen FaSMEd seront analysés et discutés. Pour mettre en évidence les choix que nous avons faits dans le cadre de ce projet, nous introduirons la méthodologie qui a été adoptée dans les deux pays et les cadres théoriques de référence aussi bien pour la construction que pour l'analyse de ces activités.

Introduction

The idea for this workshop was born from the collaboration of the French team and the Italian team engaged in the European project titled FaSMEd (Improving progress for lower achievers through Formative Assessment in Science and Mathematics Education). The aim of the project is to investigate the role of technologically enhanced formative assessment (FA) methods in raising the attainment levels of low-achieving students. Our hypothesis is that connectivity can support

- *teachers* in collecting data from the students, making timely formative interpretations, and informing their future teaching and, on the other side,
- *students* in exploiting the received feedback to improve their learning.

In line with this hypothesis, FaSMEd investigates: (a) students' use of FA data to inform their learning trajectories; (b) teachers' ways of processing FA data from students using a range of technologies; (c) teachers' ways of using these data to inform their future teaching; and (d) the role played by technology, as a learning tool, in enabling the teachers to become more informed about student understanding.

The research is based on successive cycles of design, observation, analysis and redesign of classroom sequences (Swan, 2014) in order to produce and feed into a set of curriculum materials and methods for teachers, that is called "toolkit". The core of FaSMEd is constituted by the case studies involving different classrooms and feeding little by little the toolkit.

In this paper, after introducing the theoretical frame for the analysis of FA processes, we will present two examples, from our case studies. Both the examples are aimed at investigating the role played by technology in supporting FA processes, and focus in particular on how the teacher plans and implements a lesson, starting from the elaboration of different data from class activities, provided by the technological environment.

Our theoretical framework for Formative Assessment

According to the definition of FA to which the FaSMEd partners refer, FA is conceived as a method of teaching where

> "[...] evidence about student achievement is elicited, interpreted, and used by teachers, learners, or their peers, to make decisions about the next steps in instruction that are likely to be better, or better founded, than the decisions they would have taken in the absence of the evidence that was elicited" (Black & Wiliam, 2009, p. 7).

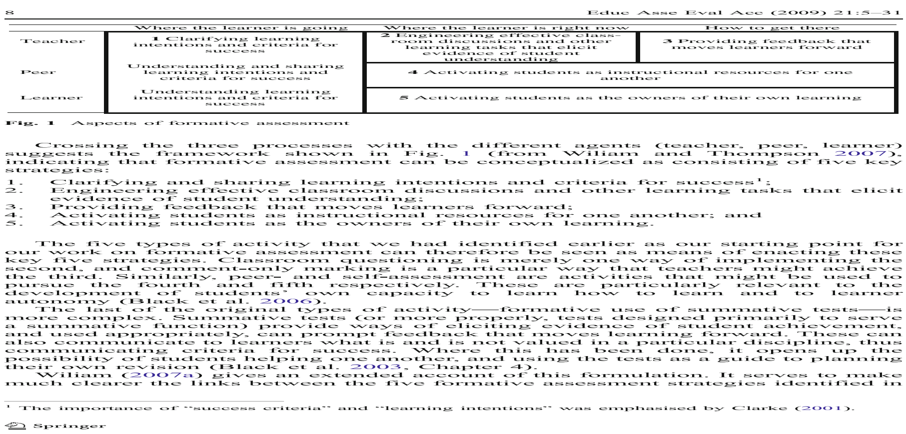
Such learning evidences can be collected, interpreted and exploited by the teacher in different moments of the learning process and with different purposes. In particular, we focus on three central processes in learning and teaching proposed by Wiliam and Thompson (2007):

a) Establishing where learners are in their learning;
b) Establishing where learners are going;
c) Establishing how to get there.

Different agents are involved in these three processes: the teacher, the learners and their peers. Wiliam and Thompson (2007) conceptualise FA as consisting of five key strategies, that could be activated by these agents:

1) Clarifying and 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 the owners of their own learning.

The following table (from Wiliam and Thompson, 2007, as quoted in Black and Wiliam, 2009, p. 8) synthetizes how the key strategies could be activated by the three agents, within the three central processes in learning and teaching: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	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 classroom 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	

Fig. 1 Aspects of formative assessment

Crossing the three processes with the different agents (teacher, peer, learner) suggests the framework shown in Fig. 1 (from Wiliam and Thompson 2007), indicating that formative assessment can be conceptualized as consisting of five key strategies:

1. Clarifying and sharing learning intentions and criteria for success[1];
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; and
5. Activating students as the owners of their own learning.

The five types of activity that we had identified earlier as our starting point for our work on formative assessment can therefore be seen as means of enacting these key five strategies. Classroom questioning is merely one way of implementing the second, and comment-only marking is a particular way that teachers might achieve the third. Similarly, peer- and self-assessment are activities that might be used to pursue the fourth and fifth respectively. These are particularly relevant to the development of students' own capacity to learn how to learn and to learner autonomy (Black et al. 2006).

The last of the original types of activity—formative use of summative tests—is more complex. Summative tests (or more properly, tests designed primarily to serve a summative function) provide ways of eliciting evidence of student achievement, and used appropriately, can prompt feedback that moves learning forward. These can also communicate to learners what is and is not valued in a particular discipline, thus communicating criteria for success. Where this has been done, it opens up the possibility of students helping one another, and using the tests as a guide to planning their own revision (Black et al. 2003, Chapter 4).

Wiliam (2007a) gives an extended account of this formulation. It serves to make much clearer the links between the five formative assessment strategies identified in

[1] The importance of "success criteria" and "learning intentions" was emphasised by Clarke (2001).

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Fig. 1: FA according to Wiliam and Thompson (2007)

Effective feedback from the different agents involved in these different processes plays a central role in FA. According to Hattie and Timperley (2007), there are four major levels of feedback, influencing its effectiveness. They are:

(1) feedback about the task, which includes feedback about how well a task is being accomplished or performed;
(2) feedback about the processing of the task, which concerns the processes underlying tasks or relating and extending tasks;

(3) feedback about self-regulation, which addresses the way students monitor, direct, and regulate actions toward the learning goal;
(4) feedback about the self as a person, which expresses positive (and sometimes negative) evaluations and affect about the student.

Analysis of our examples: focus and research questions

We will present and analyse one example from the French case studies and one from the Italian case studies. For each of them, we will introduce the context, give information about the design of the activity, and analyse a brief excerpt from the videos collected in the classroom.

The focus of the analysis will be: (a) the teacher's ways of using technology to foster formative assessment and in particular of referring to feedback from technology to inform and modify her teaching; (b) the students' (in particular low achievers) exploitation of feedbacks given by technology, the teacher and also the classmates, in order to improve their mathematical understanding.

The main research questions that will guide our analyses are:
1) Which aspects of formative assessment can be highlighted?
2) Are there evidences of the teacher's use of feedback to inform and modify her teaching? Are there evidences of the students' exploitation of feedback to improve their understanding?
3) What is the role of technology in supporting the actors involved in these processes in providing feedback to each other?

An example from the French case studies

In France the project is held by the École Normale Supérieure de Lyon and different schools at different levels are involved, from upper primary school to the first year of upper secondary school.

In primary classes (grade 4-5), the focus is on mathematics. Three teachers are working on fractions, using calculators TI-Primaire Plus, an interactive whiteboard, a student response system and a micro document camera. In lower secondary school (grade 6-9) and at the first year of upper secondary school (grade 10) both mathematics and science are involved in a coordinated way. In particular, in one lower secondary school in Lyon, mathematics and science teachers are organising the work around a common theme, namely magnitudes and measure, testing a student response system. They are encouraged to share methodologies and, if possible, activities that could be approached from both perspectives.

In the grade 10 classroom, as well as in another grade 9 classroom out of Lyon, every student is equipped with a tablet. Mathematics and science teachers are using connected classroom technologies. They have the possibility to pose questions to students and collecting the answers, and to check the work done by each student on her tablet in real-time.

These technologies were sometimes already present in the classroom due to school local projects (this is the case for the tablet classrooms) or chosen by the teachers according to their needs at the beginning of the FaSMEd project.

All the classes engaged in the project are mixed ability classes, and some of them include identified lower achievers. In addition, the majority of them are situated in the suburbs where the social context is often source of difficulties.

We consider that formative assessment is a process that is observable over a long period of time. Therefore, our methodology is built in order to catch information over time: the observations as windows open on the classroom at key moments, accompanied by teachers' auto-reflections and description of the whole scenario, from the introduction to the institutionalization of knowledge at stake, in reference to the Theory of Didactic Situations (Brousseau, 2004). Hence, we ask the teachers to fill in a grid of description where the following points have to be considered.

- Before the lesson: the prerequisites, the objectives, the planned organisation of the classroom (which tools, which technologies, individual or collective work,…), in reference to the instrumental orchestration (Trouche, 2004), forecast difficulties of the students and forecast answers to cope with them.
- After the lesson: brief summary of what happened in the classroom, possible gap with the forecast plan for the lesson.

This information is used by the researchers for preparing the observation and by the teachers for enriching their data for the process of formative assessment.

From the different observations carried out in the FaSMEd project, we present a case study in mathematics. It is a grade 9 tablet classroom where each student has his/her own tablet and is responsible for it during school hours. For networking tablets, the teacher (Thomas) uses the NetSupport School software that allows classroom monitoring, management, orchestration and collaboration. As a mathematical platform, Thomas decides to use Maple TA that is an online testing and assessment system designed especially for courses involving mathematics. The classroom is also equipped with an IWB. All the digital equipment has been provided by the school, since the classroom takes part in a school project about the integration of technology in the classrooms. The teacher has to appropriate such technologies also from a technical point of view. Nevertheless, what is completely new for him, from a didactical point of view, is the use of such technologies for formative assessment in his classroom.

The case study leans on a sequence about linear functions, where the following competences are to be acquired, according to the different representations of functions.

(a) Calculating and detecting images.

(b) Calculating and detecting inverse images.

(c) Recognising a linear function.

(d) Shifting from the graphical frame to the algebraic frame and vice versa.

Thomas decides to create a sequence of questionnaires around these four competences, using Maple TA. Following a typical Thomas' teaching sequence with Maple TA, we propose to analyse three specific episodes taken from our observations and referred to the third quiz proposed by Thomas to the students during this learning sequence about linear functions. The first moment concerns a student taking the quiz and the teacher declaring his potential use of the class' results. In the second episode, the teacher comments the quiz results of a student and, during the third excerpt, the teacher comments the whole set of the class' results.

First episode

A student (Mathieu) is working on a question concerning the competence (a): calculating and detecting images. Formulated in the graphical register of representation, the question is: "The curve below represents a linear function. The image of 9 is -2. True/False." Since he is working alone on the mathematical task, Mathieu is *active as the owner of his own learning*. He is reading the task that he has received from the teacher on Maple TA. In this first phase of the work, technology is used as a communication mean for sending tasks to the students.

Mathieu faces the didactic situation devolved by the teacher. After a while, he copies the question, leaves Maple TA, and pastes the question on the interactive environment of his tablet (OneNote) in order to work on the given graphical representation using his previous experience of such an exercise. On his screen, indeed, we can see a previously solved exercise that is very similar to the new one (Fig. 2a). Mathieu starts using the same graphical technique (Fig. 2b), mobilising his knowledge as a reflexive student (Margolinas, 2004). He has transformed the didactic situation into an a-didactic situation where he acts on a reacting milieu.

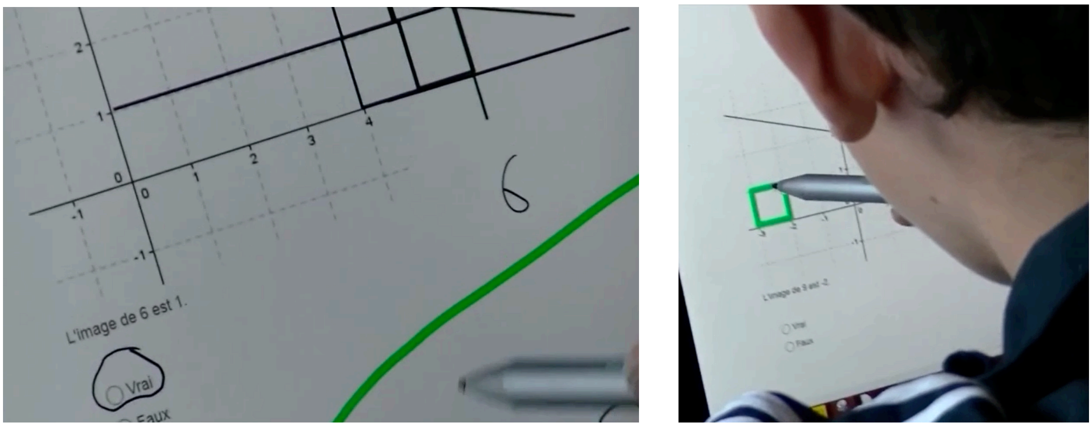

Fig. 2 a and b: Mathieu working on OneNote.

The student starts acting on the technology at his disposal, using it as an interactive environment, and the fact that the teacher has devolved to him the responsibility for solving the mathematical situation (devolution) is at the base of this action. Finally, Mathieu submits his answer, sending it back to the teacher.

To go further in our analysis, we can move on to the teacher's level. This dynamics occurs when the teacher is confronted to the students' answers, and uses technology for analysing such data. In our case, talking to another student, the teacher declares his potential strategies depending on the students' responses.

Thomas : "*I don't know if I'm going to take it into account or not. The idea is that I would like to mark it. If I realise that it doesn't work… I don't know… I'm going to see what's going on… At least I'll know that you don't succeed here. You can skip it if you don't know what to do.*"

The student's results are a feedback for the teacher, who will process and analyse these data. Depending on the student's performance, he may adapt his teaching, for example by choosing another FA strategy, and provide feedback to students. In his words, we detect also a 'feedback about the task' that Thomas gives to the student, by saying "*At least I'll know that you don't succeed here*".

Second episode

Teacher's feedback can be made on the spot, like in the second transcription that we propose to analyse. A student has completed his quiz, submitted his answers and got a 'feedback about the task' from Maple TA: "good answer" or "wrong answer". Then he calls Thomas in order to have further explanations.

Thomas: "*The first one is right, the second one is wrong, the third one is right, and the fourth one is wrong. Finally, I consider that you were right on the two that are easier to explain and you got false on the two that require more mathematical work. That's normal. I consider your result as normal.*"

Both the teacher and the student benefit from the feedback in this episode. The student gets a 'feedback about the processing of the task' and also on his global performance according to the teacher's norm. The teacher, who analyses this quiz result on the spot and considers it as normal, gets information about the student's achievement.

Third episode

Sometimes the teacher's feedback is not given immediately, but during another lesson, as a result of a deep reflection, developed by the teacher, on the data at his disposal and this is the case of the third episode. When all students have completed the quiz, Thomas leads the correction of the questions with the whole classroom using NetSupport School. The lesson after, he proposes a global lecture of the class' results at the three quiz and analyses the whole set of answers stored by Maple TA, by showing them at the IWB and commenting them with the students. In this way, he provides feedback for the whole class on the attained mathematical competences.

Thomas: "*[Here are your results] on several trials. What we can see is that in calculating images you reached 0.778. What does it means? [...] about 8 successful students over 10, here. There we had 6 over 10, then 8 over 10. So we are good in calculating images. [...] I'm not going further. However, we'll come back on determining the expression of a linear function. 0.1, you see 0.1, 0.3, and here we went down at 0.2. [...] I would like to get to realise if I succeed in teaching you two or three things last time, so we are going to work again on these two questions. Open Maple TA, and answer the two questions of the day. Let's go.*"

Thomas analyses the class' results and he *clarifies the learning intentions and criteria for success*. He has worked again with the students on the required competences during the correction phase, and now he wants to test again the competences revealed as not achieved by the analysis of the results, namely competences (b) and (d). Thus, he *engineers other learning tasks* on Maple TA. Two new questions are properly prepared and sent to students as a result of this dynamics. From Thomas' words, we can observe that, as he expected in the first episode, he has adapted his teaching depending on students' progressive achievement.

More generally, relatively to FA strategies, Thomas orchestrates the use of technology in direction of individual students, of the whole classroom or even of himself. Instrumental orchestration helps him in refining his FA strategies. Indeed, analysing students' data in order to share and discuss results in the classroom or to send new learning tasks to the students allows him to choose the most powerful FA strategy according to students' mastering of the competences at stake.

An example from the Italian case studies

In Italy the FaSMEd project involves 19 teachers, from three different clusters of schools located in the North-West of Italy. 12 of them work in primary school (grades 4-5) and the other 7 in lower secondary school (grades 6-7). Within the project, all the teachers work on the same mathematical topic: functions and their different representations (symbolic representations, tables, graphs).

Low-achievers are identified mainly through the teachers' assessment, and attend regular classes with the other students, because (as in France) schooling is based on mixed ability classes.

A research hypothesis of our team is that low achievement is linked not only to lack of basic competences, but also to affective and metacognitive factors. Furthermore, another important assumption is that argumentation can be exploited as a formative assessment tool in the interaction between the teacher and the students. As a consequence, we believe it is important that during class activities students should be guided to: (a) develop ongoing reflections on the teaching-learning processes; (b) make their thinking visible (Collins, Brown and Newmann 1989) and share it with the teacher and the classmates; (c) highlight their affective pathways (De Bellis & Goldin, 2006).

Starting from these assumptions, when we planned our work within the FaSMEd project, we looked for a technology that could support the teachers in the sharing of students' screens and of their ongoing and final written productions and in the collection of students' opinions and reflections both during and at the end of each activity. We chose connected classroom technologies, i.e. networked systems of personal computers or handheld devices specifically designed to be used in a classroom for interactive teaching and learning (Irving, 2006). They both enable to share the ongoing and final productions of the students, and to collect their opinions during the activities and at the end of them (Irving 2006, Roschelle et al. 2004, Shirley et al. 2011). Specifically, we chose the IDM-TClass classroom software, which allows the teacher to: (a) show, to one or more students, the teacher's screen and also other students' screens; (b) distribute documents to students and collect documents from the students' tablets; (c) create different kinds of tests and have a real-time visualization of the correct and the wrong answers; (d) create instant polls and immediately show their results to the whole class. Moreover, the students' written production can be displayed through the data projector or the interactive whiteboard.

Each school has been provided with tablets for the students (who work in pairs), computers for the teachers and, where the interactive whiteboard was not available, a data projector. The students’ tablets are connected with the teachers’ laptop through the IDM-TClass software. During the teaching-experiments, the teachers use this technology for the first time, and one researcher is present both to collect data and to help the teacher to carry out the activities.

The teaching experiments integrate the connected classroom technologies within activities coming from different sources. Among them, the ArAl Units, which are models of sequences of didactic paths developed within the project “ArAl – Arithmetic pathways towards favouring pre-algebraic thinking” (Cusi, Malara & Navarra 2011). In particular, for each lesson we prepared a set of different worksheets that can be sent by the teacher to the students’ tablets. Each lesson is organized with the aim of (a) supporting the students in the verbalisation and the representation of the relations introduced within the lesson; (b) enabling them to compare and discuss their answers; (c) making them reflect at both the cognitive and metacognitive level.

In this paper we analyse an excerpt from a grade 5 class discussion referred to the following worksheet:

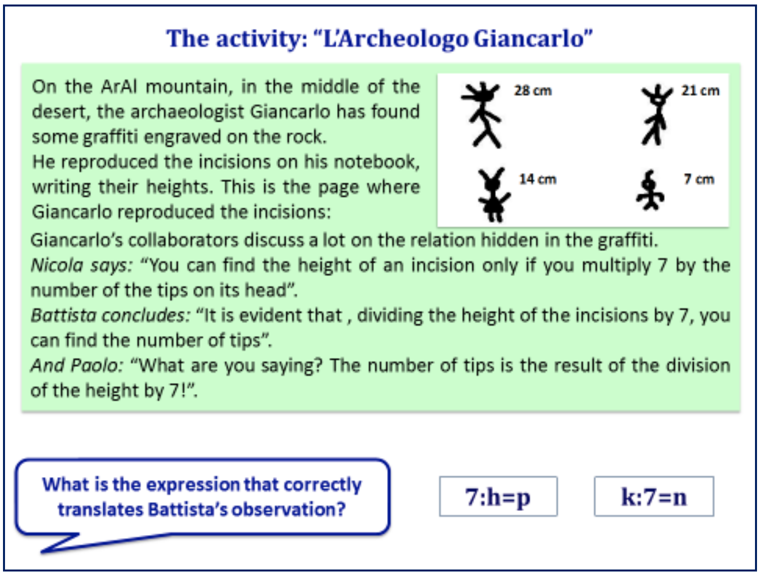

Fig. 3: The worksheet provided to students.

During the lesson reported in this example, the students, who work in pairs, are asked to answer to the question in this worksheet through a poll.

The IDM-TClass software collects all the students’ answers and processes them, displaying an analytical as well as a synthetic overview (bar chart) to the teacher. Using the software the teacher can choose to provide or not an immediate automatic correction of students’ answers (right/wrong). We (the teacher and the researchers) decided not to provide this correction. The software enables also to choose the time given to students before completing the poll. In this case, students had 6 minutes at disposal.
During the lesson, when all the students answer to the question, the teacher (Monica) shares with them her screen, where the bar chart and the list of students’ answers are displayed:

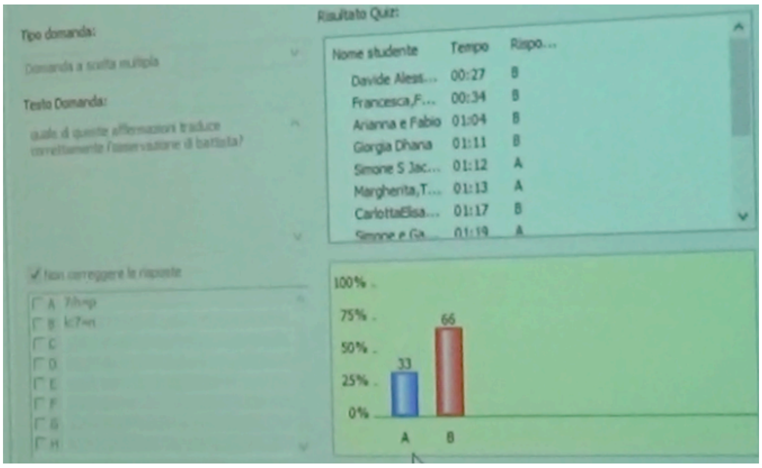

Fig. 4: The teacher's screen shared with the students.

The worksheet is also projected on the interactive whiteboard, next to the poll.

The software's processing of the poll's data enable to highlight that the 33% of the students chose the answer 7:h=p, while the 66% of the students chose the answer k:7=n. The names of the students and the corresponding answers are also displayed.

The teacher chooses not to tell to the students what the right answer is, and asks to the different pairs to explain why they chose a specific answer. The class discusses on the possible strategies that could be used to identify the correct expression, in case the only reading of Battista's observation is not enough. The students are invited to check if the number of tips and the height of every incision verify the two expressions. Some students are asked to substitute, in the two expressions, the different values connected to each incision (4,28; 3,21; 2,14; 1,7). One of them observes that she discarded expression A because the result of the division 7:28 is not 4. Alice, softly, says that 7:7=1. Monica asks her to explain what she means. We report the related excerpt:

Transcript from the class discussion focused on the results of the poll
1. Teacher (*to Alice*): "What were you saying?" 2. Alice: "I was saying that, for example, the figure, the one on the bottom right, is 7cm, so 7:7 is 1, therefore the result is not a decimal number, while with the others (*the other figures*) it is (*the result is a decimal number*). …
Monica focuses on Alice's observation and states that the chosen expression should represent all the incisions, not only the first one. Lisa and Nicolò ask if they can change their mind.
9. Teacher: "Have you changed your mind? That is, Lisa, you chose answer A, but now you have changed your mind. Why?" 10. Lisa: "Ahem … 7 is only that figure. While, if you divide the height by 7, you mean all the figures." …
Another student, Jack, declares that, although h in Italy always stands for the height, in the expression "7:h=p" h does not refer to the height.
14. Teacher: "It does not refer to the height. Is it right, Lisa?" 15. Nicolò (*raising his hand*): "Monica, because h refers only to one (*height*), while k…" 16. Lisa: "Both (*the letters*) … (*Nicolò is speaking*)…no, wait! (*to Nicolò*)"

17. Teacher: "One at a time"

18. Lisa: "Both the letters are always the height, but h is only for one (*height*) … only for this one (*Lisa goes near the interactive whiteboard to indicate the incision 7 cm height*), while k is valid for all (*the incisions*)."

19. Teacher: "k is valid for every incision. (*Stefano is raising his hand*) Stefano?"

20. Stefano: "The first expression … No, I mean: the second expression is more correct than the first. Battista says … where is it? (*Stefano is trying to find Battista's statement*) 'It is evident that dividing by 7'. It is 'Dividing by 7', not 'dividing the height'… that is …

21. Teacher: "Dividing 7 by …the height" …

Dialogue between Monica and Amalia, who observes that Lisa's interpretation of the two expressions is right and declares that, after having listened what Lisa and Nicolò said, she realised that the expression could be interpreted in different ways. Nicolò asks to intervene.

36. Nicolò: "In the first statement (*he is referring to the first expression*) 7 is divided by the height. Instead, in the second (*expression*) the height is divided by 7!"

37. Teacher: "Very good! So … Many times, I realised that many times it is not the same thing. It is necessary to pay attention. It is necessary to think very carefully to what is written. Exchanging, inverting the numbers is not the same thing." …

The FA process '*establishing where the learners are in their learning*' is central in this lesson: the discussion is planned in order to support the students in making the motivations of their choices explicit. This enables to highlight erroneous ways of reasoning and incomplete explanations, but also to highlight the evolution of students' reasoning, together with the way in which it is influenced by the other students' interventions. For example, it is evident how Lisa and Nicolò, two low-achiever students, are *activated as owners of their own learning* during the discussion: they ask to correct their initial answers, effectively motivating their new choice (from line 10). Moreover, it is possible to highlight examples of the *activation of students as instructional resources for one another*. Lisa (lines 10 and 18), for example, refers to Alice's intervention (line 2) and elaborates it to start developing her own argumentation. Also Nicolò (line 36) refers to Stefano's intervention (line 20) and elaborates it.

Another FA process that is central in this lesson is '*establishing what needs to be done to get them there*': the teacher intervenes to highlight the most effective ways of reading symbolic expressions and of identifying the one that better represents the involved relations, providing also guidance on how to read the tasks and the texts of the problems (line 37).

Different kinds of feedback are given during this discussion. In particular, it is possible to highlight feedback related to two of the four categories proposed by Hattie and Timperley (2007): feedback about the task and feedback about the processing of the task. Students' explanations of the reasoning on which their choice was based represent an example of *feedback about the task*, which is given among peers, because of the different levels of effectiveness of these explanations. For example, Stefano's intervention (line 20), which highlights that the expression 7:h=p does not represent Battista's sentence because, in the symbolic expression, 7 is divided by the height and not vice-versa, represents a feedback for Nicolò, who refers to Stefano's statement, clarifying it in an effective way (line 36).

The teacher's meta-level intervention in line 37 aims at sharing criteria to correctly identify the expressions that better represent specific relations among quantities: it can be interpreted as *feedback about the processing of the task*. This is also an example of the teacher's exploitation of feedback from the students, because Nicolò's statement (line 36) provides the teacher the opportunity to discuss the importance of a careful interpretation of symbolic expressions (line 37).

Another example of this kind of feedback is Alice's intervention (line 2), which introduces the special case of the 7cm figure, enabling Lisa to understand her mistake and ask to change her answer, proposing motivations (line 10, line 18) that clearly refer to Alice's observation.

As already stressed, starting from the poll, the teacher has organized a rich discussion, which enables the activation of different FA strategies by the different agents. The technology plays an important role in supporting the agents involved in these processes, in particular in providing feedback to each other. First of all, the software elaboration of the data and the graphical representation of the results of the poll give the teacher the chance to ask for the interpretation of these results and to plan the order of students' interventions during the discussion (Monica decides to start the discussion involving first those who have given the wrong answer).

The teacher's choice of not providing, to students, an immediate automatic correction of their answers may represent a support for students at different levels: (a) it enables to focus on the explanations of the answers, more than on the identification of the correct answer; (b) it pushes the students to motivate their answers; (c) at the affective level, the lack of a written evaluation ensures that the students do not feel worried when they comment upon their choices.

Finally, the long time given (6 minutes) to students to choose their answer enables them to reflect, in pairs, on the motivations on which their choice is based. The moment that precedes the answer to the poll is, therefore, preparatory to the subsequent discussion.

Conclusion

The observations in the classrooms show clearly the contribution of FA in the teaching and learning processes. Moreover, the technology appears as a medium facilitating the different FA strategies but also the dynamics between these strategies. It is possible to '*clarify learning intentions and criteria for success*' also without technology but technology allows to display these intentions and to share with students as a class or with the student as an individual. '*Engineering effective classroom discussions and other learning tasks that elicit evidence of student understanding*' is also facilitated by giving the opportunity of '*providing feedback that moves learners forward*' on the spot as well as after reflection. The possibility given by technology to store data and the ease to come back to these data is an important functionality that teachers can use to enhance their teaching strategies. As recognised also by the teachers in the interviews, technology is not at the base of FA, but appears as an essential tool to improve the effects of FA for students and for teachers as well.

Concerning students, it appears that the strategies of '*activating students as the owners of their own learning*' and '*activating students as instructional resources for one another*' constitute the core of FA, since they enable the active involvement of all the participants (teacher, students, peer/group) within the FA process. These strategies are also facilitated by the instrumental orchestration and the possibility given to students to use technology regarding the particular moment of FA at stake.

Our analysis brings to the fore the crucial role of the teacher as a guide in FA lessons with technology. When we began the project, most of the involved teachers stated that FA was present in their practices. However, most of the time, FA was not developed over time and appeared occasionally in the classroom more as a reassuring method than as a teaching strategy. Professional development is surely a big issue of the next years in order to consider technology as a tool enabling the enhancement of teaching strategies including FA.

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