FAMT&L

FORMATIVE ASSESSMENT IN MATHEMATICS FOR TEACHING AND LEARNING

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Executive summary

This document is an Analysis Report including the methodology and the results of the survey for the beliefs and conceptions of teachers and students about formative assessment in mathematics and directions for the pilot training courses aiming to improve beliefs emerged in survey.

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About the document

This document is an Analysis Report including the methodology and the results of the survey for the beliefs and conceptions of teachers and students about formative assessment in mathematics and directions for the pilot training courses aiming to improve beliefs emerged in survey. This report includes information collected from the literature, projects, studies, conference proceedings. Its content is be based also on the outcomes of the analyses of quantitative data collected from mathematics teachers and students in the country of each project partner. Based on the empirical results emerged from the survey and the results of the literature review directions for the pilot training courses (WP4) aiming to improve teachers' conceptions and beliefs about formative assessment in mathematics are be drawn.

Regarding the data collection there were some difficulties and limitations. In particular, details are provided about the partners from the Netherlands. The University of Applied Sciences Inholland acts as a partner in the research project FAMT&L. During the first months of the project there was an internal reorganisation. This had a big effect on the participating employees. Although it was clear there would be a reshuffle, it took quite some time before it was clear who would be participating in the project. As a result the start up of the project was delayed.

Furthermore, it took longer than previously anticipated to find teachers at schools willing and able to participate as research-partner in the project. As the school year 2014 – 2015 had already started most of the teachers were given their tasks and assignments. This meant that it was hard to find teachers who had any time left in their schedule to give their contribution. Other contributing factors in the difficulties of finding partners in schools are that the government has made mandatory changes in the examination of mathematics what resulted in the introduction of a new school subject (basic calculations) and a new program for the nationwide exams in mathematics. A lot of time and energy of colleagues at the schools in Holland is used for the preparation and implementation of these changes. This will take up to five years. As a consequence not many schools and teachers are eager to take on more work in research as this would be another amount of work resting on the shoulders of the same teachers implementing the nationwide changes. Schools give priority to these because this has a direct effect on the education of the students and their examination. All these factors contributed to the fact that the results from the questionnaires could be analyzed at a much later date than planned. Another consequence is that especially the response from teachers was very low. For this reason, no report about

the teachers' results is included, but only the results of the implicative analysis, just for presenting some indications about the teachers' thoughts in this country.

INFORMATION COLLECTED FROM THE LITERATURE, PROJECTS, STUDIES, CONFERENCE PROCEEDINGS.

PART A: formative assessment in the teaching and learning of mathematics

1. PURPOSE OF FORMATIVE ASSESSMENT

The National Council of Teachers of Mathematics Assessment Standard (NCTM, 1995) define assessment as "the process of gathering evidence about a student's knowledge of, ability to use, and disposition towards mathematics and of making inferences from that evidence for a variety of purposes" (p.3). In accordance to this, Harlen (2000) points out that "children have a role in assessment for this purpose since it is, after all, the children who do the learning" (p.112). That is why many researchers stress that assessment must be formed "for" learning and not "of" learning, as it is generally acknowledged that increased use of formative assessment (or assessment for learning) leads to higher quality learning (Wiliam, Lee, Harrison & Black, 2004).

In this sense, Nicol and Macfarlane-Dick (2004) argued that formative assessment should be an integral part of teaching and learning in higher education. We agree with this opinion, because of the fact that formative assessment is useful in the learning process; it explains how well the process progresses and it guides students what they wish to learn. In addition, we agree with the aforementioned opinion, emphasizing that the use of formative assessment in teaching can have many benefits on one hand on improving the students' mathematical learning but also the development of positive beliefs towards the learning of mathematics, and on the other hand in helping the teachers in doing proper adjustments according to their students' needs. Formative assessment develops fully autonomous learners, who can self-assess their work, make meaningful inferences from it and plan the next steps for further progress (Black and Wiliam, 1998). Formative assessment also provides information to teachers about students' difficulties and where to focus their teaching efforts. Our opinion is also in line with other researchers' definitions (e.g. Black and Wiliam, 1998) that stress the effects of formative assessment in modifying learning in relation to the students' needs. Van De Walle, Karp and Bay-Williams (2013) define formative assessment as "an along the way evaluation that monitors who is learning and who is not and helps teachers to form the next lesson". Wiliam (2007) claims also that "to be formative, assessment must include a recipe for future action" (p.41). Formative assessment then is a strategic process which uses evidence regarding the extent of student knowledge (declarative knowledge) and skill (procedural knowledge) to support further learning (Clark, 2011a) and as such increases student motivation, engagement and achievement (Cauley & McMillan, 2010). In accordance to this, Chappuis and Stiggins (2002) argue that formative assessment is designed to monitor student progress during the learning process (i.e., assessment for learning).

Additionally to the aforementioned focus points about the monitoring of teaching and learning, the role of feedback is also emphasized in many other definitions about formative assessment. According to such definitions, formative assessment refers to assessment that is specifically intended to provide feedback on performance for improving and accelerating learning (Sadler, 1998). Cauley and McMillan (2010) add to this by defining formative assessment as a process through which assessment elicited evidence of students' learning is gathered and instruction is modified in response to feedback. In the same sense, for Nicol and Macfarlane-Dick (2004) formative assessment, besides providing a framework for sharing educational objectives with students and for charting their progress, it can also generate feedback that can be used by students to enhance learning and achievement and by teachers for adjusting their teaching practices in order to correspond to their students' needs. Furthermore, Popham (2008) defines formative assessment as 'a process used by teachers and students during instruction that provides feedback to adjust ongoing teaching and learning to improve students' achievement of intended instructional outcomes'. It is thus obvious that formative assessment can have a powerful influence on achievement by providing meaningful feedback to students as to what they know and where they make errors or have misconceptions (Hattie, 2009). Moreover, formative assessment can be helpful for teachers too, while the formative assessment results suggest teachers how to 'modify' and 'adapt' their instructional plans according to their students' needs (Young and Kim, 2010). [P9]

Regarding to the statement saying that 'Formative Assessment is subjective while summative assessment is objective', it refers to a myth about formative assessment. Formative assessment is considered subjective while summative assessment is considered objective. According to Black and Wiliam (2009) 'formative assessment occurs during the learning process while summative happens at the end, but formative assessment is equally objective. The difference lies in how evaluative instruments are used. For example, a rubric that lists criteria for evaluating writing can be used formatively to help students understand what is expected and summatively to assign a grade. High-quality formative assessment avoids being subjective by focusing on the learning task.' Another myth related to the purpose of formative assessment argues that the purpose of formative assessment is to improve teaching. In reality, the results from formative assessment help teachers in decision making, because of the fact that it gives information about students' difficulties, what they have understand and it leads teachers to change classroom practices in order to reach instructional goals (NCTE, 2010).

High-quality formative assessment always puts student learning at the center. For this reason, formative assessment is using testing / outcomes to direct future learning of groups and/or individuals. Providing feedback to individuals on specific skill areas enhance students' learning (Century Island School, February, 1999 in Lee & Wiliam, 2005).

Summarizing, a definition combining all the points stressed previously is the one provided by Popham (2008, p.5), who characterizes formative assessment as "a process used by teachers and students during instruction that provides feedback to adjust ongoing teaching and learning to improve students' achievement of intended instructional outcomes". This definition is accepted by the Formative Assessment for Teachers and Students (FAST) group as the most accessible to educators (Clark, 2011b; Melmer, Burmaster, & James, 2008).

2. TECHNIQUES OF FORMATIVE ASSESSMENT

The second focus point for our examination is the teachers' beliefs about the use of particular techniques and practices for implementing formative assessment and about factors that influence their choice of particular techniques and practices. In fact, assessment practices and their outcomes on the students' learning, but also their affective domain have drawn the interest of different researchers in the last 30 years (i.e Crooks, 1988; Black & Wiliam, 1998). The actual methodology, data analysis, and use of the results are what distinguish the difference between formative or summative assessment and not the form that may be designed and named as formative or summative. Previous works suggest different formative assessment techniques, most of which appear to have common points. For example, Cauley and McMillan (2010) try to highlight some formative assessment techniques by comparing formative with summative assessment. They actually say that the results of summative assessment provide evidence only about the current achievement of the students, at the time the assessment is done. On the contrary, despite the fact that a summative technique can be used in formative assessment, such as a test, the results of formative assessment can provide teachers information about students' misunderstandings and use these information during their teaching in order to provide feedback to students and help them correct their errors. Cauley and McMillan (2010) provide particular techniques that should be used in teaching for the effective integration of formative assessment in instruction. Specifically, informal observations and oral questions posed to students while content is being taught or reviewed is a practice that allows ongoing formative assessment. And if the information from the observations and questions to students is accurate, the teacher identifies instructional adjustments that can help improve the students' learning. According to Bliem and Davinroy (1997) the fairness of formative assessment includes standardized tasks administered to individuals rather than groups of students. Moreover, in 2011, Clark emphasizes to teachers' comprehension and recognition about the social construction of knowledge in order to improve their students' learning. This practice leads to the professional development of classroom assessment.

From our experiences, observations and oral questions are included in the teachers' repertoire of formative assessment techniques and are very commonly used in teaching. Despite the frequency of their use, we are not sure that these techniques can be included among the most effective ones for formative assessment. However, research indicates that teachers' opinions and preferences are not totally in line with our opinion. In fact, Kyriakides and Campbell (1999) examined primary teachers' opinions about the appropriateness of particular techniques of assessment in mathematics. Performance test and structured observation were considered to be the most appropriate methods. On the other hand, unstructured observation and oral question-and-answer were seen to be the least appropriate techniques. Teachers were also asked to express the degree of difficulty of these techniques. The results indicated that unstructured observation was considered to be the easiest technique and oral question-and-answer as the next most easy. In an effort to shed some light to this contradiction, statements examining the teachers' beliefs about the appropriateness of the use of the aforementioned assessment practices were included in our questionnaire (Table 2).

Furthermore, Cauley and McMillan (2010) recognize that formative assessment does not always mean giving students a grade, while the comments on students' work can be important for students' improvement, however the absence of grade does not constitute high-quality formative assessment. Black and Wiliam (2009) claim that high-quality formative assessment takes many forms (quality, advice and guidance, not comparison and feedback), but they focus on some of them which are used in table 2 (T18). Furthermore, significant quality formative assessment can take different forms, but it always has some standards. For example, a high-quality formative assessment emphasizes the quality rather than the quantity of student work. Moreover, it targets in giving advice and guidance over giving grades, it avoids comparing students in favor of enabling individual students to assess their own learning, fosters dialogues that explore understandings rather than lectures that present information. Moreover, formative assessment encourages multiple iterations of an assessment cycle, each focused on a few issues and provides feedback that engenders motivation and leads to improvement. Nevertheless, whatever the form the formative assessment takes, it should aim acquiring the knowledge of the task rather than the student. In more detail, instead of saying "You are a great writer," a teacher who uses high-quality formative assessment will say "You used transitions very effectively in this middle section. See if you can do the same thing in the last section of the paper" (Kluger & DeNisi, 1996). The emphasis and detail provided in this type of assessment aims to give students a clear idea of what, why, and how to proceed, as they continue to work on a mission or an assignment. On the other hand, this method should be offered into manageable pieces of work so that students are not overwhelmed such processing. Formative assessment, for example, is much more efficient since focuses only on some specific features, such as the organization and transitions rather than identifying any possible review a student can do. However, students should be given more immediate formative assessment for unknown and more difficult tasks so that they don't become too overwhelmed or frustrated. When they are requested to read a new classification or a particularly hard text, for instance, answering (either orally or in writing) teachers' questions about the text can provide a clear indication of students' understanding. As a result, this will enable teachers to illuminate misunderstandings or misinterpretation and help students determine what they still need to learn (Clariana, 1990).

In addition, Cauley and McMillan (2010) stress also the power of using the practice of providing clear learning targets to the students. They explain that formative assessment is more effective when students have a clear idea about their teachers' expectations of them, because providing clear expectations enables students to set realistic and attainable goals. Thus, teachers can improve the clarity of student learning targets by providing examples of both weak and stellar work. Furthermore, such knowledge is powerful because students have a good understanding of what they are doing and why the teacher provides them feedback and these help them understand what they are learning, to set goals, and to self-assess. Although this technique was suggested by Cauley and McMillan (2010) for formative assessment in general, we consider that this practice is also important for the formative assessment in mathematics also, as the students' knowledge of their teachers' criteria allows them have a clear idea about the mathematical content they learning or the mathematical

processes, the strategies they need to develop and the way they are expected to be involved in the teaching and learning process.

The aforementioned techniques discussed by Cauley and McMillan (2010) and Kyriakides and Campbell (1999) are also found in the "Teaching Quality Papers" published by the General Teaching Council for England (2011). In fact, the General Teaching Council for England (GTCE) considers the effective use of questioning techniques, the use of marking and feedback strategies, the sharing of learning goals to students and peer and self-assessment by pupils to be key characteristics of formative assessment. As a result, such policies generate a classroom climate of low-control and high-autonomy, which in turn catalyzes greater congenial motivation, stronger desire to learn, and desire for challenge (Deci, Nezleck and Sheinman, 1981).

The GTCE provide also a number of techniques, which embody these key characteristics. Some of these techniques include sharing learning goals with pupils (Turner, Warzon and Christensen, 2010, p.5), helping pupils know and recognize the standards to aim for, providing feedback that helps pupils to identify how to improve and pupils learning self-assessment techniques to discover areas they need to improve. Black and Wiliam (2009) highlight that self-assessment by pupils, far from being a luxury, is in fact an essential component of formative assessment. When anyone is trying to learn, feedback about the effort has three elements: redefinition of the desired goal, evidence about present position, and some understanding of a way to close the gap between the two. All three must be understood to some degree by anyone before he or she can take action to improve learning.

It should be comprehensible that formative assessment lessons are necessarily less dogmatic and as a consequence the students are energetic and active participants in the co-construction of the learning procedure. Students may be motivated to capture with an activity by writing the issue on the board as a question and then using cooperative learning groups to consider and debate how the answer may be found (AAG/APMG, 2002-2008). More specifically, Clark (2011) provides a richer list of sixteen formative assessment-teaching techniques, suggesting that these techniques engage students in reflective thinking and problem solving. Among these sixteen techniques, higher order questioning techniques, feedback for students as comments and not grades, oral feedback to students, sharing assessment criteria with students, peer-assessment and collaborative goal setting with and by students are included. Thus, the strategies used in formative assessment aid creative social behavior because the learning situation is one of mutually helpful interaction and positive interdependence among students (Johnson & Johnson, 1996). It is obvious that the techniques suggested by Clark (2011) are also found in the previous suggestions that were discussed. Therefore, we can see that there is a general agreement between the different researchers in the techniques they consider as important for the effective implementation of formative assessment in the mathematics classroom.

Another one issue, which impacts teachers' techniques in formative assessment, is related to teachers' prediction of students' outcomes. According to Muijs and Reynolds (2001), there exist some factors that may form teachers' expectations about their students' future assessment. These factors are described in table 2 (T19).

Nevertheless, Black and Wiliam (2009) list some factors that promote formative assessment in the classroom. More specifically, they refer to understanding and articulating in advance of teaching the achievement targets that their students are to hit, informing their students about those learning goals, in term that students understand, from the very beginning of the teaching and learning process, becoming assessment literate and thus able to transform their expectations into assessment exercises and scoring procedures that accurately reflect student achievement, using classroom assessment to build students' confidence in themselves as learners and help them take responsibility for their own learning, so as to lay a foundation for lifelong learning, translating classroom assessment results into frequent descriptive feedback (versus judgmental feedback) for students, providing them with specific insights as to how to improve, continuously adjusting instruction based on the results of classroom assessments, engaging students in regular self-assessment, with standards held constant so that students can watch themselves grow time and thus feel in charge of their own success, and actively involving students in communicating with their teacher and their families about their achievement status and improvement. In short, the effect of assessment for learning, as it plays out in the classroom, is that students keep learning and remain confident that they can continue to learn at productive levels if they keep trying to learn. In other words, students don't give up in frustration or hopelessness.

Last but not least, Brown (2004) claims that any assessment strategy that aims to be *inclusive* should establish a range of techniques for assessment (for example written assignments, presentations, reflective accounts and so on), so that the same students are not always impoverished. All participants need to be provided with *the same opportunities* to show their abilities and potentials. This indicates that the assessment criteria need to be clear, explicit, framed in language that is worthwhile to staff and students and available well in advance of the beginning of activities that will eventually be assessed.

3. THE EFFECTIVE USE OF FORMATIVE ASSESSMENT RESULTS

3.1. The use of feedback

Feedback is an important dimension of formative assessment, either as provided by teachers to students through questions, comments etc., by students to the teacher, or by students between them or, in relation to self-assessment and peer-assessment practices. Thus, the use of feedback as a result of formative assessment is included in our third research question about the teachers' beliefs about the way the results of formative assessment can be used effectively.

It is noteworthy that feedback is not always formative, but there are some factors which determine when the feedback becomes formative. More specifically, feedback becomes formative when students a) are engaged in a process which focuses on meta-cognitive strategies, b) are supported in their efforts to think about their own thinking, c)

understand the relationship between their prior performance, their current understanding, and clearly defined success criteria, and d) are activated as owners of their own learning (Clark, 2011a).

Assessment considered as a way for sharing educational objectives with students and for charting their progress. It generates feedback information that can be used by students to enhance learning and achievement. This feedback information is also helpful to teachers in order to re-align their teaching according to their students' needs. When assessment serves these purposes it is called 'formative assessment'. It is argued that formative assessment should be an integral part of teaching and learning process (Nicol and Macfarlane-Dick, 2004).

The power of feedback becomes evident in different definitions of formative assessment that highlight the importance of integrating feedback in instruction. For example, Sadler (1998) refers to formative assessment as specifically intending to provide feedback on students' performance for improving and accelerating their learning. In line with this opinion, Cauley and McMillan (2010) explain that by showing the students specific misunderstandings or errors that frequently occur in a content area or a skill set, and showing them how they can adjust their approach to the task, students can see what they need to do to maximize their performance. As a result, feedback to students that focuses on developing skills, understanding, and mastery, and treats mistakes as opportunities to learn is particularly effective for their progress in learning and gives students hope and positive expectations for themselves. Besides the focus on the positive effects of providing feedback to students, researchers emphasize also on gaining feedback from students about their learning and understanding. Actually, Hattie (2009) adds that a powerful influence of formative assessment on achievement is the meaningful feedback from students as to what they know and where they make errors or have misconceptions. Therefore, formative feedback is benefit both to students and to teachers. Feedback on performance, in class or on assignments, enables students to restructure their understanding /skills and enhance their ideas and capabilities (Nicol and Macfarlane-Dick, 2004). For this reason, formative feedback is crucial. It is very important formative feedback to be detailed, comprehensive, meaningful to the individual, fair, challenging and supportive (Brown et al., 1994).

However, not only the teacher can provide feedback information, but peers often provide feedback. For example, in group-work contexts, students generate their own feedback while engaging in and producing academic work (Nicol and Macfarlane-Dick, 2004).

Despite the fact that providing feedback to students occurred as one of the formative assessment techniques in the previous session, in this section we focus on feedback in the sense of incorporating the information and results of feedback for improving the students' teaching and learning. Therefore in this section we discuss about how feedback should be provided, referring to how and when it should be provided and what the results of providing effective feedback to students are. Nicol and Macfarlane-Dick (2004), suggest that the good feedback practice facilitates the development of self-assessment (reflection) in learning, encourages teacher and peer dialogue around learning, helps clarify what good performance is (goals, criteria, expected standards), provides opportunities to close the gap

between current and desired performance, delivers high quality information to students about their learning, encourages positive motivational beliefs and self-esteem and provides information to teachers that can be used to help shape the teaching. In order to be able to benefit in the aforementioned ways, these researchers provide also suggestions drawn from research about particular strategies that increase the quality of feedback, in relation to the way and the time feedback should be provided. Specifically, these strategies include making sure that feedback is provided in relation to pre-defined criteria (paying attention to the number of criteria) providing feedback soon after a submission, providing corrective advice not just information on strengths/weaknesses, limiting the amount of feedback so that it is used, prioritizing areas for improvement and focusing on students with greatest difficulties. Furthermore, Nicol and Macfarlane-Dick (2004) suggest some good examples of feedback dialogue in class which include (1) providing feedback using one-minute papers (Cross and Angelo, 1990), (2) reviewing feedback in tutorials where students are asked to read the feedback comments they have been given and discuss these with peers, (3) asking students to find one or two examples of feedback comments that they found useful and to explain how they helped. Other ways of using feedback dialogue in a planned way, for assignments, might involve (1) having students give each other descriptive feedback on their work in relation to published criteria before submission and (2) group projects.

Sadler (1998) raises an important issued regarding the use of feedback, turning the focus on the way the students can reclaim and benefit from feedback. He identifies three conditions necessary for students to benefit from feedback. In particular, the student must possess a goal or standard level for the concept acquisition, compare the actual level of performance with that goal or standard and engage in appropriate action, which leads to some closure of the gap. He also notes that for feedback to act, the teacher has to provide a verbal statement about the quality of the students' work (the reasons for the judgment and ways in which some of the shortcomings could be remedied). Therefore, students should also be trained in how to interpret feedback, how to make connections between the feedback and the characteristics of the work they produce, and how they can improve their work in the future. Sadler (1998) successfully claims that we cannot simply assume that when students are given feedback they will know what to do with it. This is indeed an important factor to take into account when providing feedback to students, in order not only to provide comments about their performance or errors, but also to include particular suggestions and solution about ways that can help the students overcome their weaknesses and improve themselves. Further, Ames (1992) recommends that feedback should be private, must be linked to opportunities for improvement, and should encourage the view that mistakes are a part of learning. Nevertheless, it would be significant to help students to understand not only where they have gone wrong, but also what they need to do to improve. The positive feedback when they have done well is essential in order to help them understand what is good about their work and how they can build on it and develop further.

3.2. The use of students' errors

The use of students' errors is an important dimension of formative assessment, as it helps the teachers modify their practices for helping the students correcting them, but also the students in identifying their weaknesses and try overcoming them. We strongly agree with this, thus in this section the important of using and interpreting the students' errors is going to be discussed emphasizing on the role of the teachers' beliefs about errors, which is a part of our objectives for our project when examining the teachers' beliefs for formative assessment. Wragg (2001) supports that "if students are to learn from their assessment, then correction of errors and discussion of what they have done is essential" (p.74). This strengtheners our opinion about the significance of studying teachers' beliefs regarding the origination of the students' errors, as these beliefs can affect the way the teachers will decide to discuss about errors and work with them for helping the students overcoming them.

In fact, the identification of mistakes helps teachers decide how to identify and meet pupils' learning needs and how to use their teaching time and their resources (Kyriakides, 1999). The reason on which the teachers attribute the errors will affect their decisions for their future intervention teaching practices. Therefore, the students' errors can have a formative use, as the teachers can exploit this information for modifying their future actions (Gagatsis & Kyriakides, 2000). Thus, decisions about the next learning steps follow from the formative identification of pupils' errors (Desforges, 1989). And this is particularly important, because a teaching plan which is organized in such a way, might help teachers to plan class and individual programs of work according to the different performance levels of the pupils (Gagatsis & Kyriakides, 2000).

Therefore, in order to be able to provide suggestions through our project towards the effective formative use of students' errors we have to get an insight to the teachers' beliefs about the source of these errors. By encouraging the analysis of pupils' errors in the training model we plan to develop, we can enable teachers to seek specific information about individual pupils' thinking and understanding and then adjust the level of content to match individual pupils' performance levels. A number of studies (Milhaud, 1980; Charnay, 1989; Economou, 1995) revealed that teachers attributed errors mainly to the pupils' lack of interest or lack of preparation. Gagatsis and Christou (1997) examined also the extent to which the didactical and epistemological approaches to the concept of error influence teachers' attitudes investigated. They actually examined the interpretations that primary school teachers give about their pupils' errors. The results of their study showed that the majority of teachers hold similar beliefs. For example, 90% of primary school teachers attributed errors to the psychological situation of the pupil, 80% of the teachers attributed errors to the limited capabilities of the pupil, and 85% considered the lack of knowledge as a reason for errors. Gagatsis and Kyriakides (2000), examined not only whether teachers agreed with aspects of the didactical and epistemological approach to the concept of error but also whether they could identify errors of their pupils associated with the concepts of obstacle and didactic contract. In their study, teachers' responses revealed that items concerned with reasons for errors can be classified into four broad categories. These are pupils' characteristics, teachers' role, the mathematical knowledge, and the rules which

pupils are supposed to follow in a typical mathematics classroom. The first factor is related to items which imply that errors are a negative behaviour. Errors are seen as the result of "confusion" (Economou, 1995) and thereby pupils' lack of interest and/or preparation are the main reasons for errors. The second factor is concerned with the role that the teacher has to play in order to enable pupils to avoid mistakes, and is very significant educationally. A significant contribution of this study to educational theory on reasons associated with mathematical errors has to do with the other two factors which emerged. More specifically, the items associated with the third factor partly derive from the epistemological approach to the concept of error and especially with the concept of obstacle. Finally, the fourth factor is highly correlated with items concerned with the concept of didactic contract.

The survey, also, showed that teachers supported that errors in mathematics are often associated with the characteristics of the pupils. This seems to be in line with the findings of a number of studies (i.e Charnay, 1989; Economou, 1995; Milhaud, 1980) which revealed that teachers attributed errors mainly to the pupils' lack of interest or lack of preparation. Finally, the teachers considered error analysis as a significant way of improving their teaching practice.

4. FORMAL AND INFORMAL FORMATIVE ASSESSMENT

Formative assessment can be distinguished in two dimensions. More specifically, it can be formal-a planned act designed to provide evidence about students learning, or informal-where students learning is evident during the course of a teacher' s daily activities (Bell & Cowie, 2001; Duschl, 2003; Shavelson et al., 2003). Each type can be characterized in a different manner. In particular, in formal formative assessment information is obtained based on the whole class. It usually begins with students carrying out an activity designed or selected by the teacher so that information may be more precisely collected. The activity allows teachers to focus on key points during instruction, check student understanding (interpreting), and design more targeted the next steps that they must take in order to develop their students' further learning (acting). In usual, formal formative assessment practices take the form of curriculum embedded assessments. These practices focus on some specific aspect of learning, such as students' knowledge about why objects sink or float. Furthermore, formal formative assessment can take the form of direct questioning, quizzes, brainstorming, generation of questions, and the like (Bell & Cowie, 2001). The implementation of this type of assessment is planned in advance by the teachers and it can be conducted at the beginning, during, or end of a unit.

The second type of formative assessment -informal formative assessment- can take place in any interaction between teacher and his/her students. Informal formative assessment can happen anytime and it can also engage whole class, small group or individual interactions, which means that it may occur from any instructional/learning activity (gathering). Therefore, it is embedded and strongly linked to learning and teaching activities (Bell & Cowie, 2001, p. 86). Informal formative assessment not to be planned in

advance, because it can happen at any time and there is no specific activity designed for students; however, teachers have the potential to be prepared in advance for this type of formative assessment. Thus, teachers cannot predict exactly when they will be able to gather evidence about students understanding during the lesson of non-planned activities, but they can give students varied opportunities for doing so (e.g., by creating more interactions in class, group discussions, or informal observations). The information gathered during informal formative assessment such as students' comments, responses and questions is impermanent (Bell & Cowie, 2001) and many times is not recorded. Informal formative assessment can be distinguished as verbal or non-verbal. Students' questions are considered as verbal informal formative assessment, while teachers' observations are considered non-verbal informal formative assessment. The time frame for interpreting and acting is more immediate when compared with formal formative assessments. A students' wrong answer or unexpected question can guide to an assessment event which helps teacher to identify a student's misunderstanding. Then, the teacher helps student to overcome his/her misunderstanding using different methods such as responding with a question, eliciting other points of view from other students, conducting a demonstration when appropriate or repeating an activity. Nevertheless, both types of formative assessment (formal and informal) involve gathering, interpreting, and acting on information. The difference between formal and informal formative assessments lies in how much planning is done and the type of planning required. The interpretation and the acting aspects of the process of the two types of formative assessment are determined by two critical factors –teacher content knowledge and pedagogical content knowledge. The figure below (Figure 1) provides a schematic representation of the two types of formative assessment and gives information about the relationship between them. The processes involved in formal and informal formative assessment are determined using different words like 'gathering, interpreting, and acting' for formal formative assessments and 'eliciting, recognizing, and using' for informal formative assessments (Ruiz-Primo & Furtak, 2004). Other authors have used different names to describe the same processes (Bell & Cowie, 2001; Duschl, 2003). The black boxes between units in Figure 1 represent specific points in the curriculum in which the formal formative assessments are implemented. Both formal and informal formative assessments are connected through the general purpose for formative assessment. The continuous line between the units and informal formative assessment is intended to indicate the continuous nature of this type of assessment.

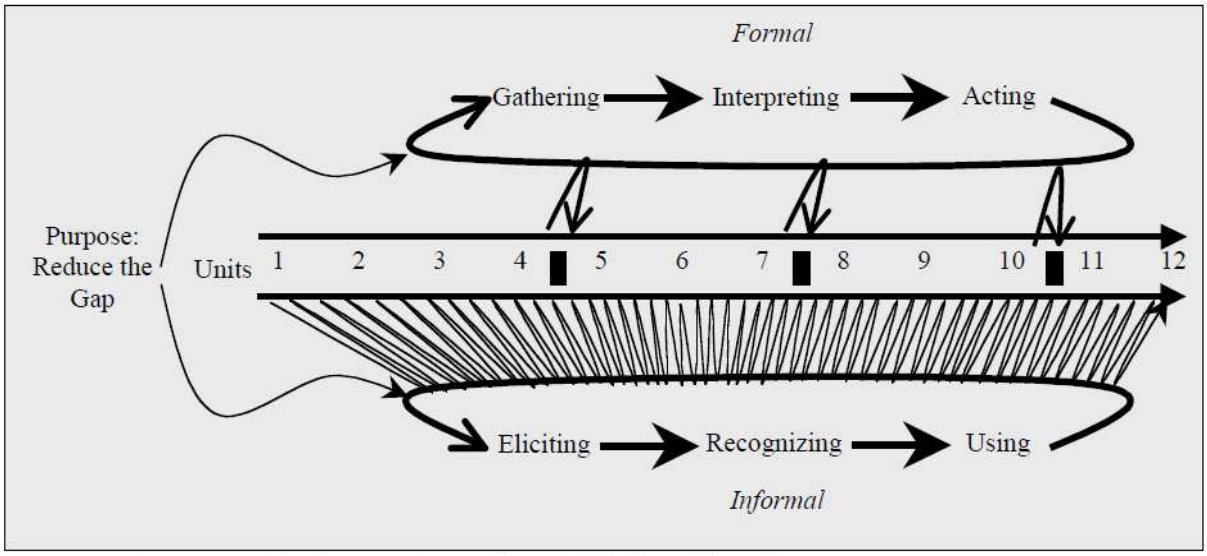

Figure 1. Graphical representation of formal and informal formative assessment.

A basic method/strategy of informal formative assessment which improves students learning is informative questioning (Furtak and Ruiz-Primo, 2005). Informative questioning as assessment for learning in the context of inquiry, gives students information about the correctness or failure of their responses and focuses students' attention on their correct answer, rather than allowing them to explore how they are coming aware of what they know (Duschl 2003). Teachers should avoid the method of asking a question, receiving a response from a student, evaluating the answer, and moving quickly to the next question. Informative questioning is beneficial both students and teacher. In specific, the targeted actions possible in the informative questioning cycle can help students to understand more clearly how they are thinking about concepts and processes and to lead them to reach inquiry learning goals. As regards the teacher, informative questioning helps him/her to understand students' thinking and provides a basis for action. Moreover, practicing informative questioning is practicing high quality informal formative assessment, which improves student learning. Ruiz-Primo and Furtak (2004) claim that when teachers use informative questioning their students have better performance on several types of formative embedded assessments (e.g., predict-observe explain, open-ended questions) and summative assessments (e.g., performance assessments, predict-observe-explain, open-ended questions) aligned with the learning goals of their curriculum.

Some other strategies are organized by the informal formative assessment characteristics (i.e., eliciting, recognizing, and using information) and the three domains (i.e., epistemic frameworks, conceptual structures, and social processes). The strategies reflect the questions that teachers may ask students to elicit information and the teacher actions that may reflect the recognition and use of information (Ruiz-Primo and Furtak, 2004). Examples of these strategies are presented in the table below (Table 1).

Table 1.

Strategies for Recognizing and Guiding Assessment Conversations by Dimension and Informal Formative Assessment Components.

	Eliciting	Recognizing	Using
Epistemic Frameworks	**Teacher asks students to:** Apply procedures involved in science Provide responses not based on observations Share/Provide observations Make predictions/ Provide hypotheses	**Teacher** - Clarifies/Elaborates based on students' responses -Takes votes to acknowledge different students ideas - Compares/contrasts students responses to acknowledges and discuss alternative explanations conceptions - Repeats/paraphrases students words	**Teacher** - Promotes argumentation/ Helps students to achieve consensus - Helps relate evidence to explanations - Provides descriptive or helpful feedback - Promotes making sense
Conceptual Structures	**Teacher asks students to:** Provide potential or actual definitions Apply, compare/ contrast concepts Elaborate their responses Share students thinking/ classroom	**Same as Above**	**Same as Above**
Social Processes	**Teacher asks students to:** Share everyday experiences related to	**Same as Above**	**Same as Above**

	current discussions		
	Share responses not based on observations (e.g., from homework)		
	Share students thinking/ classroom presentations		
	Share/Provide observations		

5. SUMMARY OF FRENCH PUBLICATIONS ABOUT FORMATIVE ASSESSMENT

In this section we present some research related to the formative assessment that were conducted in France in order to approach this topic from French scope/view too. First of all, we judge appropriate to refer that the initial conception of formative assessment which proposed by Bloom has been enlarged in several directions by researchers working in French. A description/presentation of the main orientations of this enlargement follows.

In the initial conception of mastery learning proposed by Bloom (1968; Bloom et al, 1971), an instructional unit is divided into several successive phases. First of all, teaching/learning activities are related with the objectives of the unit. When students complete these activities, a formative assessment, is proposed to the students. The results of the assessment provide feedback both to the teacher and students and are used as a means for determining corrective measures for students who appeared to have difficulties in the concepts were taught. Additional exercises, different types of instructional material (eg,, verbal vs. visual representations), small-group discussions and computer-based tasks are some forms of the correctives. Nevertheless, in all these cases the aim remains the remediation of learning difficulties identified by formative assessment. All these phases (teaching, testing, remediation) are planned, prepared and managed by the teacher whose goal is to help all the students to master the objectives of the unit.

The characteristics of an enlarged perspective of formative assessment are frequently lie in contrast with those of the approach initially defined by Bloom, as several authors report (in particular, Allal, 1979, 1988; Perrenoud, 1998). In particular, the enlarged perspective supports the integration of formative assessment within each instructional activity, which means that the materials of the assessment should be diversify. In addition to paper-pencil tests, quizzes or worksheets designed to verify whether students understood the content of a lesson, assessment is carried out informally. Teacher's observation, exchanges among students (reciprocal assessment) at various points during an instructional activity, and whole-class discussions are some informal assessment methods.

Thus, a distinction was subsequently made between three modalities of regulation associated with formative assessment (Allal, 1979, 1988): interactive regulation, retroactive regulation and proactive regulation. *Interactive regulation* occurs when formative assessment is based on the interactions of the student with the teacher or other students and/or with material allowing self-

regulated learning. Interactive regulation contributes to the progression of student learning by providing feedback and guidance that stimulate student involvement at each step of instruction. *Retroactive regulation* occurs when a formative assessment is conducted after completion of a phase of teaching and allows identification of the instructional objectives attained or not attained by each student. The feedback from the assessment leads to the selection of means for correcting or overcoming learning difficulties encountered by some students. It corresponds to the notion of remediation present in the initial conception of formative assessment defined by Bloom. *Proactive regulation* occurs when different sources of information allow the preparation of new instructional activities designed to take into account differences among students. Innovative approaches to formative assessment often combine these three types of regulation.

The difference between the Bloom's initial conception of formative assessment and an enlarged conception lies in the teacher's role. In specific, in Bloom's conception of formative assessment, the teacher is responsible for the planning and management of each assessment operation, while in an enlarged conception, students have more active involvement in formative assessment through procedures of self-assessment, reciprocal peer-assessment, and joint teacher-student assessment (Allal, 1999).

A key point of the above comparison associated to the aim of formative assessment. Feedback and correction are the basic means in formative assessment in order to allow all (or virtually all) students to attain the instructional objectives. In the perspective proposed in the French-language literature, a much greater emphasis is given to the differentiation of instruction.

After a brief presentation of the main orientations of the enlargement the conception of formative assessment, we will describe some developments in the evolution of work on formative assessment. Four major developments in the evolution of the conception of formative assessment are identified in the French-language literature. These developments are presented in the order of their emergence and each new development has attempted to overcome certain limitations of prior perspectives.

Focus on instrumentation is considered the first development in the evolution of the conception of formative assessment. French-language researchers initially adopted the focus on instrumentation that characterized formative assessment. Several collections of instruments were published in different subject matter areas (eg, Marchandisse and Blampain, 1974; Tourneur, Noel and Honclaire, 1975) and general guidelines for the construction of criterion-referenced tests were established (Racine, 1982). Later, more advanced instrumentation was developed based on the computer item banks and systems of "tailored testing" allowing diagnostic error analysis (e g , Dassa, 1988; De Campos, 1990; Leclercq, 1980; Seguin, 1984). Scallon (1988) supported instrumentation of formative assessment claiming that instrument development can take into account the aims and contextual constraints of classroom instruction.

The second development in the evolution of the conception of formative assessment includes the *Search for theoretical frameworks.* The search for theories that can offer conceptual orientation for conducting assessment has been pursued in several different directions in the French-language literature. More specifically, several conference papers and articles described the implications of a constructivist conception for specific subject matters, such as mathematics (Brun, 1979; Thouin, 1993), French (Weiss, 1979), sciences (Thouin, 1982). Simultaneously, new orientations were sought in theories emphasising social and philosophical dimensions of teaching and learning. Another theoretical approach to formative assessment has been proposed by French-language researchers in the areas of "didactics" (Bain, 1988; Chevallard, 1986; Garcia Debanc and Mas, 1987). According to this approach, the assessment is considered as part of a triadic system which constitutes of the teacher, the learner and the knowledge being dealt with. Schubauer-Leoni (1991)

proposed an interpretation of assessment within the framework of the "didactical contract" linking the reciprocal expectations of teacher and learners with respect to a given content area or task.

Studies of existing assessment practices in their contexts are the third development in the evolution of the conception of formative assessment. Studies in this direction are related with several phenomena: the interplay between instrumentation and intuition in teachers' practices of formative assessment (Allal, 1983); the fundamental incompatibility between certain instruments of formative assessment and the everyday assessment practices of teachers (Weiss, 1984); the forms of teacher-student negotiation of assessment rules and norms (Chevallard, 1986); the institutional factors affecting teachers' attitudes toward inequalities of students achievement and the effect on assessment practice (Grisay, 1988); the pragmatics of actually doing formative assessment without worrying about doctrine (Perrenoud, 1991); the systemic aspects of assessment that can foster or inhibit the development of formative assessment practices (Perrenoud, 1993).

The last development in the evolution of the conception of formative assessment refers to the *Development of active student involvement in assessment.* Nunziati (1990) and Vial (1995) highlighted the student's role in the formulation of assessment goals and criteria, in the conduct of interactive assessment, and in the construction of shared understanding of what assessment means. Allal (1999) proposed three different but interrelated forms of student involvement in assessment: individual self-assessment, reciprocal peer-assessment, and co-assessment entailing confrontation of teacher and student assessments. A common theme in the French-language literature is that interactive formative assessment, between peers and between teacher and students, constitutes a framework of social mediation that fosters the student's increasing capacity to carry out more autonomous self-assessment and self- regulated learning.

As regard the publications of empirical research in French-language literature, they have been classified in three major categories: experimental studies of the effects of formative assessment; development of instruments and procedures of formative assessment; and studies of teachers' attitudes and practices of formative assessment.

Regard to the first category of research, only two of the 105 articles in the database (which used for this summary) present experimental vs control group comparisons of the effects of formative assessment on student learning. The first study was based on a design comparing mastery learning (with formative assessment) in two history classes to traditional instruction (Huberman, Juge and Hari, 1985). The results showed a positive effect the first trimester however this effect was not maintained subsequently in the second and third trimesters. Various factors which limited the effectiveness of mastery learning, such as the principally institutional constraints and student tendency to make the minimum effort needed for passing a grade, are discussed in this article. The second study (Gagne and Thouin, 1991) concerned a formative assessment procedure focused on the correction of spelling mistakes (lexical and grammatical) in student texts. The comparison focused on pretest-posttest gains on a spelling test and on a scale measuring student attitudes towards assessment. The results showed a relatively small effect of formative assessment on spelling scores but a substantial improvement of student attitudes toward assessment. In the books we consulted, only one experimental study of the effects of formative assessment on student learning was identified. In this study, Del' Guidice (1999) conducted an investigation in which five groups of 4th grade students received different types of diagnostic assessment and regulation. The results revealed the beneficial effect of the integration of formative assessment in learning situations on immediate learning and on transfer.

For the second category of the research, there is only a limited number of articles (around a half-dozen) which present empirical evidence of the validation of formative assessment instruments. The development of diagnostic instruments for error analysis and regulation of

learning in the area of mathematics stands out because this type of instrumentation was the object of a substantial number of studies by Canadian researchers. Research in this area includes a variety of approaches: comparison between different models of diagnostic test construction, estimation of reliability, information on validity, indications about conditions of application (Bertrand et al, 1985); qualitative analysis of computer-based error diagnostics and their didactical validity (Dassa and DeCotret, 1993; De Campos, 1990); critical reflections about the place of computerised systems of diagnostic testing (Dassa, 1988; Dassa and Vazquez-Abad, 1992). Computer-based diagnostic instrumentation in the area of text revision has also been developed (Laurier, 1996) and extended to student self-assessment and self-regulation (Coen and Gurtner, 1999).

Important information comes from studies based on teachers' attitude towards assessment, by using questionnaires or interviews. Canadian researchers used standard instrument development methodology in order to validate scales for measuring teacher's beliefs and attitudes about assessment and student learning (Gadbois et al, 1991; Louis and Trahan, 1995). A questionnaire survey, addressed to 113 Belgian elementary school teachers, showed that teachers were generally favorable to formative assessment. However, research had shown that there was often a gap between espoused teacher's beliefs and classroom practice (Van Nieuwerrhoven and Jonnaert, 1994). Other study conducted by Campanale (1997) using questionnaires and interviews, showed a positive evolution of teacher conceptions of learning and assessment during a professional development programme that focused on the self-assessment method.

The French-language publications on formative assessment have enlarged the knowledge about the conception of formative assessment. The central idea of this conception is the regulation of teaching and learning through informal, interactive assessment and through the use of instruments that are adapted to classroom practice. The work by French- language researchers has led to a diversification and enrichment of the ways of carrying out formative assessment.

6. THE ADOPTED DEFINITION OF THE PROJECT

Based on the results of the literature review, a synthesis of different definitions was done in order to be able to express the way formative assessment in mathematics teaching and learning is defined in our project. Therefore, according to our synthesis, we resulted in providing the following extended definition and description of formative assessment.

"Formative assessment is connected with a concept of learning, according to which all students are able to acquire, at an adequate level, the basic skills of a discipline. The learning passes through the use of teaching methodologies which can respond effectively to different learning times for each student, their different learning styles, and their zones of proximal development. Formative assessment is an assessment FOR teaching and learning. It is part of the teaching-learning process and regulates it. It identifies, in an analytical way, the strengths and weaknesses of student's learning, in order to allow teachers to reflect on and modify their own practices. It allows, in a form of formative feedback, to establish a dialogue between teacher and student and to design educational interventions; It also promotes and fosters the learning of all students through differentiated teaching that ensures each student different rhythms and different teaching and learning strategies, involving at the same time the student in the analysis of own errors/weaknesses and own ability to promote self-assessment and peer-assessment and active participation in the teaching-learning process.

It is intended to give information, feedback and feed forward – in and outside of the classroom – related to the development of mathematical life-skills. In particular, it involves the different components of mathematical learning of the students (conceptual, procedural, semiotic, communicative, problem posing and solving aspects, misconceptions, organization of mathematical experience), the students' beliefs, the students' image of mathematics and of specific segments of mathematics, their behavior and classroom interaction when involved in different mathematical tasks and the outputs of teacher's choices (transposition of mathematical contents, interface between contents and methods)".

Trying to provide a complete and thorough description of formative assessment, we tried to include main points describing the purpose, the techniques and the results of formative assessment, preserving the relation with the literature review and the main axes of our research. The following table (Table 1) is an effort to deconstruct our definition in relation to our main research axes, for making their correspondence more explicit.

Table 2

Definition of formative assessment in relation to the main research axes

Purpose	Techniques	Results
Teachers		
assessment FOR teaching and learning • regulates teaching -learning process • establish a dialogue between teacher and student	• teaching methodologies which can respond effectively o to different learning times for each student o their different learning styles o their zones of proximal development • formative o feedback o feed forward	• allows teachers to reflect on and modify their own practices. • design educational interventions • the outputs of teacher's choices (transposition of mathematical contents, interface between contents and methods)".
Students		
• students to acquire the basic skills of a discipline • identify the strengths and weaknesses of student's learning • to give information, feedback and feed	• promotes students' ability for self-assessment and peer-assessment	• learning for all students through differentiated teaching (different rhythms and different teaching and learning strategies) • students' active participation in the teaching-learning process. • involving the student in the analysis of own errors/ weaknesses

forward – in and outside of the classroom – related to the development of mathematical life-skills	

Particular elements of our definition are categorized in relation to the main axes regarding the purpose, the techniques and the results of formative assessment. We intentionally do not include the dimension of the teachers' training for formative assessment in our definition, as it is a dimension that has an indirect relation to the application of formative assessment in the classroom.

7. THE POLICY OF EDUCATION AND ASSESSMENT

If policy and training are to be effective, they must deal with teachers' conceptions as much as they deal with declarative or procedural knowledge requirements. The implementation of any new assessment policy, tool, or practice, whether at the national or local school level, needs to take account of the complex structure of teachers' conceptions of assessment to ensure success.

Certainly, the implementation of new standards from professional bodies or state authorities, while well intentioned, may be reduced in effectiveness if teachers' conceptions of assessment remain unchanged or unchallenged, or if teachers remain unaware of their own conceptions. Simply introducing an assessment innovation, as in the hypothetical conversation at the start of the article, even if it is accompanied by appropriate teacher professional development, will not necessarily achieve policy objectives unless the differing, interlocked conceptions of teachers are exposed and addressed. Otherwise, quite possibly few teachers will adopt and utilize the innovation in a manner consistent with the intentions of developers of the innovation.

In other words, assessment policy may be most powerful if structured as a means of giving education professionals self-managed feedback about the quality of their own work. Emphasis on a school-based and managed process of improvement-oriented evaluation of student assessment results is likely to result in educational improvement in the quality of teaching and the quality of student learning outcomes (see for example the SEMO model, Timperley & Robinson, 2002). The development of assessment policy should include identification of and appropriate response to teachers' conceptions of assessment.

Likewise, teacher professional pre-service preparation and in-service development in the area of assessment needs to take account of teachers' pre-existing conceptions, if it is to be effective in moving teachers toward a desired set of conceptions.

An improvement-oriented assessment policy or practice in that school, without explicit attention to the differing conceptions of assessment held by the teachers, would likely be adopted and assimilated into the pre-existing conception of assessment as something that may be used but ignored.

Assessment policy in each partner country

The following table (table 2) summarizes the theoretical references, regulations and practices of the formative assessment in mathematics for teaching in each partner country.

Table 2

Theoretical references, regulations and practices of the formative assessment in mathematics for teaching in each country

Partner Country	**1. Main theoretical references on the subject of learning assessment (particularly in the didactics of mathematics).**	**2. The relevant regulatory framework and latest regulations (with links)**	**3. Brief presentation of the ways in which the scholastic assessment must be conducted from the normative perspective**	**4. Brief presentation in evaluation arrangements from the point of view of consolidated practices in schools**	**5. Assessment of Mathematics in curriculum and training for teachers.**
ITALY	Start Italian studies on the evaluation: Calonghi, 1954 Visalberghi, 1955 M. Gattullo, Didattica e docimologia, 1969 B. Vertecchi, Valutazione formativa, 1976 (Introduced for the first time the term "formative assessment" in Italy)	eg.: L. 517/77- Formative Assessment is nominated for the first time. D.M. 50/1979 It is pointed that the evaluation process is "both aimed to the appropriate cultural and educational interventions, with constant monitoring of the planned teaching." During curriculum	eg. The FA is used to adjust the teaching-learning process (without vote); it has essentially a function of feedback training . This concept is emphasized since the 70s until the late 90s , connecting it to the educational perspective of individualization . By the regulations of 2000, the focus is on the importance of learning assessment also useful as	CONTEXT '70-'80 -'90: it is difficult to bring a culture of evaluation in schools and there is a strong resistence to the concept of formative assessment. Practice of in-service training is not effective on a large scale . Since the year 2000 the legislation also forgets the concept of FA: - In-service training on educational	Some TFA, postgraduate courses to enable teaching (eg in Bologna), have introduced some modules related to the evaluation

	More recent references to FA: Vertecchi B. (2002), *Manuale della valutazione. Analisi degli apprendimenti e dei contesti*, Milano, Angeli. Benvenuto G. (2003). *Mettere i voti a scuola*, Roma, Carocci. Capperucci D. (2011). *La valutazione degli apprendimenti in ambito scolastico*. Milano, Angeli In maths: Fandiño Pinilla M.I. (2002). *Curricolo e valutazione in matematica*. Bologna, Pitagora.	programming are planned "systematic observation of the teaching processes", "continuous checks of educational process, informing about the results achieved and serve as a guide for subsequent interventions" L.148/90 It is emphasized the importance of an individualized teaching Regulation for autonomy (DPR 275/1999, art 10: delineation evaluation system, internal as well as external. Attention to the	evaluation system, both hetero- and in self-assessment for the improvement of the educational offer of schools. The concept of formative assessment in the classroom is often forgotten. It is clearly stated in INC , 2007: " The assessment precedes, accompanies and follows the curricula; enables actions to be taken , those initiated rule , promotes critical assessment of those carried out ; assumes a educational function, accompanying the learning process and to stimulate continuous improvement." Regulation for	assessment is almost absent; - At present, a real "carpet bombing" is in act to push on the issues of system evaluation and national tests, but without an effective training about in-school evaluation and without a real discussion on the possibility to reach the individualization of teaching and the educational success for all students; - INVALSI: great activity for the evaluation of the school system; - Established of “comprehensive schools” (IC): vertical curriculum 3-14 years and need to design tests to	

		educational success of all pupils and recovery initiatives.) Law March 28, 2003 n. 53 (Article 3) the "regular and systematic checks" on "knowledge and skills" students are aimed at "improving and harmonizing the quality of the education and training" - -Indicazioni nazionali per l curricolo… (INC) (National guidelines for the curriculum in kindergarten and primary school)2012 Legge 169/2008	autonomy: Teachers College decides methods of evaluation. The Law No. 135 of 7 August 2012 (art.7), included the introduction of online register (it is still a goal to be achieved when resources and tools allow). It has created a very strong rigidity in the form of ongoing evaluation, impacting on the attempts of embryonic formative assessment practices that exist in the school, preventing their development. The different USR (regional school office) have enacted provisions regarding the minimum	assess common, shared, in continuity between different levels of education. THE FUNCTIONS (AIMS) OF THE ASSESSMENT Confusion in schools about the themes of assessment and evaluation. The school intends to use the formative assessment as a mere ongoing testing of pupils' learning: the assessment is used to assign grades to the students. At the end of the semester, the teachers compute those grades' average for the final evaluation. WHICH PROCEDURES? Most used procedure and connected risks:	

		Presidential Decree No. 122/2009 (the Regulation on rating) c.m. 50/2010 refer to the average of all the evidence (grade of admission, written and oral tests, national test) C.M. n. 49 of May 20, 2010:documents needed to promote a correct evaluation culture; specifies that certification (should allow every student, already at the end of the 1st cycle, to know their position with respect to levels of learning and frameworks skills that are relevant to general references).	number of periodic checks (and maximum?), quite inhomogeneous from region to region. This implicates the problem of triangulation autonomy / central / regional management of the Italian school. Also, recently the provisions of the courts have referred to the construction of centralized policy evaluation (see, eg, http://www.tecnicadellascuola.it/index.php?id=51775&action=view)	Use of traditional assessment tests. Difficulties in the use of structured tests, aimed only to answer INVALSI ones (risk to finalize the teaching to good performances in tests). Use of textbooks to build structured assessment tests Lack of capacity for collegial work of teachers in designing common tests for parallel classes. The schools have strong difficulties in the construction of tests to assess internal reliability (due to lack of	

		INVALSI: • Leg. 258/1999 legislative foundation, • Leg. 286/2004 mission and purpose, • L. 176/2007 and L.10/2011 - new organizational structures and management.		specific skills of teachers) Lack of capacity to read the results of the OECD and Invalsi surveys, in order to identify the ways to improve teaching. [In fact, only half of the schools get their results Invalsi and all analyzes that are in the package, including those that engage school classes and the socio-economic parameters]	
Cypus	Kyriakides L. (1997) Primary Teachers' Perceptions of Policy for Curriculum Reform in Mathematics	– Decision of the Council of Ministers (Decision No. 67339, dated. 11/6/2008) for a process of "*revising the*	- There are no formal decisions or description of how assesssement should be carried out. - The teachers are	- National Tests from the pedagogical Institute of Cyprus - Classroom assessment has a summative form.	• There is no specific reference in the mathematics curricullum regarding assessment. • In the recent

	, *Educational Research and Evaluation: An International Journal on Theory and Practice,* *3*:3, 214-242, Kyriakides, L. & Campbell, R.J. (1999). Primary teachers' perceptions of baseline assessment in mathematics. *Studies in Educational Evaluation, 25*, 109-130. Gagatsis, A. and Kyriakides, L. (2000). Teachers' attitudes	*curricula of pre-primary, gymnasium and upper secondary education".* – There is no regulatory framework regarding assessment. – Participation in the PISA examination.	only encouraged to use multiple ways for assessing their students, without being provided any particular guidelines. - There are only some sample tests in the website of the Ministry of Education or some suggested exercises for revision. - http://www.schools.ac.cy/eyliko/mesi/themata/mathimatika/ekp_yliko_exetastika_dokimia_epanalipti kes_askiseis.html -	Teachers' mostly use traditional written tests for assessing their students, assigning them grades. - They usually conduct more than one test each semester and a final grade is assigned for each student, based on the grades of these tests. - The tests include mostly tasks which are similar to the tasks of the school textbook. - Each maths teacher is responsible for the construction of the tests that are used and usually each teacher uses	years there is an ongoing effort for Educational reform. • The formation of the new mathematics curriculum is still on processes. The general aims, more specific goals and the mathematical content are defined. • As regards to assessment, the relevant framework is still under formulation. • There are no particular training programs for the in-service teachers. There is an effort for starting

	towards their pupils' mathematical errors. *Educational Research and Evaluation, 6*(1), 24–58.			his/her own tests, without any collaboration with the rest maths teachers that teach in the same grade. - A final exam is done at the end of each school year. The test is developed by the school, with the collaboration of the mathematics teachers that teach in the same grades. - A final report is given to the students, including the marks of the two semesters and the score they get in the final exam.	developing relevant material and training programs for the mathematics teachers of all educational levels. • The focus will be on ongoing and formative assessment.

Swiss	Start Swiss (Canton of Ticino) studies on the evaluation: Allal, L. (1988). Vers un élargissement de la pédagogie de la maîtrise : processus de régulation interactive, rétroactive et proactive. In M.Huberman (Éd.), Assurer la réussite des apprentissages scolaires ? Les propostions de la pédagogie de maîtrise (pp.86-126). Neuchâtel : Delachaux et Niestlé. Bélair L.M.	**Division of School - Office of the teaching medium - Training Plan of middle school – 2000** "The complexity of the assessment act has led in recent years to distinguish at least three basic types of assessment which correspond to functions: formative assessment (...) , summative assessment (...) , assessment certification (…)" (pag. 17). **The students assessment in middle school - 2003 - edited by Edo Dozio (http://www4.ti.ch/decs/ds/cdc/scuoladec**	**Division of School - Office of the teaching medium - Training Plan of middle school – 2000** "Deal with the issue of assessment of learning on a new basis . The problem of teaching is known to be central to any assessment school. Teachers know what assessment practices affect the entire didactic and educational activity and therefore reiterate the need to tackle the problem on a new basis , consistent with the perspectives of the Training Plan" (UIM , 2000).	**CONTEXT '70 - '80 - '90 :** As was the case in Italy , even in Ticino is difficult to bring a culture of evaluation in schools and there is a strong resistance to the concept of formative assessment, especially in mathematics. In particular, the practice of formative assessment in in-service training is almost non-existent. At present, we are delving into studies on the topics of system assessment and national tests. In Switzerland the discussion is vibrant and connected with the harmonization process involving the	During the Master course planned for future teachers of mathematics at the middle school is treated the topic of formative assessment is in the form of the Laboratory of mathematics education in both theoretical courses of science education. In particular, in the second year of the Master course for prospective teachers of middle school there is a module of Education entitled: "Assessment" of 2 ECTS. Plan of Study is reported: "In this course a large group are presented the theoretical basis underlying the more

	(1999). *L'évaluation dans l'école. Nouvelles pratiques.* Paris: ESF. Bonniol, J.J., Vial M. (1997). *Les modèles en évaluation*. Textes fondateurs avec commentaires. Bruxelles: De Boeck. Vertecchi B. (1995). *Decisione didattica e valutazione*. Firenze: La nuova Italia. More recent references to FA: Vertecchi B. (2002), *Manuale della valutazione. Analisi degli*	**s/riforma3/assi-tematici/valutazione-degli-allievi/)** **Reform 3 of the middle school.** This report in the first part presented a budget for the situation in Switzerland, some reflections on the functions of assessment and highlighted the close connections between design teaching and assessment; in the second part illustrated learning experience , conducted in two locations of middle school, aimed at assessment skills. Reform 3 of the middle school. A glossary is where you find the item : • Formative	"The complexity of the assessment act has led in recent years to distinguish at least three basic types of assessment which correspond to functions: • **Formative assessment** : observation and continuous monitoring by the teacher during the didactic itinerary and self-assessment by the student. Formative assessment serves the student to be aware of their progress and their own weaknesses , the teacher for provide the students with the necessary directions for improvement and to correct its learning path. **summative**	several cantons in Switzerland, and that concerns the compulsory school (HarmoS Concordat of 14 June 2007; http://www.edk.ch/dyn/23222.php). From this point of view in 2011 were defined fundamental competencies in mathematics. These fundamental competencies are the first national training standards for compulsory education and represent an important contribution to the harmonization of the objectives of the stages of training at the national level. - the Ticino since 2010 a project with the aim of producing	recent reflections on the assessment and differentiation. More specifically, the student will be confronted with various forms of assessment including formative assessment, summative, the formal and informal assessment. Also will learn how to relate to theoretical frameworks that motivate the use of a differentiated pedagogy. "

	apprendimenti e dei contesti, Milano, Angeli. Domenici G. (2007). *Manuale della valutazione scolastica*. Roma: Editori Laterza. In maths: Fandiño Pinilla M.I. (2002). *Curricolo e valutazione in matematica*. Bologna, Pitagora.	assessment formative observation. Its function is to improve , guide and control the learning process , the behavior of the student and of the teacher in the perspective mastery of the learning objectives. It has an intention of training, overcoming obstacles, individualized help , but also of mirror for the teacher who can see the effects of his actions: - is an integral part of the process of teaching / learning; - errors are moments not to be avoided in a learning process; - implies that there is a phase adjustment or remediation to "gaps " recorded; - is linked to a	**assessment (...) and assessment certification (...) ".** (p. 17) **The documents in support of the Reformation 3** **(http://www4.ti.ch/decs/ds/cdc/scuoladecs/riforma3/assi-tematici/valutazione-degli-allievi/)** shows the following aspects : Formative assessment , which should be integrated in the process of teaching-learning , training consists of observation, from the self-learning by part of the student , and finally by the procedures regulation and differentiation activities. It should be criterial , that is	and administering a standardized test (Woolfolk, 2007) to evaluate mathematical competencies in the fourth class of primary school has been running. As regards the external assessment in Ticino requiring testing Cantonal system in the second and fourth class of the middle school. The themes of the role of evaluation in school and the importance of reaching individualization of teaching are the subject of discussion for years but still do not see a real spread in practice.	

		pedagogy of success.	based on criteria explicit recognition and verification useful for summative assessment. A plan training sets of skills should include criteria to determine whether these skills are acquired. In this framework , for the assessment students would be expected moments of : • formative observation (formative assessment) during the teaching - learning in order to know the progression acquisition objectives and to correct eventually the didactic trail; • self-assessment by the student of his learning in relation	- New study plan of compulsory school for the first time in continuity from 3 to 15 years has seen the need to deal with the issue of assessment for all three grade levels. THE FUNCTIONS (AIMS) OF THE ASSESSMENT The assessment is used to assign grades to the students. At the end of the semester, the teachers compute those grades' average for the final evaluation. WHICH PROCEDURES? Most used procedure and connected risks. As is found in Italy,	

			to the objectives or skills laid down ; • summative assessment occurs during the cycle , the objectives on time and / or expertise in situations significant integration; • at the end of each cycle, certification assessment with communication to the family of the achievement of the skills provided by the training Plan. For certification could be used also different way from the usual mode of scale grades. It could be done by means of : • write comments which explain the student's situation in relation to the assessment criteria defined;	in Switzerland (Canton Ticino) it is noted: Use of traditional assessment tests. Difficulties in the use of structured tests. Use of structured forms and materials ready to build structured assessment tests. The schools have strong difficulties in the construction of tests to assess internal reliability (due to lack of specific skills of teachers) Lack of capacity to	

			• scales of skills such as those used in international research (levels of skill used by the Council of Europe for languages or for international projects type PISA); • Dossier or Portfolio. Mode that are not in use. **Division of School - Office teaching medium 10 thesis on the assessment of the students - Reform 3 SM February 2004** Ten theses that should constitute the reference point to guide the practices of assessment of students in middle school. Among these ten are below the main thesis for our topic:	read the results of the OECD and Cantonali surveys, in order to identify the ways to improve teaching. The teachers are placed , often only in their underwear , many questions on how to use in the assessment of students; difficult , however, is the comparison and research sharing between colleagues and more generally in the school . It was followed by some specific projects in some schools linked to the reform 3 of the middle school. The projects were targeted on three pillars , between which there was the assessment of the	

			THESIS 2 To engage students and motivate them to learn, it is appropriate that they know the expectations that the school and the teachers have towards them on the various activities of learning. The objectives are then explained and communicated regularly to students. The middle school aims to promote the habit to explain and to communicate the formative intentions to the students. THESIS 3 Formative assessment accompanies the path of acquiring the skills below form of observation of the	students. The implementation of these axes has been linked to a reduced number of teachers of institutions. The initiatives also interesting and commendable that are carried out in limited areas (groups class , for example .) leave traces in the skills of teachers involved but not extend to others. The risk is that the experience is lost and must be reinvented by others in the following years . A formative assessment make sense if it is followed by a remediation, ie by adjustment of the student learning and / or teacher teaching based on the	

			learning process. It's then integrated into the normal teaching practices . The assessment is thus a tool of control learning that contributes to the improvement of the education of the student. The school aims to promote the formative observation and to postpone the summative assessment at the end of a learning unit . THESIS 4 The differentiation of the teaching is an inevitable consequence of the differences existing among students in acquiring targets. It takes place mainly in the classroom to	information gathered from the same teacher and / or from the student self-assessment, but this practice is not widespread . The differentiated teaching is a way to facilitate the adjustment and calibration of the intervention on the characteristics , interests and rhythms of the students. To make this possible is needed a definition and a clear analysis of the pedagogical objectives targeted , as well as a sensitivity to the processes of knowledge construction of students (operation, strategies , possible errors , ...). This didactic attention is	

			work of the teacher of the discipline and can result in either a change in didactic itinerary in class , either a change of objectives. The middle school aims to develop differentiated teaching practices . THESIS 5 Students should learn to self-regulate their learning and their school behavior as a function of regular appraisals carried out with the teacher: this is for them to discover through these exchanges, the expectations of the school against them and improve procedures to help meet them. The middle school aims to promote the practice of self-	not widespread.	

			assessment of students. THESIS 6 The distinguishing feature of students in compulsory school is not a priority. The sommative assessment occurs at the end of a unit of teaching in relation to objectives. It is primarily criterial and gives rise to a comment in relation with the parameters set. THESIS 8 Should try to experiment with other forms of communication of the assessment using the verbal description of learning in relation to the established criteria, student self-		

			assessment and the use of other tools that collect performance considered the most significant of the learning process . The middle school aims to encourage experimentation with other forms of communication of the assessment, alternatives to the usual ones . THESIS 9 For teachers it is important to have reference materials on the levels of competence to reach with the students in order to better adjust their teaching. The middle school aims at providing teachers' references and useful tools for the collection of		

			information on the level of competence of the students in relation to cantonal school population.		
France					
Netherland					

SOS: Our partners from <u>France</u> and <u>Netherlands</u> need to complete this table.

PART B

TEACHERS' AND STUDENTS' BELIEFS AND CONCEPTIONS OF ASSESSMENT IN MATHEMATICS

1. DEFINITIONS OF BELIEFS AND CONCEPTIONS

As it comes from the literature, there are various opinions concerning the notion of "beliefs". According to Goldin (1999), a belief may be "the multiply encoded cognitive configuration to which the holder attributes a high value, including associated warrants". Cooney (1999), asserts that a belief is "a cluster of dispositions to do various things under various circumstances", which leads to the acceptance that "different circumstances may evoke different clusters of beliefs" (Presmeg 1988). It is widely accepted that beliefs are the individual's personal cognitions, theories and conceptions that one forms for subjective reasons. Their nature is partly logical and partly emotional. According to Mc Leod (1992) "beliefs are largely cognitive in nature and are developed over a long period of time". In addition, "beliefs are a multifaceted construct, which can be described as one's subjective understandings, premises, or propositions about the world" (Philipp, 2007, p. 259). Beliefs are the meanings connected to psychological objects or phenomena and are an environmentally contingent and culturally defined lens through which sense is made of events, people, and interactions (Pratt, 1992; Ekeblad & Bond, 1994).

Many researchers use attitudes as a term, which includes beliefs about mathematics and about self. Mc Leod (1992) accepts that attitudes "refer to affective responses that involve positive or negative feelings of moderate intensity and reasonable stability"; they may appear as a result of the automation "of a repeated emotional reaction to mathematics" or of "the assignment of an already existing attitude to a new but related task". According to Hannula (2002) "attitude is not seen as a unitary psychological construct but as a category of behavior that is produced by different evaluative processes. Students may express liking or disliking of mathematics because of emotions, expectations or values". Hanulla (2002) declared that attitudes can change under appropriate circumstances.

However, to address the varying terminology about knowledge, beliefs, belief systems, and belief clusters more efficiently, Thompson (1992) invoked conceptions "as a more general mental structure, encompassing beliefs, meanings, concepts, propositions, rules, mental images, preferences, and the like" (p. 130)

A "conception" is a mental construction or representation of reality (Kelly, 1991), communicated in language or metaphors (Lakoff & Johnson, 2003) and which explains complex and difficult categories of experience (White, 1994) such as assessment. Thompson (1992) invoked conceptions "as a more general mental structure, encompassing beliefs, meanings, concepts, propositions, rules, mental images, preferences, and the like" (p. 130). Furthermore, conceptions represent different categories of ideas held by teachers behind their descriptions of how educational things are experienced (Pratt, 1992). Thus, conceptions act as a framework though which a teacher views, interprets and interacts with the teaching environment (Marton, 1981).

"Conceptions" is the term used to describe the organizing framework by which an individual understands, responds to, and interacts with a phenomenon. The structure

of teachers' conceptions is not uniform and simple; they appear to be multifaceted and interconnected. (Brown, 2004)

The major premise of the improvement conception is that assessment improves students' own learning and the quality of teaching. This improvement has two important caveats:

- assessment must describe or diagnose the nature of student performance and
- the information must be a valid, reliable, and accurate description of student performance.

A second conception of assessment is that assessment can be used to account for a teacher's, a school's, or even a system use of society's resources. The premise of the third conception of assessment is that students are held individually accountable for their learning through assessment. The premise of the final conception is that assessment, usually understood as a formal, organized process of evaluating student performance, has no legitimate place.

2. THE IMPORTANCE OF RESEARCH IN TEACHERS' CONCEPTIONS OF ASSESSMENT

The study of teachers' conceptions of assessment is important because evidence exists that teachers' conceptions of teaching, learning, and curricula influence strongly how they teach and what students learn or achieve (Thompson, 1992; Calderhead, 1996). Indeed, teachers' beliefs about student self-confidence, morale, creativity, and work are "closely linked to one's choice of evaluation techniques" (Asch, 1976, p. 18). Tittle (1994), proposed that teachers "construct schemas or integrate representations from assessments into existing views of the self, of teaching and learning, and of the curriculum, broadly construed" (p. 151). From their survey of elementary school teachers, Cizek et al., (1995) argued that, based on the highly individualistic nature of assessment practices, many teachers seem to have assessment policies based on their idiosyncratic values and conceptions of teaching. In a study of high school English classes, Kahn (2000) has argued that teachers used a wide variety of seemingly conflicting assessment types because they eclectically held and practised transmission-oriented and constructivist models of teaching and learning. And yet, as individualistic as conceptions may appear, it can be argued they are socially and culturally shared cognitive configurations or phenomena (van den Berg, 2002).

3. TEACHERS' BELIEFS ABOUT MATHEMATICS

Scholars and teacher educators agree that, apart from knowledge of the subject and its teaching, teachers' beliefs about and attitudes toward mathematics and its teaching and learning are consequential for teachers' instructional approaches (Philipp, 2007).

Teachers' beliefs are organized into systems where in some beliefs are more central or primary while others are peripherally linked to those central beliefs (Pajares, 1992; Thompson, 1992). A wide variety of language has been used to refer to teachers' beliefs, including "teachers' subjectively reasonable beliefs" (Harootunian

& Yarger, 1981), "untested assumptions" (Calderhead, 1996), and "implicit theories" (Clark & Peterson, 1986).

Teachers have various beliefs: about themselves as teachers and learners of mathematics; about the manner in which knowledge is acquired, about the nature of the discipline of mathematics, and about internal and external factors that affect the learning of mathematics.

Educationalists have attempted to systematize a framework for teachers' mathematical belief systems into smaller sub–systems. Most authors agree with a system mainly consisting of beliefs about (a) what mathematics is, (b) how mathematics teaching and learning actually occurs, and (c) how mathematics teaching and learning should occur ideally (Ernest, 1989, Thompson, 1991). Certainly, the range of teachers' mathematical beliefs is vast since such a list would include all teachers' thoughts on personal efficacy, computers, calculators, assessment, group work, perceptions of school culture, particular instructional strategies, textbooks, students' characteristics, and attributional theory, among others. (Handal B., 2003).

Ernest (1989), suggests that a teacher's belief system has three components; the teacher's conception of the nature of mathematics as a subject for study (M), of the nature of mathematics teaching (T) and of the process of learning mathematics (L). Askew et al. (1997) characterized the orientations of teachers towards each of these components as transmission (T), discovery (D) or connectionist (C). These categories are 'ideal types' and an individual teacher's conception of mathematics, teaching and learning may combine elements of each of them, even where they appear to conflict.

In addition, there is a discrimination of beliefs, as epistemological beliefs about mathematics and efficacy beliefs about teaching mathematics. Teachers' epistemological beliefs pertain to the nature of knowledge and learning. Ernest (1989) proposed that teachers' epistemological beliefs be clustered in three categories, which correspond to three different perspectives. The first perspective, the Platonic, considers mathematics as an a priori static unified body of knowledge, which exists out there and waits to be discovered. The second perspective, the instrumentalist, regards mathematics as an organized set of instruments (e.g., rules, operations, algorithms), and hence, can be linked to a formalist view of mathematics. Finally, the experimental view regards mathematics as a dynamic and continually evolving field of human creation, the results of which are open to revision.

However, several studies suggest that teachers' epistemological beliefs are crucial to teaching, because they influence teacher-student interactions (Buehl, Alexander, & Murphy, 2002). For example, teachers who tend to consider mathematics a static body of knowledge to be learned – the Platonic and the instrumentalist perspectives – may be more inclined to adopt approaches that emphasize drill-practice and memorization.

As regards self-efficacy, Bandura (1997) defines self-efficacy as one's perceived ability to plan and execute tasks to achieve specific goals. Within the context of his theory, teacher efficacy beliefs are viewed as a subset of the general construct of efficacy beliefs, and are related to the extent to which teachers view themselves as capable of affecting student learning. Some researchers distinguish between personal teacher efficacy beliefs, which reflect the degree to which a teacher considers herself or himself capable of affecting student learning, while general teacher efficacy beliefs refer to a teacher's judgment about the ability of teachers in general to affect student learning (Tschannen-Moran, Hoy, & Hoy, 1998).

Several studies have shown that teachers with high efficacy beliefs are more willing to adopt innovations, more open to student ideas, and less concerned about student erring (Gordon, Lim, McKinnon, & Nkala, 1998). In contrast, teachers with low efficacy beliefs underestimate their capacity to influence student learning and teach mathematics "by telling" (Lin & Gorrell, 2001). Teacher efficacy beliefs are also positively correlated with student motivation (Soodak & Podell, 1996) and performance (Ross, 1992).

According to Pajares (2008) "self-efficacy should not be confused with self-concept, which as a broader evaluation of one's self, often accompanied by the judgments of worth or esteem that typically chaperone such self-views" (p. 114). Self-efficacy beliefs refer to matters related to one's capability and revolve around questions of "can", whereas self-concept beliefs refer to matters related to being and reflect questions of "feel". Academic self-concept is referred as self-perceptions of ability, which affects students' effort, persistence, anxiety (Pajares, 1996), and indirectly their performance. Self-concept includes beliefs of self-worth associated with one's perceived competence (Pajares & Miller, 1994). Besides an individual impression, students could develop their academic self-concept externally through a comparison with their classmates (Wang, 2007). People who believe that they are capable of performing academic tasks use more cognitive and metacognitive strategies, and, regardless of previous achievement or ability, they work harder, persist longer, and persevere in the face of adversity. People with strong sense of efficacy approach difficult tasks as challenges to be mastered rather than as treats to be avoided. They have greater intrinsic interest in activities and they set themselves challenging goals and maintain strong commitment to them (Pajares, 2008).

These beliefs act as a filter through which teachers make their decisions rather than just relying on their pedagogical knowledge or curriculum guidelines (Clark & Peterson, 1986). In fact, these beliefs appear to be cogent enough to either facilitate or slow down educational reform, whichever is the case (Handal & Herrington, 1993, in press).

Theoretical conceptualizations of teachers' mathematical beliefs show that the range of these beliefs can be expressed in multiple dimensions (Ernest, 1991). Ernest (1991), for example, outlined a developmental sequence of five different mathematics-related belief systems that are hypothesized to be found amongst teachers: authoritarian, utilitarian, mathematic centered, progressive, and socially aware. Ernest's contribution showed that it is possible to relate these attitudinal representations to conceptions on the theory of mathematics, learning mathematics, teaching mathematics, and assessment in mathematics, as well as identifying beliefs on the aims of mathematics education.

However, there are several views about how teachers' mathematical beliefs originate. In part, teachers acquire these beliefs symbiotically from their former mathematics school teachers after sitting and observing classroom lessons for literally thousands of hours throughout their past schooling (Carroll, 1995). This process parallels in many respects the apprenticeship style of learning that takes place while learning a trade.

Pajares (1992) points out that the origins of teachers' conceptions is their own experience as students of assessment; if that experience is largely one of accountability and irrelevance then it is likely that some teacher trainees and practicing teachers will have conceptions that need to be developed.

In the schooling process, students not only learn content-based knowledge but also instructional strategies as well as other dispositions. By the time the aspirant is admitted to a teacher education program, these beliefs about how to teach and learn are deeply embedded in the individual, and very often are reinforced by the traditional nature of some teacher education institutions which may not have positive effects on pre-service teachers' mathematical beliefs (McGinnis & Parker, 2001).

Moreover, the everyday constraints under which teachers work often lead to inconsistencies between what they say they believe and what they do in practice.

Teachers may hold isolated 'clusters of beliefs' that apply only in particular situations (Wilson and Cooney, 2002). Recent research suggests that teacher' beliefs about their subjects and approaches to teaching are closely related to classroom practice. Teachers' beliefs influence the likelihood of their implementing changes in the classroom (Thompson, 1992), and changes in teaching practice commonly reflect changes in belief structures (Cooney & Shealy, 1997). The relationship between teachers' beliefs and classroom practice is dynamic with each influencing the other. Some research indicates that teachers' practices are shaped by their beliefs about mathematics and the nature of teaching and learning (Fernandez, 1997).

Studies on the relationship between pedagogical beliefs and instructional behaviour have reported different degrees of consistency (Thompson, 1992). While the nature of this relationship seems to be dialectical in nature (Wood et al., 1991) it is not clear whether beliefs influence practice or practice influences beliefs (McGalliard, 1983). It is in fact a complex relationship (Thompson, 1992) where many mediating factors determine the direction and magnitude of the relationship.

Brown and Rose (1995) conducted an interview study with 10 elementary mathematics teachers in order to determine their theoretical orientations. Teachers' responses showed a varied range of theories of teaching and learning mathematics. Teachers also said that these orientations influenced their instructional behaviour. The analysis of data revealed that teachers do not implement fully their ideal conceptions of mathematics education because of perceived pressure from parents and school administrators to implement traditional teaching. Other identified mediating factors were the need for more preparation time to satisfy instructional and curricular demands, and the challenges of mixed ability classes.

Raymond (1993) investigated beliefs and practices of six beginning elementary mathematics teachers and found diverse degrees of consistency. Two teachers displayed a high degree of correspondence between belief and practice, two teachers showed a moderate level, while the other two showed a low level. Reasons for the inconsistencies were found to be lack of resources, time limitations, discipline, and pressure to conform to standardized testing. The author concluded that there is a dialectical relationship between beliefs and practice. According to the researcher, teachers' mathematical beliefs influenced their practice more than their instructional practices influence their mathematical beliefs. The researcher also found that previous school experiences, teachers' current practice, and, importantly, teacher education courses also influence teachers' mathematical beliefs. Teachers also identified their own mathematical beliefs, students' abilities, the particular topic to be taught, the school culture, as well as the mathematics curriculum as factors that influenced their instructional practice.

Teacher's resistance to adopting new approaches in the teaching of mathematics may be part of a defense mechanism that teachers adopt to avoid changes in their own mental structures (Clarke, 1997) because "changing beliefs causes feelings of discomfort, disbelief, distrust, and frustration" (Anderson & Piazza, 1996, p. 53). Orton (1991) stated that it is not easy to change a long-cherished mathematical belief since this belief proved before to be rewarding and useful to the teacher in the performance of his or her professional duties. Furthermore, changing a particular belief implies a re-structuring of the whole network of one's belief system, a feeling that might cause anxiety and emotional pain (Rokeach, 1968).

As regards teachers' conceptions, Pajares (1992) has argued that they are a product of their educational experiences as students, suggesting strongly that similar conceptions might be found in both teachers and students. Research into the conceptions teachers have about the purposes of assessment has identified four major purposes: that is, (a) assessment improves teaching and learning, (b) assessment makes students accountable for learning, (c) assessment makes schools and teachers accountable, and (d) assessment is irrelevant to education (Brown 2002).

4. TEACHERS' BELIEFS ABOUT ASSESSMENT

There is a paucity of research on what teachers believe about the purpose of assessment and how they use data they collect during the assessment process, despite the fact that much has been written about the purposes of assessment. The NCTM Assessment Standards (1995) note four purposes – promoting student growth, improving instruction, recognizing accomplishments, and modifying programs. Such purposes have two foci – teachers and learners. Clarke, Clarke and Lovitt (1990) claim that the major uses of assessment focus on three areas – teachers (to improve instruction), students (to inform them on their strengths and weaknesses), and parents (so they can give support).

These three factors indicate that beliefs about the uses of assessment fall into three main categories - to inform the teacher, to inform the learners, and for accountability purposes. The factors correspond closely to the three focus areas proposed by Clarke, Clarke and Lovitt (1990). The first factor is essentially about teachers evaluating their teaching, and reflects feedback and planning components, corresponding to two of the purposes of assessment stated in the NCTM Standards (NCTM, 1995), namely, improving instruction and modifying programs. The second factor supports the notion of assessment promoting student growth, recognizing accomplishments, and giving feedback on students' strengths and weaknesses.

According to Nisbet and Warren (2000), teachers emphasize the use of assessment to inform their teaching. Next, they use assessment to inform students about their learning, and lastly, they use assessment for accountability purposes. In regard to views of mathematics, neither the static view of mathematics nor the mechanistic view of mathematics rated highly, however the mechanistic view was stronger than the static view. Regarding views of teaching mathematics, the contemporary view rated more highly than the traditional view. Thirdly, with regard to assessment, although it seems that teachers in general consider assessment important for evaluating their teaching and their students' progress, one suspects that the mathematics curriculum is assessment driven.

Further, one wonders how much influence external parties such as parents have on teachers' beliefs about assessment practices and the choices teachers make on how to assess learning.

Many teachers are content with conservative methods of assessment because they know that good results from rote teaching enhance their image. Consequently, teachers are not pioneers in alternative strategies of assessment. They believe that their use of new models of assessment would invite educational authorities, parents and school heads to negatively assess the quality of their teaching (Gao, Du & Yu, 2006).

These factors contribute to teacher's complex and contradictory conceptions of assessment. On the one hand, teachers know that the present practices are detrimental to their students' learning, but on the other hand, the cost to bring about innovative assessment strategies is too great because both the teachers and the students cannot afford to perform poorly in competitive scholastic achievement tests which emphasize rote learning.

5. THE EFFECT OF TEACHERS' CONCEPTIONS OF ASSESSMENT

Brown (2004) further argues that the various conceptions might interact with each other and that these conceptions can lead to different practices, which are often in tension with the original purposes.

All pedagogical acts, including teachers' perceptions and evaluations of student behavior and performance (i.e., assessment), are affected by the conceptions teachers have about many educational artifacts, such as teaching, learning, assessment, curriculum, and teacher efficacy. It is critical that such conceptions and the relationships of those conceptions among and between each other are made explicit and visible.

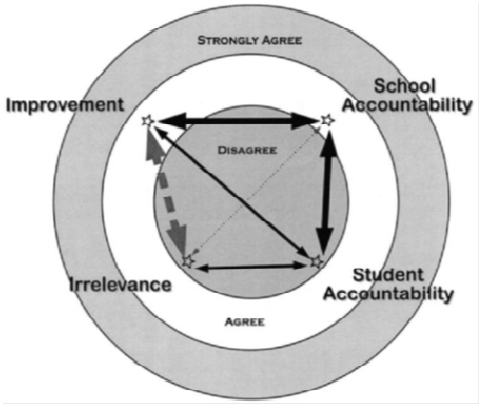

Figure 2. Strength and inter-correlations of COA-III conceptions of assessment

In the figure above the thickness of the arrows shows the degree of inter-correlation of conceptions, while the solid lines indicate positive correlations and dashed lines showing negative correlations. As it seems from the figure, if teachers think assessment is about Improvement then it is unlikely they will consider

assessment as Irrelevant (r=2.69) and they are likely to believe that assessment is connected to School Accountability (r=.58).

Teachers who conceive of assessment as Improvement tended to have just moderate likelihood of agreeing that assessment is about Student Accountability (i.e., certifying student performance or achievement). This may be because of the impact of student-centered philosophies or conceptions.

If teachers think assessment is about School Accountability, then they may or may not believe that assessment is Irrelevant; belief in one is independent of belief in the other. Teachers who believe in assessment as School Accountability are highly likely to also conceive of assessment as a process of Student Accountability and Improvement. This suggests a nexus of conceptions around the idea that assessment for school accountability may lead to a raising of educational standards that will in turn lead to improved ability of students to receive qualifications and recognition of achievement.

When teachers think assessment is about Student Accountability, it is moderately likely they will also consider assessment to be Irrelevant, because it is bad for students or inaccurate, such that they can safely ignore it. It is possible that this conception is related to strong student-centered learning beliefs or humanistic curriculum or nurturing teaching beliefs. Teachers who conceive of assessment as Student Accountability are likely to have only a weak relationship to Improvement. In other words, assessment of students is likely to be Irrelevant when it is connected to Student Accountability but is more likely to be acceptable if it is related to Improvement of teaching and learning.

When assessment is considered Irrelevant, it is highly likely to be disconnected from the goal or improving instruction or learning. This discontinuity may be driven by a rejection of Student Accountability uses of assessment, whereas it does not appear to be related at all to the conception of using assessment to evaluate the quality of schools or teachers.

6. STUDENTS' BELIEFS ABOUT MATHEMATICS AND ASSESSMENT

Over the last two decades the role of beliefs, as well as the role of knowledge, in cognitive processes has been recognised. In particular, students' general beliefs about the nature and acquisition of knowledge, namely epistemological beliefs, have been investigated regarding their influence on text comprehension and meta-comprehension (Kardash & Howell, 2000), problem solving (Schraw, Dunkle, & Bendixen, 1995), and conceptual change (Mason, 2000). Students' beliefs have been investigated not only as general convictions, but also as convictions about knowing and learning in specific domains, including mathematics (De Corte & Op't Eynde, 2002). Schoenfeld (1983) pointed out the existence of a system of beliefs that drives students' behaviour when trying to solve mathematical problems, since problem-solving performance cannot be seen as purely cognitive. He revealed that students' beliefs about what is useful in learning maths affects the cognitive resources available to them when learning in this domain, making a large portion of stored information inaccessible when the beliefs impede rather than facilitate understanding.

Garofalo (1989) pointed out different kinds of students' beliefs affecting mathematical performance, for example:

- the difficulty of math's problem is due to the size and quantity of the numbers
- all problems can be solved by performing one arithmetical operation, in rare cases two
- the operation to be performed is determined by the keywords of the problem, usually introduced in the last sentence or in the question, thus it is not necessary to read the whole text of the problem
- the decision to check what has been done depends on how much time is available

Given that teachers' beliefs, as reflected in their practice, influence students' beliefs, it appears evident that pre- and in-service teacher training should include activities aimed at making them manifest, and encourage teachers to analyze and reflect on their own convictions about the discipline and different ways in which it can be approached in the classroom (Franke, Fennema, & Carpenter, 1997).

Consequently, teachers have a remarkable influence on students' construction of their beliefs through the ways in which they present the subject matter, the kinds of task they set, assessment methods, procedures and criteria (Pehkonen, 1998).

Furthermore, students' conceptions of assessment are of particular importance because assessment has a significant impact on the quality of learning (Ramsden 1997).

The research literature on students' conceptions of assessment is not vast, and is largely focused on tertiary or higher education students (Struyven et al. 2005). Review of the empirical literature on students' conceptions of the purposes of assessment has identified four major purposes, some of which can be matched to teachers' conceptions of assessment. Students are reported as conceiving of assessment as (a) improving achievement, (b) a means for making them accountable, (c) being irrelevant, and (d) being enjoyable.

7. RESEARCH ON BELIEFS FOR ASSESSMENT

It have been shown that teaching conceptions could be related to measures of the quality of student learning, so are modeled as influencing teaching approaches which in turn affect student learning approaches and learning outcomes. Teaching approaches are strongly influenced by the underlying beliefs of the teacher. (Kember, 1997, p. 255) How teachers conceptualize teaching influences their practice of teaching. This also applies to conceptions of assessment (Tittle, 1994; Brown, 2003 & 2004).

Watkins (1998) studied the assessment of university students in Hong Kong. He concluded the majority of respondents (151 Hong Kong university academics) felt that they were the ones making assessment decisions about courses they were teaching. (Watkins, 1998, p. 14)

The assessment methods that these academics chose (over half of them reported using individual assignments, essay examination questions, group assignments, short

answer questions, and tutorial participation) are deep-rooted in their beliefs that tertiary education should achieve higher order learning outcomes such as critical thinking, self-directed learning, and the ability to apply knowledge to novel situations. (Watkins, 1998, p.16)

However, Watkins (1998) further points out that, although the link of conceptions to practices is strong, it is still not enough for university teachers to desire to influence student learning by rewarding high order learning outcomes. This is because over half of those interviewed claimed to desire such an outcome but felt that they were unable to achieve it. (Watkins, 1998, p. 17)

A research about Cypriot teachers' conceptions of methods of teaching and assessment in Mathematics (Kyriakides, 1997), Cypriot teachers, as a group, didn't reject the idea that assessment should be based on pupils' outcomes rather than on process. Moreover, it cannot be claimed that they agreed with assessment of pupils' attitudes to Mathematics. Also, a very substantial agreement among Cypriot teachers was observed. It can be claimed that there was consensus among teachers' opinions about methods of teaching and assessment in Mathematics.

In the same research, teachers were asked to rank twice eight techniques of assessment in Mathematics according to their appropriateness and their ease. The results showed that Cypriot teachers agree among themselves in their ranking of the relative appropriateness of each technique and also agree among themselves in their ranking of the relative ease of each technique. Structured observation and interview were considered as the most appropriate methods. The oral question- and-answer is the method considered as the next most appropriate. Methods in the middle range of appropriateness are the extended written questions, multiple choices questions and direct written questions, which have mean ranks very close to 4.5. Finally, unstructured observation was seen as the least appropriate technique and sentence completion as the next least appropriate. Interview and structured observation were considered as the most appropriate but the least easy techniques. Likewise, the direct written question and the unstructured observation were regarded as one of the easiest but least appropriate. However, oral question-and-answer was seen as the third most appropriate and as the easiest method. It can be argued that, with one exception, there is a negative correlation between the appropriateness and ease of techniques of assessment.

As regards teachers' perceptions of methods of improving assessment, the study (Kyriakides, 1997) showed that the most important ways of improving assessment were further training in techniques of assessment and smaller class size, whereas the least important was the existence of another adult in the classroom. The other way of improving assessment which is differentiated from all the others is the one concerning time free of class contact which was seen as the second least important way.

Two significant implications emerged from the data on Cypriot teachers' perceptions about the appropriateness and ease of the eight techniques of assessment. First, the ideological position in Cyprus is less clear-cut than in England. Cypriot teachers considered as more appropriate the techniques, which operate under controlled conditions. This might reflect the highly centralized educational system of Cyprus and especially a perceived need to have "tangible proof to show to parents and inspectors. With the term tangible proof teachers meant information gathered from assessment, which can be easily understood, by parents and inspectors since numbers can be used to represent pupils' attainment. However, the appropriateness of the

techniques of assessment should be judged on the kind of information they make available to teachers.

Thus, if assessment policy emphasizes only written tests, it would neither find ideological support among teachers nor improve assessment practice, but it would provide the government with another way to control curriculum practice. Second, there was an inverse relationship between assessment techniques seen as most appropriate and those seen as most easy. Teachers regarded interview and structured observation as the most appropriate techniques but as the least easy.

In summary, on the basis of the evidence, two conclusions are constructive to effective learning and assessment in the professional and vocational education context.

These are (i) an urge to change the belief and judgment of what counts as valid assessment and (ii) the development of an "assessment for learning" culture through professional development and training.

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OUTCOMES OF THE ANALYSES OF QUANTITATIVE DATA

1. INTRODUCTION

The Analysis Report (Deliverable 2.2) is a report including the results of the survey and directions for the pilot training courses aiming to improve beliefs emerged in survey. It actually contains the data collected from the submission of the 2 questionnaires developed under the FAMT&L project:

1. Questionnaire for mathematics teachers' conceptions and beliefs on formative assessment in mathematics teaching and learning.
2. Questionnaire for students' conceptions and beliefs on formative assessment in mathematics teaching and learning.

The above mentioned questionnaires contain statements that examine the teachers' and students' beliefs about the purpose and the use of formative assessment, but also the practices used by teachers and students before, during or after the assessment. The analysis of the statements has been presented in a statistical mode in order to facilitate the reading of the data.

The data have been analyzed in order to extract good practice examples and recommendations about the development of our training model and to set directions for the pilot training courses (WP4) aiming to improve teachers' conceptions and beliefs about formative assessment in mathematics.

This document, has been analyzed and discussed during the third meeting in Amsterdam and it is the starting point for the realization of Deliverable…..

2. METHODOLOGY

The methodology applied can be resumed in the following realization phases:

2.1. Phase 1: Development of the questionnaires

The formation of the research instruments were first of all based on the results of the literature review, which conducted as a first step of the project. An extensive study of the relevant literature in the field of beliefs and assessment in mathematics was conducted, from European and American researchers. A special emphasis was given in the systematic previous work produced in France and Italy. The literature review was performed in relation to two main axes.

The first axis was about collecting information for the concept of "beliefs" in general and then to trace the reported teachers' and students' educational beliefs.

Particularly, this examination was related to reviewing the literature about the definition of beliefs and conceptions, the importance of research in teachers' and students' conceptions about assessment, the teachers' and students' beliefs about mathematics assessment and the effect of teachers' conceptions of assessment. It is important to mention that regarding the students' educational beliefs, a limited number of papers were found, especially in the field of mathematics and science, showing the gap in this research area. This remark highlights the contribution of our research project in diminishing this gap, as a further step of our study is the examination of the students' beliefs regarding different aspects of teaching and learning related to formative assessment in mathematics.

The second axis of the literature review concerned the previous theoretical and research studies about assessment in general and formative assessment in mathematics. This review was performed for forming a coherent knowledge mainly about the different definitions of formative assessment, the main key elements of formative assessment, various proposed and used models for formative assessment in education and in particular in mathematics.

The results of the literature review were used for the construction of the teachers' questionnaires for examining their beliefs about the different dimensions that are involved in formative assessment. Different preliminary axes of investigation were determined and the various authors' opinions or research results were collected, which were then transformed to statements to be used in the questionnaires. During the study of the existing literature, previously relevant research instruments were also traced, parts of which functioned as examples for the formation of our statements. The different statements were then grouped according to our preliminary research axes. For the questions that could not be grouped in the predefined axes, additional axes were included.

After coming to a complete set of research axes, including a large number of questions in each axis, the questionnaires were send to all the partners of the project for content validation. The comments from the partners were presented and discussed in the kick-off meeting of the project. After the discussion of the comments, each axis of the questionnaires was further elaborated by the different groups formed by the participants of the meeting. All the groups' suggestions about each axis were collected by the leaders of the particular work package of the project (University of Cyprus), who then performed all the agreed corrections on the questionnaires. In particular, different axes were merged and some questions were decided to be eliminated, in order to reduce the extent of the questionnaires.

The corrected versions of the questionnaires were send to all the partners for revision. The different partners' suggestions were discussed in our second virtual meeting, in which the final decisions about the construction of the questionnaire were taken. The questionnaires were once again revised by the leaders of the work package and were send to all the partners for approval. After the finalization of the questionnaires, each partner was responsible for their translation in the relevant language and its administration.

2.2. Phase 2: Identification of the target group and strategy for reaching the identified target

There was not possibility for following a randomized sampling procedure. In fact, the teachers participated voluntarily in the research by completing the questionnaire and by allowing the researchers to use some of their teaching time for administering the respective questionnaires to their students.

The sample of our study is presented in the following table (Table 1).

Table 1

The participants of the study for each country

		CYPRUS	ITALY	SWISS	FRANCE	NETHERLANDS
STUDENTS (N=1649)	Grade 1	108	247	72	17	43
	Grade 2	72	139	67	63	152
	Grade 3	128	74	78	27	113
	Grade 4	--	--	17	21	105
	No answer	0	0	0	7	47
	Total	308	460	340	134	460
TEACHERS (N=201)		65	39	69	21	7

The following table (Table 2) summarizes some additional information about the teachers' demographics. In fact, information about the participants' gender, age, education and teaching experience is provided.

Table 2

Demographics of the participants of the study for each country

TEACHERS		**CYPRUS**	**ITALY**	**SWISS**	**FRANCE**	**NETHERLANDS**
Gender	Male	19	7	33	6	3
	Female	42	25	36	6	4
	No answer	4	7	0	10	0
Age	20-30	11	1	9	4	–
	31-40	30	7	24	6	–
	41-50	14	11	18	2	–
	51-60	9	9	14	0	–
	above 60	0	4	4	0	–
	No answer	1	7	0	9	–
Education	Diploma	62	4	17		-
	Bachelor	62	28	34	8	2
	Master	40	3	26	8	3
	Other	62	8	7	1	3
Teaching experience	0-10	23	13	42	10	4
	11-20	31	7	12	1	1
	21-30	7	4	7	0	0
	above 30	2	8	8	0	2

	No answer	2	7	0	10	0

2.3. Phase 3: Promotion of the questionnaire

The teachers' questionnaire was administered to lower secondary schools mathematics teachers. In Cyprus the questionnaires were administered to the teachers by the researchers. The teachers completed the questionnaires not within school time, so duration for completing the questionnaires was not defined. For the rest of the countries the questionnaires were completed by the teachers in an electronic version.

Country	**Link – teachers' questionnaire**	**Link – students' questionnaire**	**Period of administration**
Swiss	http://survey.edu.unibo.it/index.php/survey/index?sid=427761&lang=en	http://survey.edu.unibo.it/index.php/survey/index?sid=698937&lang=en	**June 2014**
Italy	http://survey.edu.unibo.it/index.php/survey/index/sid/698725/newtest/Y/lang/it		
France	http://limesurvey.techedulab.fr/index.php/admin/survey/sa/view/surveyid/685269	http://limesurvey.techedulab.fr/index.php/admin/survey/sa/view/surveyid/911818	**February and March 2015**
Netherlands			**February and March 2015**
Cyprus	—	—	**May and October 2014**

2.4. Phase 4: Codification of statements of the questionnaires

The statements in each questionnaire were codified according to the way they were grouped, based on the research axes defined during the development of the questionnaires.

The codification appears in the questionnaires below, in which each variable appears next to each question or statement. First, there is the codification about the students' questionnaire and then the codification about the teachers' questionnaire is presented.

CODIFICATION OF THE QUESTIONNAIRE ABOUT

STUDENTS' BELIEFS ABOUT ASSESSMENT IN MATHEMATICS

CODES	QUESTIONS	CODIFICATION	COLOUR
P – Purpose:	1-10	P1 – P10	BLUE
T – Techniques	Part B / Part C: Questions 11-17	T1 – T19 / T1B – T19B	RED
R – Results	18-23	R1 - R6	GREEN
S – Stakeholders	24 – 44	S1 - S21	ORANGE

PART A

Circle the proper choice for you or complete the following questions.

1. Date: …….

2. Gender: a) Male – 0 b) Female – 1

3. Grade: ……

4. School: ……

PART B

	A. How important do you think are the following methods of assessment in math? Put in order of importance the following methods for your assessment in mathematics. ******Note:** The number 4 represents the highest degree of importance.* ***B. Put a √ next to the items that represent your math teachers' method(s) of assessing you (you may choice more than one option).***					
		A				**B** **1= √** **0=nothing**
T1a	1a. Test with Completion tasks	1	2	3	4	T1aB
T1b	1b. Test with Multiple choice tasks	1	2	3	4	T1bB

T1c	1c. Test with True – False tasks	1	2	3	4	T1cB
T1d	1d. Test with Matching tasks	1	2	3	4	T1dB
T1e	1e. Test with Closed-ended tasks	1	2	3	4	T1eB
T1f	1f. Test with Open-ended tasks	1	2	3	4	T1fB
T2	2. Participation in class	1	2	3	4	T2B
T3	3. Portfolio	1	2	3	4	T3B
T4	4. Homework	1	2	3	4	T4B
T5	5. Project	1	2	3	4	T5B
T6	6. Presentation of works, reports etc	1	2	3	4	T6B
T7	7. Peer-Feedback	1	2	3	4	T7B
T8	8. Self- assessment	1	2	3	4	T8B
T9	9. Individual interviews	1	2	3	4	T9B
T10	10. Individual activities	1	2	3	4	T10B
T11	11. Group activities	1	2	3	4	T11B
T12	12. Other (Write down exactly the assessment method that your teacher uses):	1	2	3	4	T12B

PART C

Express your opinion about the following statements, by circling the proper number in the scale (from 1=never to 4=often).

		Never	**Rarely**	**Sometimes**	**Often**
P1	1. Assessment helps me identifying my good skills in math.	1	2	3	4
P2	2. Assessment does not help me facing my difficulties on a mathematical subject.	1	2	3	4
P3	3. The grades that I receive on a math test cannot show if I have understood the mathematical subjects I have been taught.	1	2	3	4

P4	4. Some assessments serve to verify only what I have understood on a mathematical subject and not for our grade report.	1	2	3	4
P5	5. When feedback is continuous I feel I have a foundation that helps me to understand what I am learning in math.	1	2	3	4
P6	6. Assessment in math provokes me anxiety.	1	2	3	4
P7	7. I feel more confidence about myself when I have more frequent feedback about my progress in a mathematic subject.	1	2	3	4
P8	8. Assessment information motivates me to set new goals in learning math.	1	2	3	4
P9	9. When I am not satisfied about the grades that I have received for my working in math, I have to try harder.	1	2	3	4
P10	10. The grades and the reports in math do not force me to work when I don't want to do.	1	2	3	4
	11. My teacher assesses our skills and knowledge:				
T13a	• before the instruction of each mathematic concept.	1	2	3	4
T13b	• during the instruction of each mathematic concept.	1	2	3	4
T13c	• after the instruction of each mathematic concept.	1	2	3	4
T14	12. After an assessment, my teacher develops mathematical tasks which will help me to face my difficulties in a mathematical subject.	1	2	3	4
T15	13. For improving students who fail in mathematics, the teacher explains again a mathematical topic.	1	2	3	4
T16	14. On my corrected works in math, my teacher makes comments that tell me what I have done well.	1	2	3	4
T17	15. The teacher has not any time to explain me what I don't understand.	1	2	3	4
T18	16. After an assessment my teacher uses to give different mathematical activities at each student, in order to help us promote our good skills in math.	1	2	3	4
T19	17. After an assessment my teacher differentiates the activities that he gives us according to our interests.	1	2	3	4

R1	18. Correcting my mistakes helps me to understand better a mathematical concept.	1	2	3	4
R2	19. My mistakes in math discourage me.	1	2	3	4
R3	20. After an assessment in math, my teacher wants to verify if I have understood the mistakes that I have made.	1	2	3	4
R4	21. My teacher uses our mistakes and interests to plan the next mathematics lesson.	1	2	3	4
R5	22. My math teacher wants to be with me while I am correcting my mistakes.	1	2	3	4
R6	23. If I make mistakes in math I deserve a low grade.	1	2	3	4
S1	24. Where appropriate, I am involved in decisions about how the assessment in math will take place.	1	2	3	4
S2	25. After an assessment in math, my teacher asks me to make a self-assessment on my corrected work.	1	2	3	4
S3	26. On my corrected work in math, I make comments that tell me what I have done well.	1	2	3	4
S4	27. After a classmate marking my test or work in math, I can acknowledge my mistakes easier.	1	2	3	4
S5	28. The opinion of the good students about my test or my work in math is more important for me than the opinion of the rest students.	1	2	3	4
S6	29. Having us giving feedback on each other's work helps me also to develop my self-assessment skills.	1	2	3	4
S7	30. Peer review leads to differentiate the good students from non-good.	1	2	3	4
S8	31. Having the students correcting each other's work in class leads to increase the competitiveness among them.	1	2	3	4
S9	32. I prefer not comparing my results in math with my classmates in order to avoid their derision.	1	2	3	4
	33. My math teacher uses to call my parents to make a discussion:				
S10a	• *before* my assessment.	1	2	3	4
S10b	• *after* my assessment.	1	2	3	4
S11	34. My parents make comments about my corrected tests or works in math, even if I get low or high	1	2	3	4

	grades.				
S12	35. When I am assessed in math, I usually do a working without knowing precisely what I am expected to do.	1	2	3	4
S13	36. My teacher's goal of assessment is identifying my learning difficulties in math in order to help me to overcome them.	1	2	3	4
S14	37. I use to discuss with my teacher his/ her own expectations before an assessment in math.	1	2	3	4
S15	38. I prefer to know the criteria that my teacher uses for my assessment in math.	1	2	3	4
S16	39. When it is clear to me what and how to learn in a mathematics class, I become a more motivated and engaged learner.	1	2	3	4
S17	40. For me, to be successful in math means to have a good grade report.	1	2	3	4
S18	41. It's more important for me to understand the mathematical knowledge I am taught than to get high grade.	1	2	3	4
S19	42. I usually create a personal check list in order to assess myself in math.	1	2	3	4
S20	43. If I don't know the grades of my classmates I am not able to know if I have succeeded in math.	1	2	3	4
S21	44. To be successful in math, I have to be more successful than the rest of the students in my classroom.	1	2	3	4

CODIFICATION OF THE QUESTIONNAIRE ABOUT

TEACHERS' BELIEFS ABOUT ASSESSMENT IN MATHEMATICS

CODES	QUESTIONS	CODIFICATION	COLOR
P – Purpose:	1-10	P1 – P10	BLUE
T – Techniques	1-21	T1 – T21	RED
R – Results	PART D: 1-7 PART E: 1-12	R1 – R19	GREEN
S – Stakeholders	1- 4	S1 – S4	ORANGE
TR - Training	1-16	TR1-TR16	PURPLE

PART A: Circle the proper choice for you or complete the following questions.

Gender: a) Male -0 b) Female -1

Age: a) 20-30 b) 31-40 c) 41-50 d) 51-60 e) above 60

Education: E1 - Bachelor ☐ Subject: _____

E2 - Master ☐ Subject: _____

E3 - Doctoral ☐ Subject: _____

1=✓ 0=NOTHING

How long have you been teaching mathematics? (indicate number of years)

__YEARS_____

Have you ever taught in school levels different than the current one? DSL

- No ☐

- Yes ☐ How long _ DSLy and at which level?

DSLl_____

1=✓ 0=NOTHING

Are you teaching in more than one schools? NS

- No ☐

- Yes ☐ Number of schools: __ NSn_____

1=✓ 0=NOTHING

Are you part of (or working with) any association operating in the field of education?
AS ☐

- No

- Yes ☐ Name of association: _____
ASn_____

1=✓ 0=NOTHING

Have you ever attended any in service training activities in assessment organized by public or private institutions? TA

- No ☐

- Yes ☐ Indicate training activities:_____
TAn_____

1=✓ 0=NOTHING

Have you read any articles on the topics of school assessment over the past three school years? AR

- No ☐

- Yes ☐

1=✓ 0=NOTHING

PART B: Express your level of agreement/ disagreement for each of the following statements, about the purpose and functions of assessment in classroom.

		Strongly
P1	1. Formative assessment establishes what students have learned in mathematics.	

P2	2. Formative assessment identifies the students' strong and weak abilities in mathematics.	
P3	3. Formative assessment identifies how students think in mathematics.	
P4	4. Formative assessment should be based on the pupils' outcomes in math rather than on the process.	
P5	5. Formative assessment should assess the students' ability to apply mathematics in unfamiliar everyday situations.	
	6. The different assessment methods aim to assess the students':	
P6a	a) Knowledge (memorization): the ability to memorize rules, axioms, theorems and other mathematical information	
P6b	b) Comprehension (understanding): the ability to perceive mathematical meaning and to transform mathematical ideas from one form to another	
P6c	c) Analysis: the ability to analyze information and to arrive to mathematical conclusions	
P6d	d) Synthesis: the ability to organize mathematical ideas altogether to form a complete image that has meaning	
P7	7. The purpose of formative assessment is to help students overcome improve themselves in mathematics.	
P8	8. Formative assessment is subjective while summative assessment is objective.	
P9	9. According to the formative assessment results, I modify my instructional plan according to my students' needs.	
P10	10. Assessing my students' is very useful for me, because it gives me a chance to verify the validity of my work.	

PART C: Express your level of agreement/ disagreement for each of the following statements, about the use of different assessment techniques.

		Strongly Disagree	Rather Disagree	Rather Agree	Strongly Agree
T1	1. For formative assessment to be fair, it must be uniform through the use of standardized the tasks.	1	2	3	4
T2	2. Assessments on a particular topic of the mathematics curriculum (e.g. Pythagoras' theorem or Space geometry) should not influence evaluation on other topics (e.g. Solving equations or Algebra).	1	2	3	4
	3. The professional development of classroom formative assessment practice requires the teachers to understand:				
T3a	a) The potential for the social construction of knowledge.	1	2	3	4
T3b	b) The potential to improve students' learning.	1	2	3	4
T4	4. Sometimes it is necessary to assign lower evaluation grades, in order to encourage the student to make a greater effort.	1	2	3	4
T5	5. The teacher shouldn't tent to make known to the students the used criteria of evaluation.	1	2	3	4
T6	6. Different mathematical capabilities (e.g. Argumentation vs Computational capability) need different assessment practices or tools.	1	2	3	4
T7	7. If a teacher does not commit itself in identifying the weakness and strengths of the students since the beginning of the academic year, then he/she cannot certainly fill in the students' gaps.	1	2	3	4
T8	8. Formative assessment in mathematics is conducted primarily through informal observations.	1	2	3	4
T9	9. Formative assessment is conducted primarily through oral questions posed to students while the mathematical content is being taught or reviewed.	1	2	3	4
T10	10. Formative assessment means giving ungraded mathematical	1	2	3	4

	assignments.				
	11. To what degree do you agree that the following assessment techniques are appropriate to be used in the teaching of mathematics?				
T11a	a) Unstructured observation	1	2	3	4
T11b	b) Oral question-and-answer	1	2	3	4
T11c	c) Structured observation	1	2	3	4
T11d	d) Interview	1	2	3	4
T11e	e) Performance test for each pupil	1	2	3	4
T11f	f) Multiple choice and	1	2	3	4
T11g	g) Matching questions	1	2	3	4
T11h	h) Sentence Completion	1	2	3	4
	12. Some characteristics of assessment are embodied in a number of processes like**:**				
T12a	a) sharing learning mathematical goals with students	1	2	3	4
T12b	b) providing feedback that helps students to identify how to improve in mathematics	1	2	3	4
T12c	c) both the teacher and the students reviewing and reflecting on their performance and progress	1	2	3	4
T12d	d) students learning self-assessment techniques to discover mathematical abilities they need to further work on.	1	2	3	4
T13	13. Formative assessment is most effective when students have a clear idea of what the teachers expect of them.	1	2	3	4
T14	14. Teachers can improve the clarity of student learning targets by providing examples of both weak and stellar mathematical work.	1	2	3	4
T15	15. Providing clear expectations enables students to set realistic, attainable goals.	1	2	3	4
T16	16. Formative assessment is most effective when teachers offer feedback about the students' progress toward meeting particular learning targets.	1	2	3	4
T17	17. Formative assessment is most effective when teachers encourage student's self-assessment.	1	2	3	4
	18. High-quality formative assessment takes many forms, but it always:				
T18a	a) emphasizes to the quality rather than the quantity of student mathematical work.	1	2	3	4

T18b	b) focus giving advice and guidance over giving grades.	1	2	3	4
T18c	c) avoids comparing students in favor of enabling individual students to assess their own learning.	1	2	3	4
T18d	d) provides feedback that strengths motivation and leads to improvement in mathematical knowledge and abilities.	1	2	3	4
	19. To what degree do you agree that the following factors form your expectations about your students' future assessment?				
T19a	a) Previous certificates	1	2	3	4
T19b	b) Current scores	1	2	3	4
T19c	c) Participation in classroom activities	1	2	3	4
T19d	d) Personal behavior	1	2	3	4
T19e	e) Personal motivation to learn	1	2	3	4
T19f	f) Interest in classroom assignments	1	2	3	4
T19g	g) Interest in homework assignments	1	2	3	4

	20. How often do the following factors affect your ability to apply different assessment methods?	**Never**	**Rarely**	**Often**	**Always**
T20a	a) The curriculum workload	1	2	3	4
T20b	b) The testing workload	1	2	3	4
T20c	c) The insufficient awareness of the different assessment methods	1	2	3	4
T20d	d) The large number of students in the class	1	2	3	4
T20e	e) The insufficient teaching time	1	2	3	4
T20f	f) Students' low achievement level	1	2	3	4

	21. How skilled do you think you are in applying the following assessment techniques?	**Not skilled**	**Less skilled**	**Skilled**	**Totally skilled**
T21a	a) Classroom discussion	1	2	3	4
T21b	b) Classroom observation	1	2	3	4
T21c	c) Individual interviews with students	1	2	3	4
T21d	d) Assessing students' individual activities	1	2	3	4
T21e	e) Assessing students' group activities	1	2	3	4
T21f	f) Oral questioning	1	2	3	4

T21g	g) Assessing students' presentation skills	1	2	3	4
T21h	h) Students' self-assessment	1	2	3	4
T21i	i) Students' peer-assessment	1	2	3	4

PART D: Express your level of agreement/ disagreement for each of the following statements, about the use the results of assessment.

		Strongly Disagree	Rather Disagree	Rather Agree	Strongly Agree
	1. Providing feedback to a student can be achieved by:				
R1a	a) providing a verbal statement about the quality of work itself (the reasons for the judgment and ways in which some of the shortcomings could be remedied).	1	2	3	4
R1b	b) showing students' specific misunderstandings or errors that frequently occur in a particular mathematical content area or a skill set.	1	2	3	4
R1c	c) showing students how they can adjust their approach to the task.	1	2	3	4
	2. The results' of formative assessment should be:				
R2a	a) announced to the whole class.	1	2	3	4
R2b	b) discussed between parents and teacher.	1	2	3	4
R2c	c) discussed between the pupil and the teacher.	1	2	3	4
R3	3. Formative assessment works best when the teacher avoids grading practices and comments that show students how their performance compares to other students	1	2	3	4
R4	4. The quality of feedback increases when providing feedback right after a submission.	1	2	3	4
R5	5. Feedback about the students' progress in learning mathematics gives hope and positive expectations for themselves.	1	2	3	4
R6	6. Formative assessment during instruction provides feedback that help students correct their errors.	1	2	3	4
R7	7. Formative assessment during instruction helps the teachers identify and implement instructional correctives.	1	2	3	4

PART E: Express your level of agreement/ disagreement regarding the degree you consider that mathematical errors are derived from the following reasons.

		Strongly Disagree	Rather Disagree	Rather Agree	Strongly Agree
R8	1. Errors are associated with lack of knowledge.	1	2	3	4
R9	2. Errors are associated with the text of the problem.	1	2	3	4
R10	3. Errors are associated with the way the student studies and prepares himself/herself.	1	2	3	4
R11	4. Errors are associated with student's attitude towards mathematics.	1	2	3	4
R12	5. Errors are associated with the psychological situation of the student.	1	2	3	4
R13	6. Errors are associated with inappropriate ways of teaching.	1	2	3	4
R14	7. Errors are due to the limited capabilities of students.	1	2	3	4
R15	8. Errors are due to wrong or incomplete knowledge about a concept taught previously.	1	2	3	4
R16	9. Errors are due to previous correct knowledge which is not appropriate in a new situation.	1	2	3	4
R17	10. Errors are due to a confusion of the model needed for completing a task with an already known model.	1	2	3	4
R18	11. Errors are due to the students' tendency to fulfill their teacher's wishes without examining them.	1	2	3	4
R19	12. Errors are due to the fact that an inappropriate question for the ability of the student is given.	1	2	3	4

PART F: Express your level of agreement/ disagreement regarding the stakeholders involved in the assessment process.

		Strongly Disagree	Rather Disagree	Rather Agree	Strongly Agree
S1	1. Formative assessment provides a tangible product that the teacher can share with students and parents.	1	2	3	4

S2	2. Formative assessment gives the students the chance to assess themselves.	1	2	3	4
S3	3. Students can develop a deeper understanding of their learning when they are given opportunities to discuss the learning process with their teacher and their peers.	1	2	3	4
S4	4. While teachers provide feedback, they can encourage self-assessment by asking students questions that help them to focus on self-monitoring.	1	2	3	4

PART G: Answer the questions about the teachers' training on issues of assessment and note ✓ where it is necessary.

	Given assessment workshops in the future, please indicate which topic(s) you would like to attend.	
TR1	1. Methods to assess students' achievement.	
TR2	2. Encourage students' participation in classroom activities.	
TR3	3. The application of different assessment methods.	
TR4	4. Analyzing assessment method results.	
TR5	5. Using assessment methods to provide students with feedback.	
TR6	6. Using assessment methods to improve students' abilities.	
TR7	7. Using assessment methods to develop teachers' abilities to teach effectively.	
TR8	8. Higher order questioning techniques.	
TR9	9. Use of misconceptions.	
TR10	10. Feedback as comments and not grades.	
TR11	11. Oral feedback.	
TR12	12. Sharing assessment criteria.	
TR13	13. Peer assessment.	
TR14	14. Students' self-assessment.	
TR15	15. Other topic (please indicate):	
TR16	16. I would not like to attend any assessment workshop.	

2.5. Phase 4: Analysis of the results of the questionnaires

A descriptive report about the results of the teachers' and the students' answers in the two questionnaires were prepared by each partner. These results are indicated through graphs, showing the way the teachers and the students' way of answering in each statement. The collected data from the teachers' questionnaires were analysed using the software CHIC (Classification Hiérarchique, Implicative et Cohésitive), for tracing the relations between the techers' beliefs and the practices they use. The data from the students' questionnaire were analyzed using the computer software called C.H.I.C., using the method of the hierarchical clustering of variables for tracing the similarity connections between the variables.

In the results session, part A includes the results about the teachers' data, whereas the results about the students' data are included in part B.

3. RESULTS

3.1. PART A: TEACHERS' QUESTIONNAIRE RESULTS

3.1.1. The Teachers' Questionnaire in Italy

On the whole 58 teachers gave answers to our online questionnaire, 31 of them were from the same school where the students' questionnaire had been distributed. The answers were given in the period between May 2014 and February 2015.

Among the 58 questionnaires, 28 were from women and 30 from males; a good majority (22) is between 41 and 60 years old, among them 16 were aged between 51 and 60 and 14 between 31 and 40. Only one person was below 30 and 5 more then 60.

The greatest part (45, the 77.6%) of the teachers had a permanent position ("docente di ruolo"), while 21 (36.2%) said that they have been teaching in schools of different levels, in particular in high school (secondaria di II° grado).

About assessment, 19 people (32.8%) had specific formation on the subject, and 25 (43.1%) had been reading texts about this subject in the last three years.

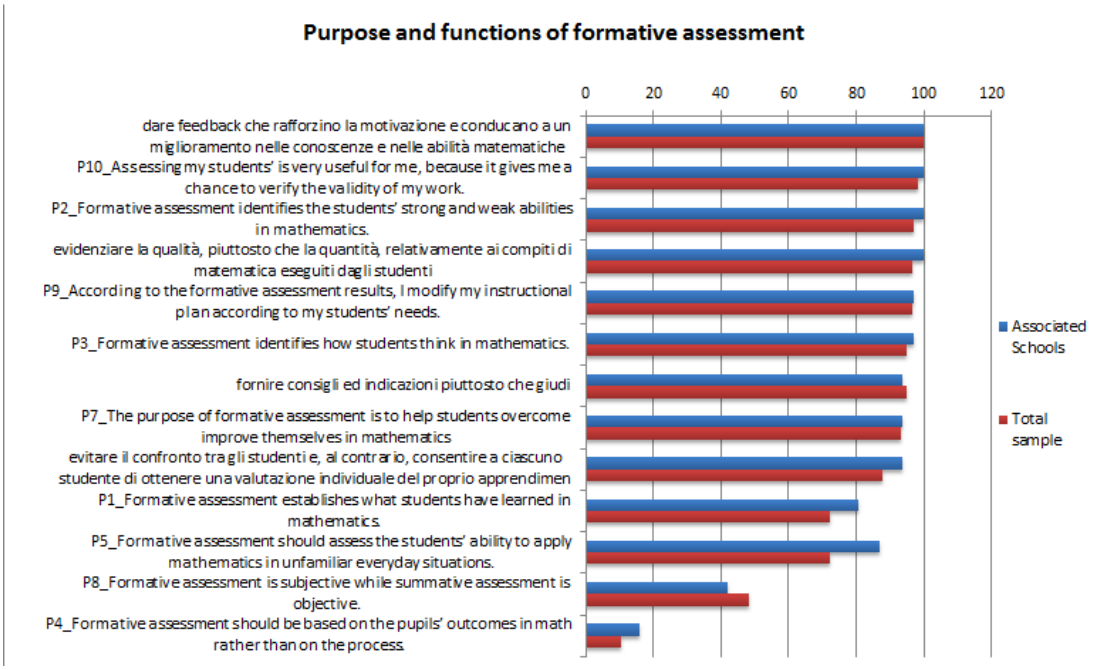
The questions in the Italian questionnaire have been grouped and stated in a different way with respect to the one shared among the partners of the project, hence this report groups the data as to get specific information for every section of the questionnaire. The data refer to percentages obtained by summing the highest values ("very" and "rather") in the answers. In the list of the answers we write in parentheses the question code, whether it corresponds to the one in the shared version, and if the question is for Italian teachers only. We add a few graphs to describe the data.

Moreover, initially only the teachers of the schools which are Associated Partners to the project were involved, but later we collected answers also from teachers of other schools (thanks to the involvement of Bologna's "Ufficio Scolastico Provinciale"/Province department for School) in a few cases we write down also data which allow to compare the results of the first phase and the total ones.

1. The aims of Formative Assessment (FA)

In the opinion of the teachers who answered the questionnaire, FA, in order of importance, should, as in the figure 1.1:

1. give feedbacks that can strengthen motivation and yield improvement of knowledge and abilities (question for Italians only, 100% of affirmative answers)
2. give the possibility to confirm how much own work is appropriate (question P10)
3. identify strong and weak points in the students' learning (question P2)
4. show the quality, rather than quantity (question for Italians only)
5. allow the teacher to understand how to improve changing her/his own programs (P9)
6. understand students' reasoning (P3)
7. give indications more than valuations (question for Italians only)
8. avoid competition among students, but allow self-assessment (question for Italians only)



This list does not show big differences among answers from teachers of the Associated Partners schools and the others; we can deduce from this that there is a good awareness, among the teachers, about the main aims that should be the

characteristics of FA in class.

On the contrary, the main "disagreement" percentages are about consideration of FA as more subjective with respect to final valuation (P8) and about the fact that FA is based rather on results

than on processes (P4), and this confirms the bigger consensus about items which underline FA importance with respect to quality and the aim of improving teaching and learning processes.

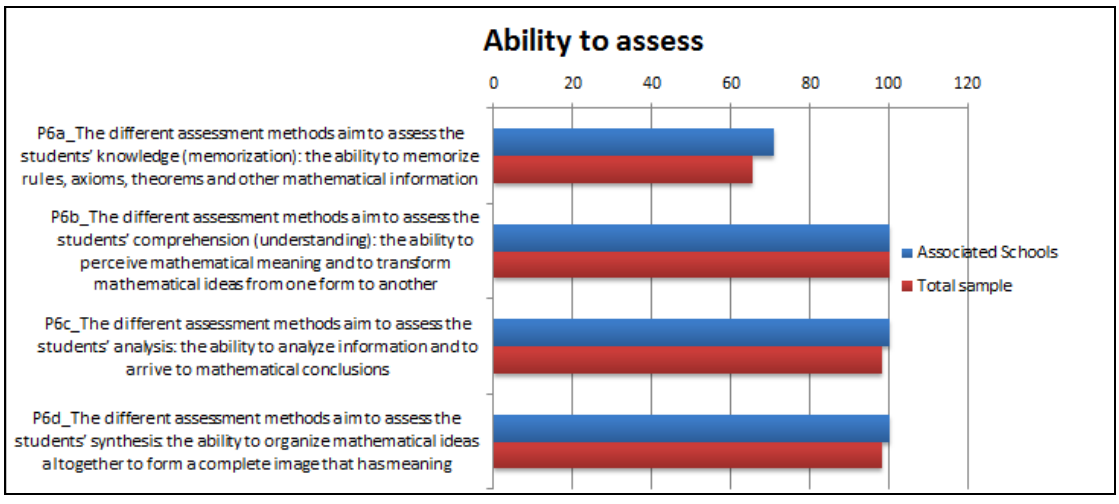
It seems, on the whole, that the teachers value FA more as aimed to disclosure of learning processes rather than as a way to evaluate results.

2. What is it important to be valued

As for the object of assessment, the teacher confirmed the ideas we described before, inasmuch they think that FA is aimed to evaluate the understanding, analysis and synthesis, rather than to understand the content of the subject. Actually they answered that, in their opinion, it is important to use FA to get information about the ability for:

1. Understanding (P6b – 100%)
2. Analysis and Synthesis (P6c and P6d)
3. Knowledge (P6a), with 65.5% for the total data, and 71% for partial ones.

As it is possible seeing in the graph n. 2.1, there are no particular differences, hence, among data coming from teachers of Associated Partners schools and the others.



3. The tools for FA

About using specific tools for Mathematics learning, the teachers seem to prefer the following items (based on the total data, as it is possible seeing in the figure 3.1):

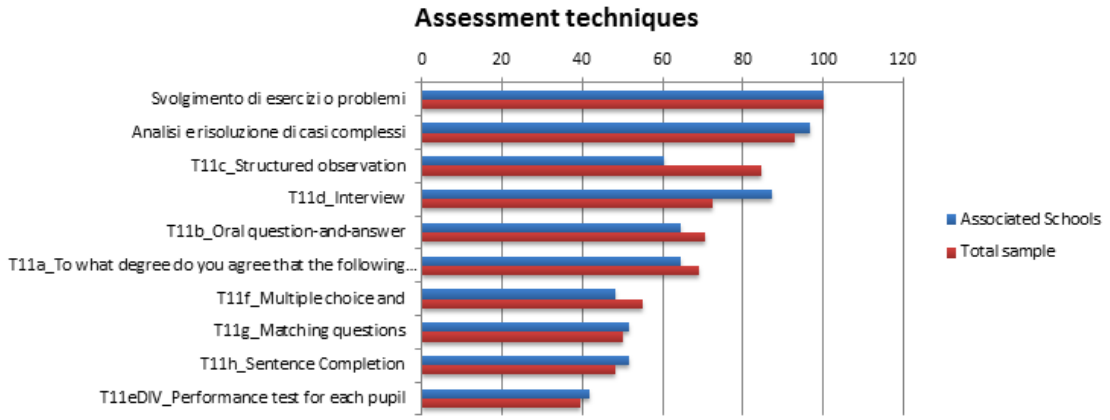
1. Exercises or problems (specific item for Italian teachers)
2. Analysis and resolution of complex cases (specific item for Italian teachers)
3. Structured observations (T11c) (84.5% on total data and 60,3% for partial ones)
4. Interviews and individual talks (T11d)(72,4% on total data and 87.1% for partial ones)

For those two last items a bigger difference between the percentages on total data and partial ones (teachers of Associated Partners schools).

Also oral questions got high percentages (T11b, 70.7% on total data 64.5% for partial ones) and Observation of the math performances of the students in class (T11a, il 69% on total data and 64.5% for partial ones).

Structured tests are considered less useful for FA (T11h, with 48.3%, and T11e (test true/false) with 39.7% .

This leads to think that teachers prefer open tests, or test oriented to understand processes and kind of reasoning, rather than mere acquisition of concepts.



4. Perceptions of Competence in the use of tools

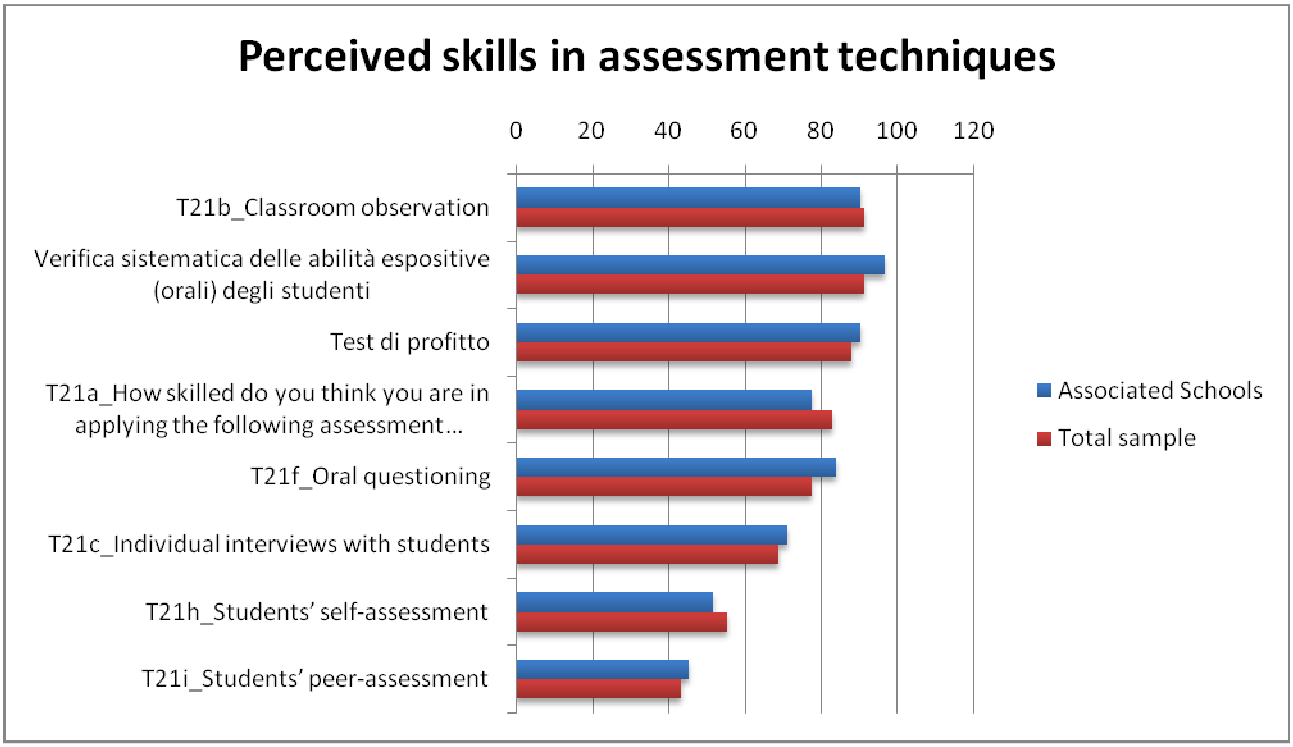
The teachers were also asked about their perception about their own skillfulness at using tools for assessment. Most of them (91.4%) think to be very competent to observe students in class and interviewing them with systematic tests about their exposition ability. This last kind of tool got even higher percentage (96.8%) in the answers coming from Associate Partner schools, and it is strengthened by the high percentage (77.6%) gotten by the answer about oral questions.

Seeing the graph, strong percentages could be noticed also for items about perception of competence in using tools such as knowledge tests (87-9%) and analysis of

discussions in class (82.8%).

The perception of the teachers' own competence is less high, instead, in items about using peer valuation (question T21i, 43.1%) and self assessment (question T21h, 55.2%); this we found also in the first data with teachers from Associate Partner schools (with, respectively 45.2% and 51.6%).

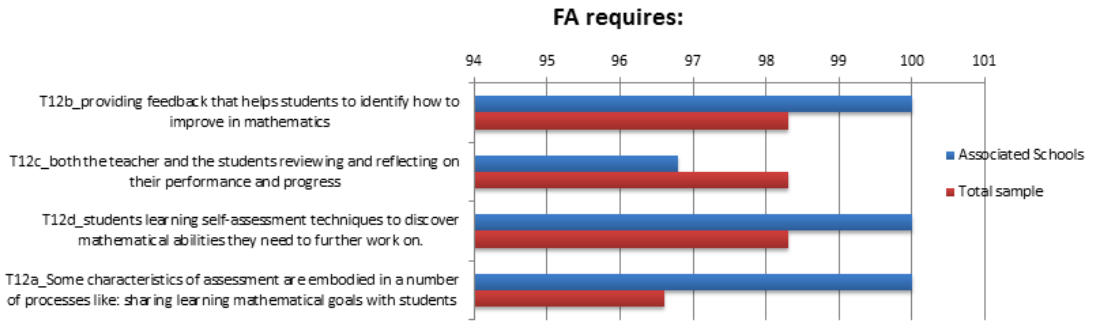
These results show a certain disagreement between the teachers' competence in using the several kind of tools and the ones they actually use.



5. Use of FA in Mathematics

From their answers, as it is confirmed in the figure n. 5.1, we know that the opinion of the teachers is that assessment in Mathematics, to be really "formative", should give feedback able to help students (T12b), it should enhance discussion together with the students about their performance and progresses (T12c), it should propose them self assessment techniques (T12d), with 98.3%). In their opinion, instead, FA is less useful to share the aims of learning with the student (T12a, 96.6%).

There is a slight difference between partial and total data, since teachers from Associate Partner schools gave larger importance (100%) to items: (T12b) Give feedback to help students, (T12a) Share the aims of learning with the students and (T12d) Propose self assessment techniques to students, while they feel that FA is less useful to enhance discussions with the students about their performance and progresses (about 97%).



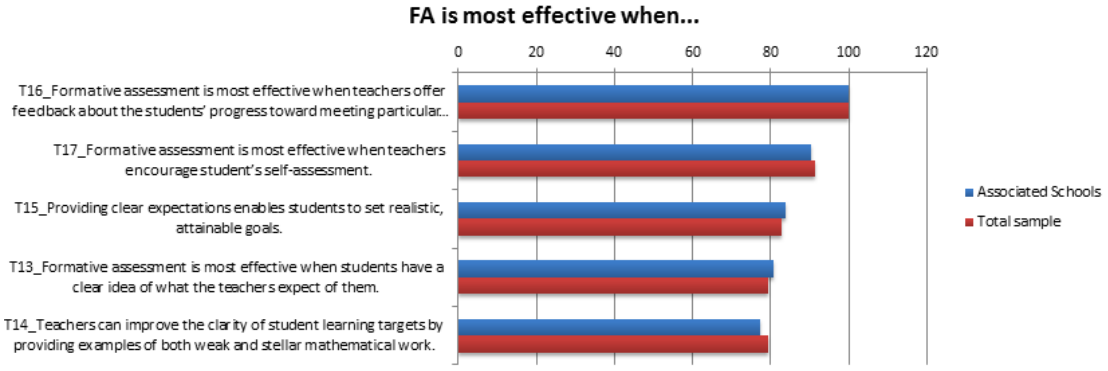
6. When FA is more effective

Considering that the teachers have the scopes of FA clear enough, their answers to "When is FA more effective?" were, as we can see in the graph n. 6.1:

1. T16_When the teacher gives feedback on students' progresses (100%)
2. T17_ When the teacher promotes the skill of self assessment (91.4%)
3. T15_ When the teacher makes explicit what is expected to fix feasible targets(82.8%)

There are no relevant differences in the answers between the two set of data (partial and total ones).

Thus it is quite clear that, in the teachers' opinion, FA should shape itself above all for the kind of feedback to give to students and for its function of self assessment and enhancement of good practices in the teaching-learning process.



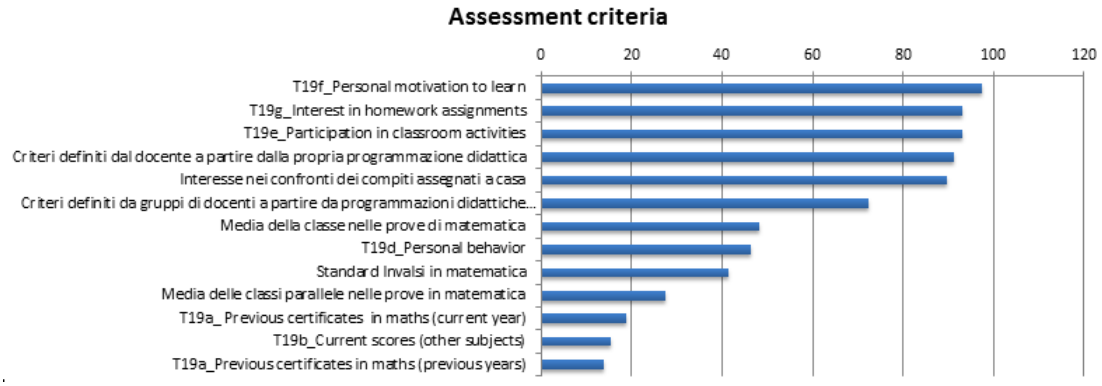
7. Assessment criteria

The criteria that were most considered by the teachers were the following:

1. T19f_ personal motivation/interest (97.5%)
2. T19g_Interest for given homework (93.2%)
3. T19e_Partecipation in the class (93.1%)
4. Criteria defined by the teacher coming from her/his teaching programs (91.4%)
5. Interest for given homework (89.7%)
6. Criteria defined by groups of teachers from common teaching programs (72.4%)

At the same time, they declared that they consider less the students' marks, in that year or in the previous one, both in Mathematics or in other subjects, and their average in parallel classes, thus showing that they prefer to base their valuation only on what they observe in the current time.

In this case, the figure (7.1.) presents only the data about the total sample.



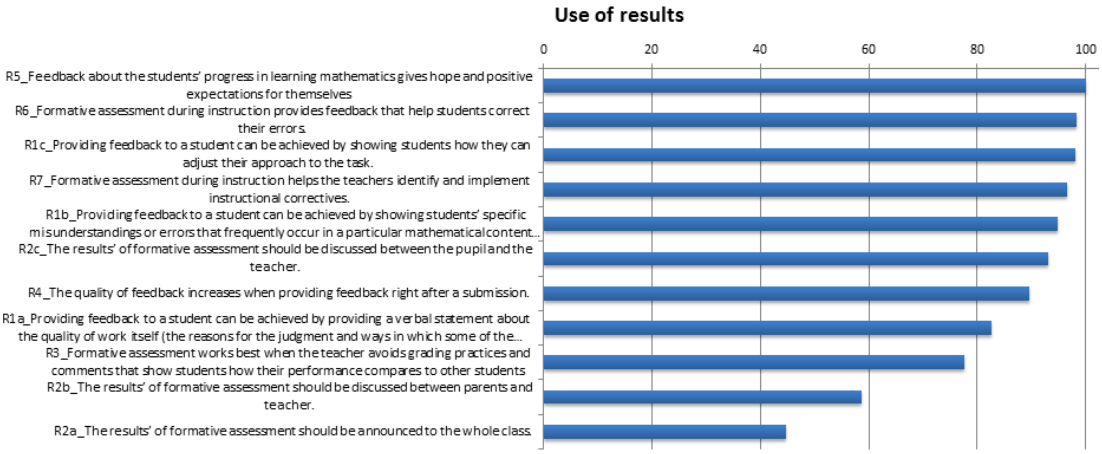
8. Use of results

As we can see in the graph (fig. n. 8.1), about teachers' opinions on the results and their use, they express, mostly, that results are useful for:

1. R5_ give confidence and posite expectations (100%)
2. R6_ help the students to correct their errors (98.3%)
3. R1c_ give feedback, showing to the strudents how they should approach their tasks (98.2%)
4. R7_ help the teachers to introduce tools to correct their teaching (96.5%)
5. R1b_give feedback showing specific mistakes that students often do on a particular content (94.9%)
6. R2c_start a discussion about the results themselves among teachers and students (93.1%)

Hence teachers see clearly the importance of feedback in order to improve students' capabilities and the teaching-learning process itself.

At the same time they give less importance (44.8%) to giving the results of FA to the class (item R2a) or to discussing them with parents (item R2b, with 58.7%).



9. Causes of mistakes and of difficulties

Some questions were aimed to show which are, in the teacher opinions, the main causes for teir students' mistakes and difficulties.

From their answers it appears, we can see itin the graph 9.1, that they mainly think that these causes lie in the students' behavior, and in particular:

1. in their method of studying (R10), with 96.5%,
2. in the student's confusion about the needed mental model (R17), with 91.4%,
3. in wrong or incomplete knowledge (R15) with 87.9%.

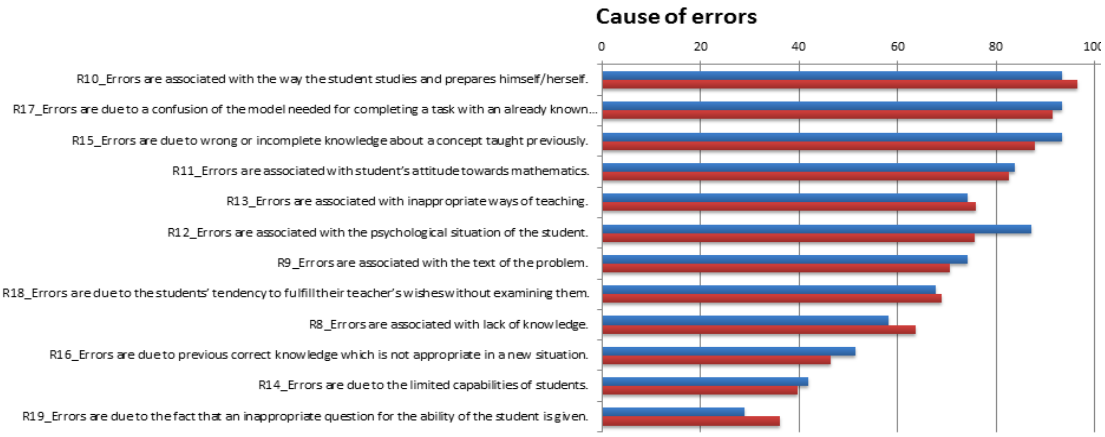
High percentages are also attributed to personal attitudes, as:

- Students' attitude towards Mathematics (item R11 with 82.7%)
- Inefficient ways of teaching (item R13 with 75,.9%)
- psychological attitude of students (item R12 with 75.8%)

Hence, in their opinion, errors and difficulties of students are not as much due to teachers but to reasons relative to the students themselves; actually, only 36.2% (and even less for Associate Partner schools, with 29%) of them think that mistakes could be caused by the use of inappropriate questions for verifying their abilities.

It must be said, nevertheless, that only a minority of teachers consider that the difficulties comes from limited capacities of the students (question R14, with 39.7%). This shows that the teachers think anyway that the results can be improved thanks to more and better studying and to better techniques in teaching and in FA.

Also for this group of questions there are no major differences between the partial and total data.



10. Courses

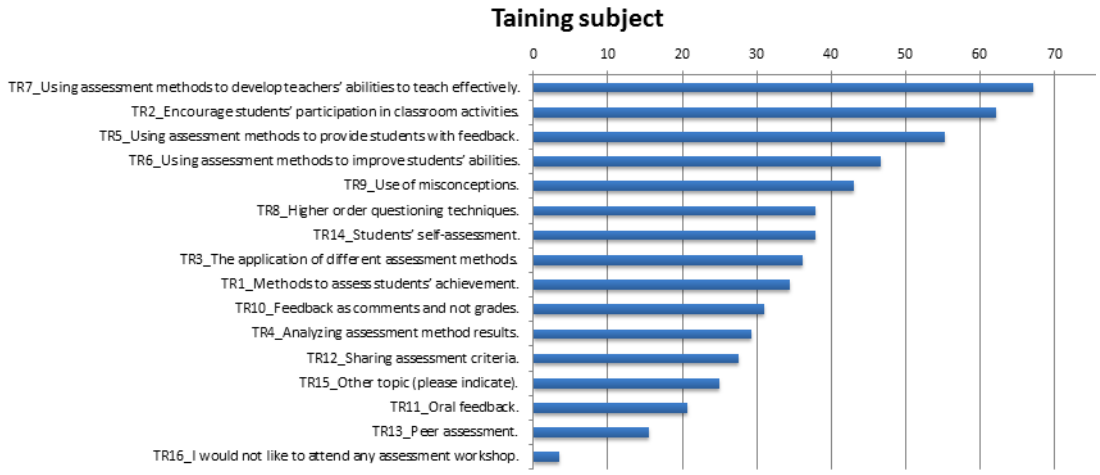
Teachers were asked if, and with which kind of tools, that would have required some formation to improve their competence in FA. Only 3.4% of them said that they do not want a specific formation, while the higher percentages were about a kind of formation which could have as a subject:

1. TR7_Procedures and valuation tools to improve teachers' efficiency (67.2%)
2. TR2_How to improve students' participation(62.1%)
3. TR5_Use of formative feedback (55.2%)

Lowest percentages were given to formation about: peer evaluation (question TR13, with 15.5%) and use of oral feedback (question TR11, with 20.7%).

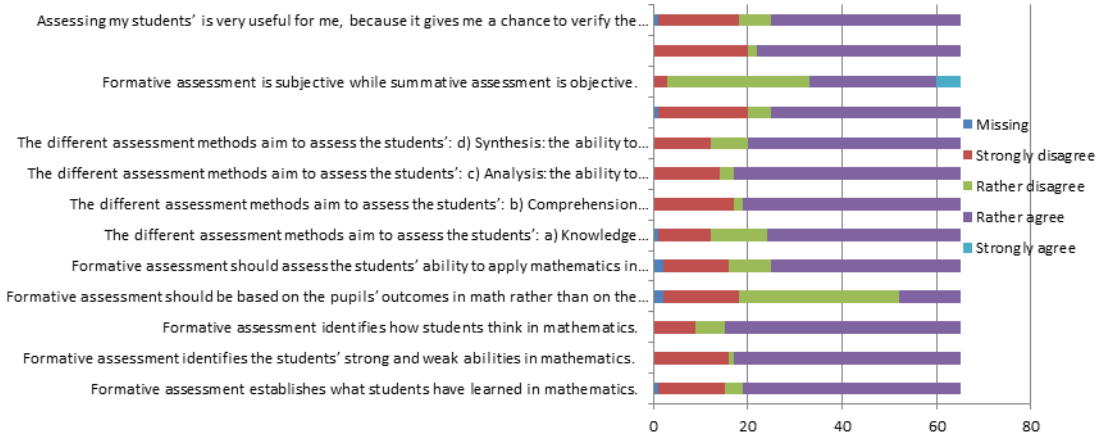
Those results can be related to the ones about perception of own competence in the use of the tools for assessment; also in that case the peer evaluation got a low percentage.

We can see all details in the Figure n. 10.1. (total sample).



3.1.2. The Teachers' Questionnaire in Cyprus

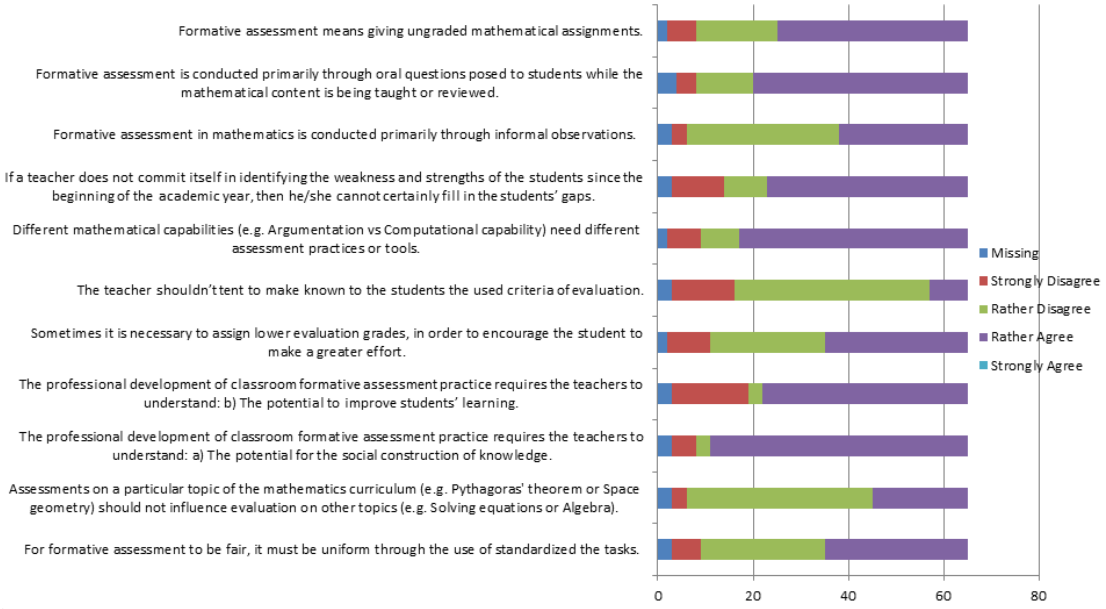
1. All questions of PART B



Graph 1

As regard teachers' beliefs about the purpose of assessment, the graph shows an agreement between the majority of the teachers. More specifically, most of the teachers argue that formative assessment identifies how students think in mathematics, students' strong and weak abilities in mathematics, establishes what students have learned in mathematics. The aforementioned objectives of formative assessment seem to be the major for the sample of our research. In addition, consistency between teachers' opinions about the aims of different assessment methods is observed. In particular, most of the teachers consider the abilities of the analysis, comprehension (understanding), synthesis and knowledge (memorization) as the next main purposes of the different assessment methods. The majority of the teachers support that the results of students' assessment give them the chance to verify the validity of their work, modify their instructional plan according to their students' needs, in order to help students overcome improve themselves in mathematics. Furthermore, they argue that formative assessment should assess the students' ability to apply mathematics in unfamiliar everyday situations. In contrast, most of the teachers disagree that formative assessment should be based on the pupils' outcomes in math rather than on the process. Similarly, most of them disagree with the opinion that formative assessment is subjective while summative assessment is objective.

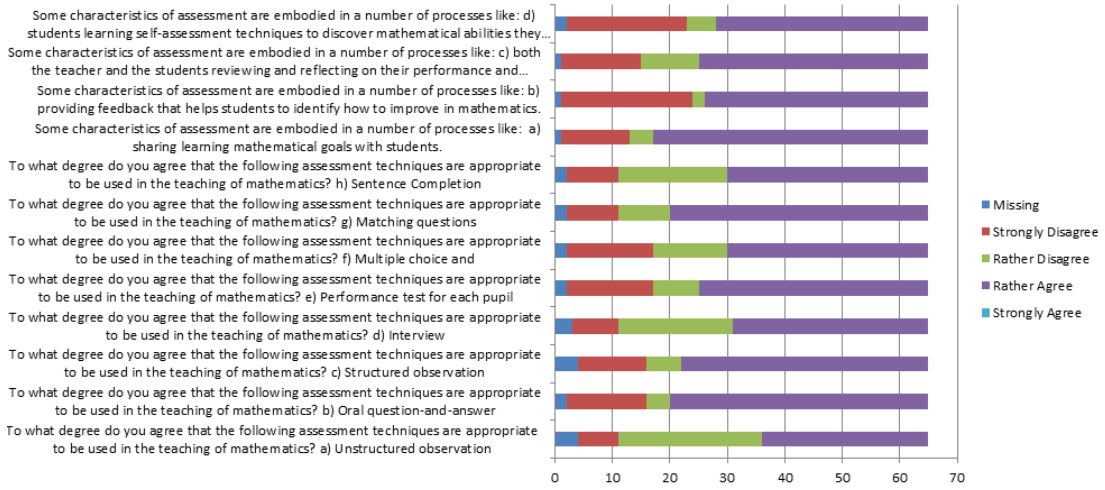
2. Questions T1 to T10 of PART C



Graph 2

Graph 2 indicates teachers' opinions about formative assessment techniques referred to the statements T1-T10. Teachers' opinions about these assessment techniques are not consistent at all. More specifically, most of the teachers agree that the professional development of classroom formative assessment practice requires the teachers to understand the potential for the social and the potential to improve students' learning construction of knowledge. In similar, most of the teachers argue that different mathematical capabilities (e.g. Argumentation vs Computational capability) need different assessment practices or tools, while they consider oral questions as the main formative assessment technique and ungraded mathematical assignments as the next important formative assessment technique. Furthermore, teachers strongly believe that identifying the weakness and strengths of the students at the beginning of the academic year is crucial for filling students' gaps. In contrast, strongly disagreement is observed among teachers for two statements of the graph. In specific, most the teachers claim that they should make known to the students the used criteria of evaluation, as well they argue that assessments on a particular topic of the mathematics curriculum (e.g. Pythagoras' theorem or Space geometry) influence evaluation on other topics (e.g. Solving equations or Algebra). It is noteworthy that teachers' opinions about some formative assessment techniques described in this graph are not explicit. In particular, it is not clear whether informal observations are important for formative assessment or the use of standardized the tasks are necessary for formative assessment to be fair. Similarly, about the half of the sample of our research agrees with the opinion that assigning lower evaluation grades is important in order to encourage the student to make a greater effort.

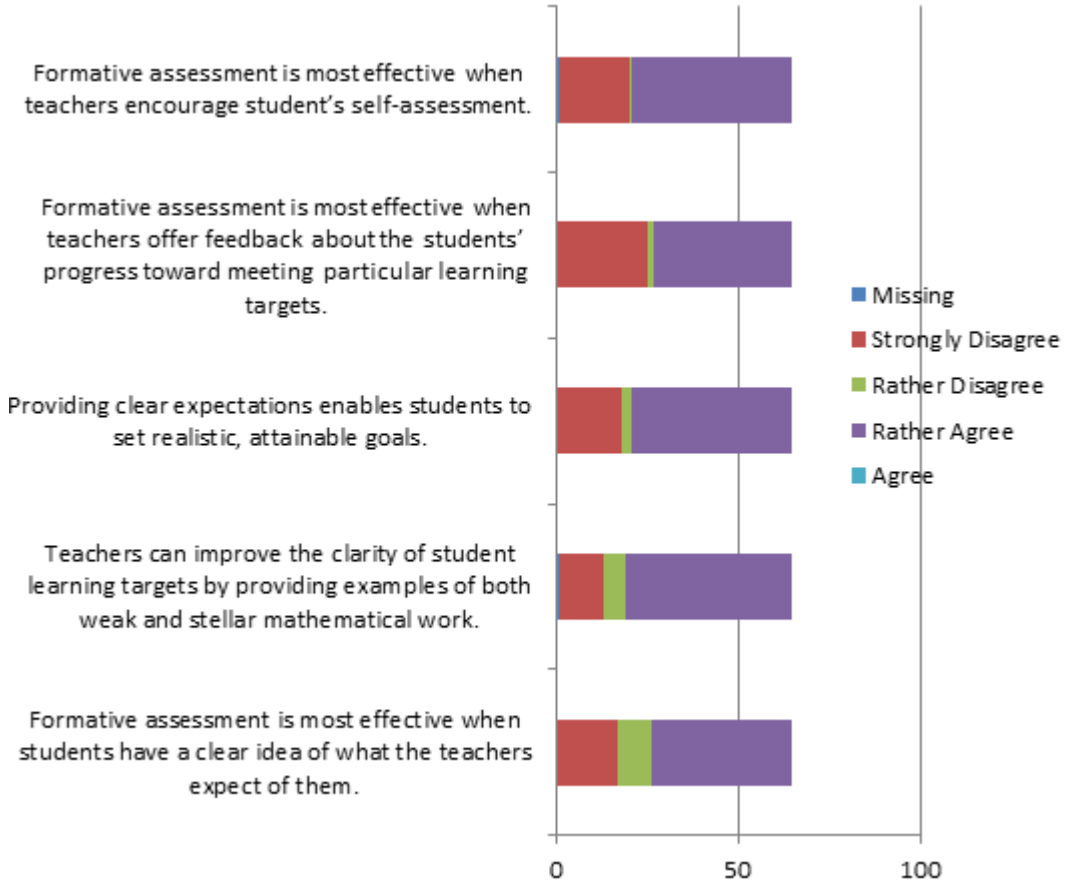
3. Questions T11 and T12 of PART C



Graph 3

Graph 3 shows that the teachers' views about the appropriateness and the characteristics of assessment techniques are consistent for all statements described in questions T11-T12. More specifically, most of the teachers argue that unstructured observation, oral question-and-answer, structured observation, interview, performance test for each pupil, multiple choice, matching questions and sentence completion are appropriate assessment techniques in the teaching of mathematics. In similar, most of the teachers agree that sharing learning mathematical goals with students, both the teacher and the students reviewing and reflecting on their performance, feedback and students learning self-assessment techniques are some characteristics of assessment.

4. Questions T13 to T17 of PART C



Graph 4

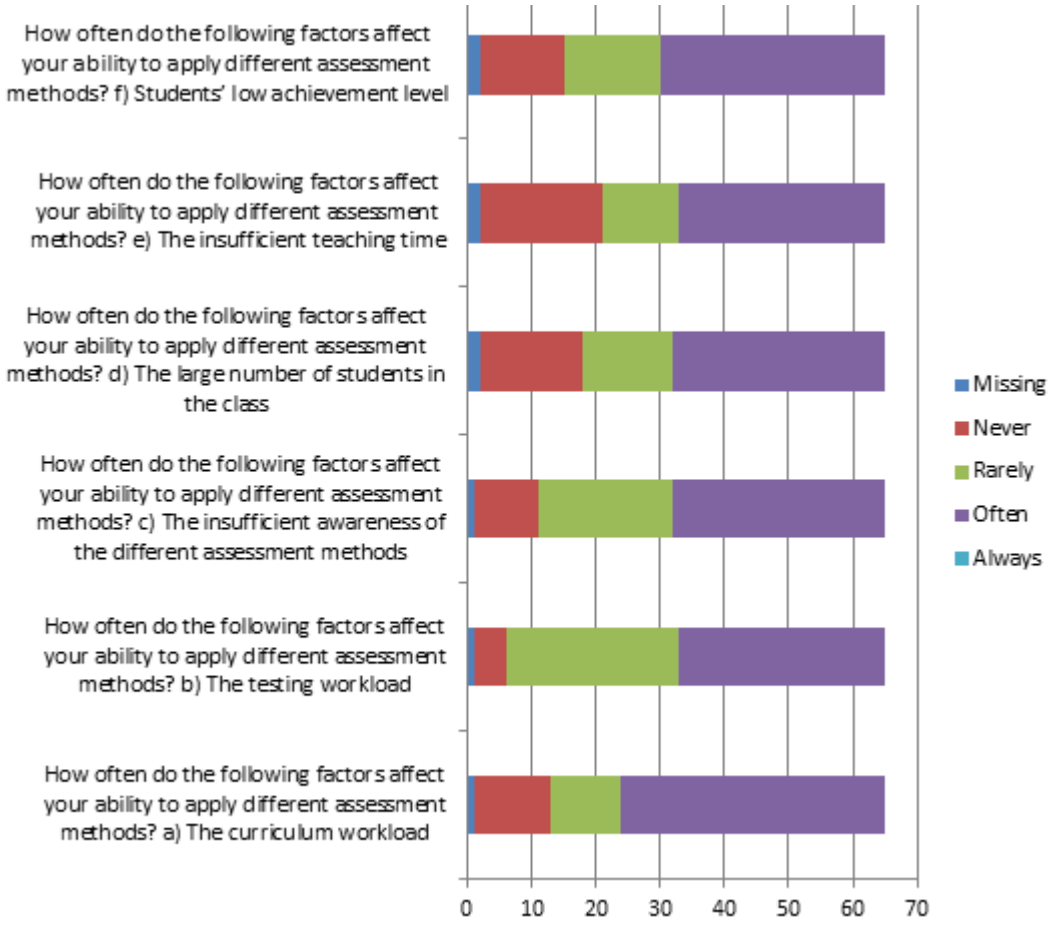
Similar to graph 3, in this graph teachers' opinions about formative assessment techniques are consistent. More specifically, most of the teachers support that providing examples of both weak and stellar mathematical work can improve the clarity of student learning targets. They also claim that providing clear expectations to students enables them to set realistic, attainable goals. Furthermore, most of the teachers argue that self-assessment, feedback and sharing with students teachers' expectations are three major factors in order to have effective formative assessment.

5. Questions T18 and T19 of PART C

Graph 5

Graph 5 presents teachers' opinions about the factors which form their expectations about their students' future assessment. It also indicates their views about the forms which high-quality formative assessment takes. In particular, the current scores, the interest in homework assignments, the participation in classroom activities and the interest in classroom assignments are considered the four major factors which form teachers' expectations about their students' future assessment. About half of the sample of our research views personal motivation to learn and personal behavior as two other important factors. In contrast, most of the teachers not consider the previous certificates as a factor which affects their expectations about their students' future assessment. Although teachers believe that high-quality formative assessment takes many forms, most of them agree that it focuses on giving advice and guidance over giving grades, emphasizes to the quality rather than the quantity of student mathematical work, avoids comparing students in favor of enabling individual students to assess their own learning and finally, it provides feedback that strengths motivation and leads to improvement in mathematical knowledge and abilities.

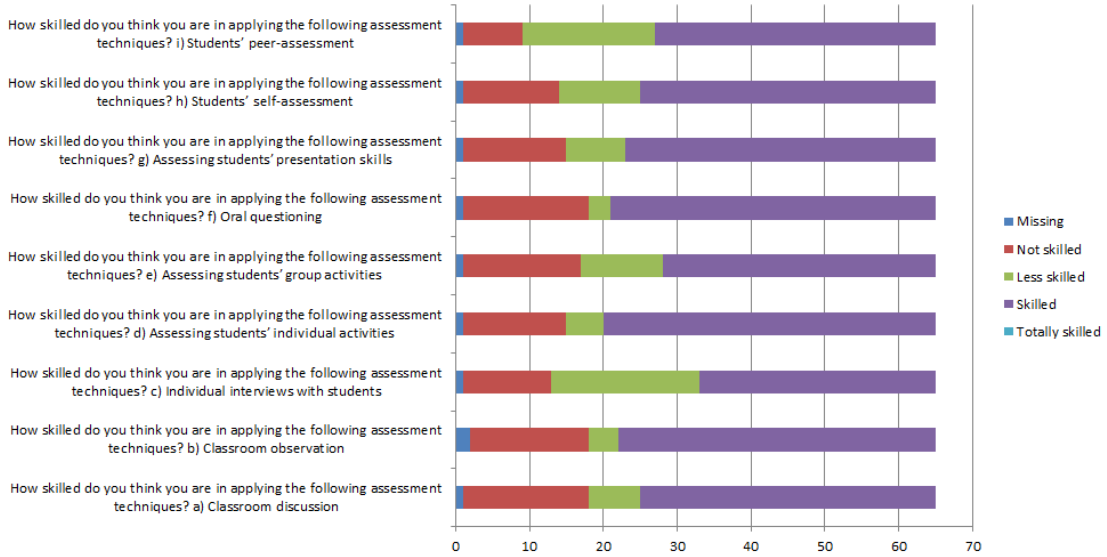
6a. Question T20 of PART C



Graph 6a

Graph 6a shows how often some specific factors affect the use of different assessment methods from teachers. About 2/3 of the sample declares the curriculum workload as the first factor which affects their ability to apply different assessment methods. Students' low achievement level, the large number of students in the class, the insufficient awareness of the different assessment methods, the insufficient teaching time and the testing workload follow in descending order of their impact on teachers' ability to apply different assessment methods. It is noteworthy that almost the 1/3 of the sample never be affected by the teaching time neither the large number of students in the class or the students' low achievement level. It is also important to refer that the number of teachers who often affected by the testing workload is the same with them who rarely affected by the same factor.

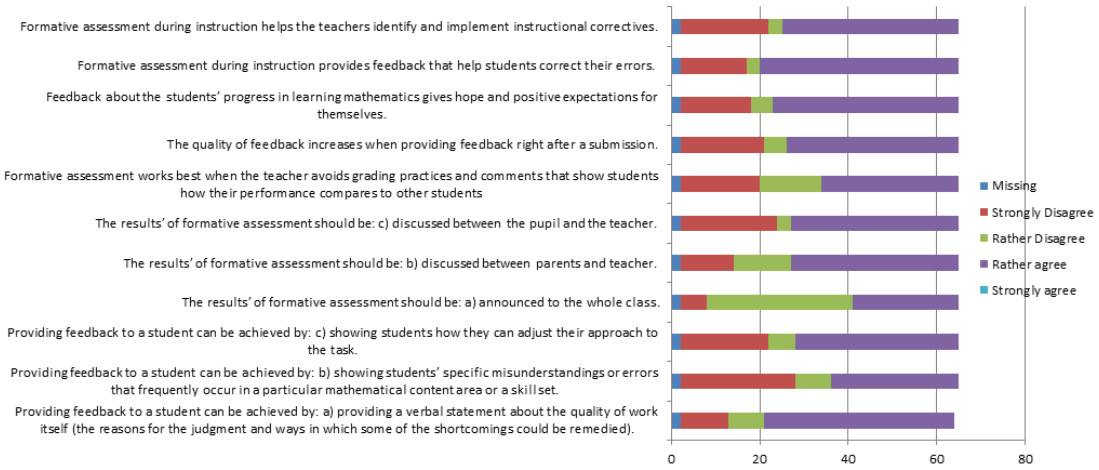
6b. Question T21 of PART C



Graph 6b

In graph 6b teachers' opinions about their ability to apply some specific assessment techniques are presented. As the graph shows more than the half of the sample considers itself skilled to apply most of the suggested techniques. More specifically, most of the teachers view themselves skilled to apply individual activities, oral questioning, classroom observation, students' presentation, classroom discussion, students' self-assessment and peer-assessment and group activities. As regards individual interviews with students, almost half of the teachers declares skilled to apply this assessment technique, while the rest of them seem to be less skilled or not skilled. It is important to refer that about fifteen of the sixty-five teachers consider themselves not skilled to apply classroom discussion, classroom observation, individual or group activities, oral questioning, students' presentation and students' self-assessment.

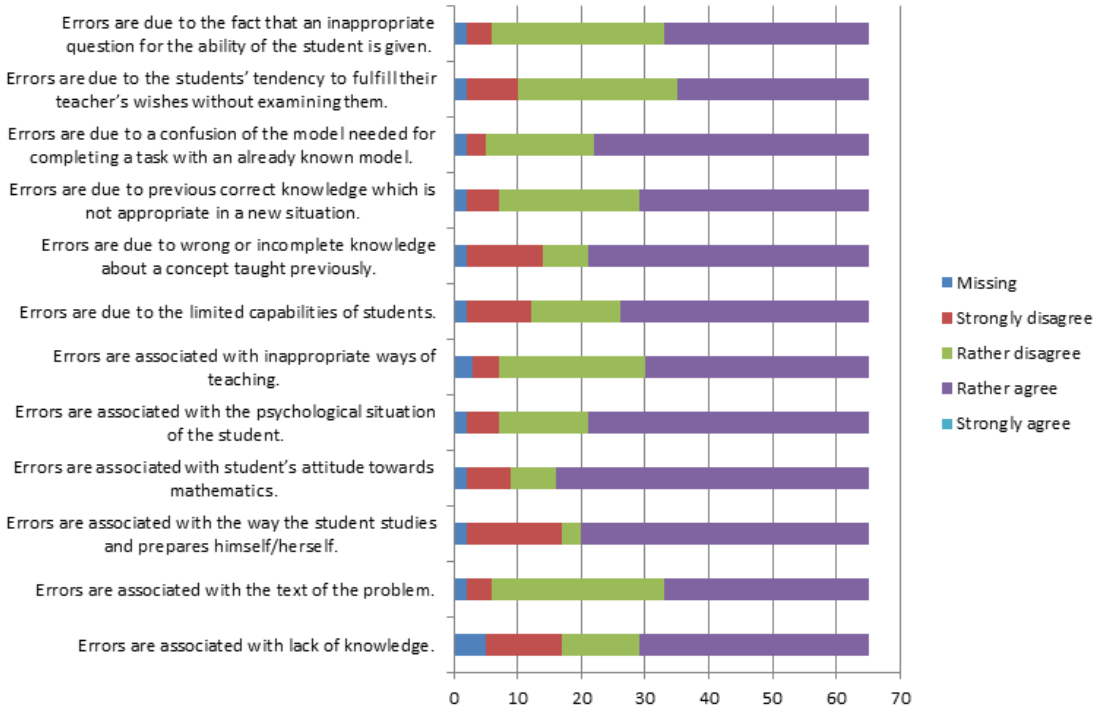
7. All questions of PART D



Graph 7

Graph 7 gives information about teachers' beliefs in relation to formative assessment's results. At a first glance we observe that most of the teachers believe that formative assessment provides feedback for helping students correct their errors and this feedback can be provided to a student verbally/orally describing students the quality of their work. More than the half of the teachers argue that feedback can be provided showing students how they can adjust their approach to the task, while at about the same number of teachers disagree with the opinion that feedback can be provided showing students' specific misunderstandings or errors that frequently occur in a particular mathematical content area or a skill set. In addition, they argue that providing feedback gives students hope and positive expectations for themselves, however they agree that the quality of feedback increases when providing feedback right after a submission. More of the half participants in the research support that formative assessment helps the teachers identify and implement instructional correctives. At about the same number of teachers claim that formative assessment's results should be discussed both between parents and teacher and between the pupil and the teacher. In contrast, less than the half teachers consider that formative assessment's results should be announced to the whole class.

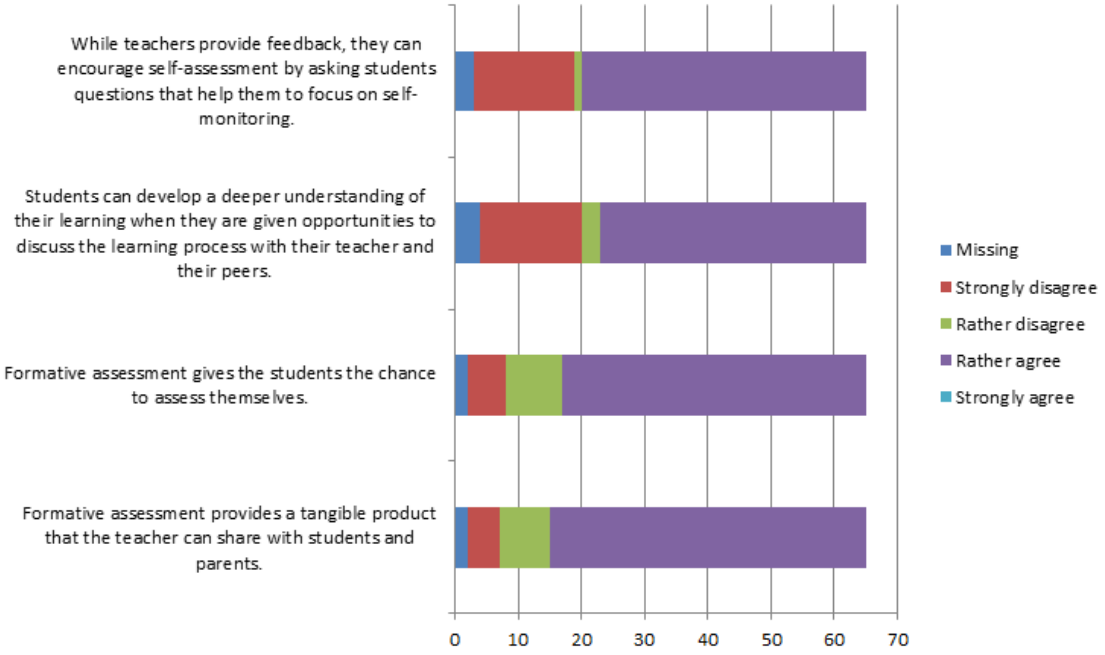
8. **All** questions of PART E



Graph 8

Graph 8 shows teachers' opinions about students' mathematical errors. What stands is a strong agreement between the teachers in relation to students' mathematical errors sources. More specifically, most of them associate the errors firstly with student's attitude towards mathematics, then with the way the student studies and prepares himself/herself and thirdly with the psychological situation of the student. Less number of teachers considers that errors are associated with lack of knowledge or with inappropriate ways of teaching and with the text of the problem. Furthermore, more than the half of the teachers agrees that errors are due to wrong or incomplete knowledge about a concept taught previously, due to a confusion of the model needed for completing a task with an already known model, due to the limited capabilities of students and due to previous correct knowledge which is not appropriate in a new situation. In contrast, less than the half number of the participants argue that errors are due to the fact that an inappropriate question for the ability of the student is given or due to the students' tendency to fulfill their teacher's wishes without examining them.

9. **All** questions of PART F



Graph 9

About fifty of the sixteen teachers argue that formative assessment provides a tangible product that the teacher can share with students and parents and it also gives the students the chance to assess themselves. However, almost ten teachers of the sample rather disagree or strongly disagree with the above statements. Forty-five teachers support that providing feedback , self-assessment can be encouraged by asking students questions that help them to focus on self-monitoring, while only the one third of them disagree with this opinion. Similarly, at about forty teachers claim that students can develop a deeper understanding of their learning when they discuss the learning process with their teacher and their peers, however almost half of them disagree with this opinion.

Concluding remarks for TEACHERS' BELIEFS ABOUT FORMATIVE ASSESSMENT IN MATHEMATICS

Teachers consider that the main purpose of formative assessment is to identify how students think in mathematics. As regard teachers' opinion about formative assessment techniques most of them argue that the professional development of classroom formative assessment practice requires the teachers to understand the potential for the social and the potential to improve students' learning construction of knowledge. Furthermore, most of the teachers view oral question-and-answer and matching questions as the most appropriate assessment techniques, while they think that sharing learning mathematical goals with students is the most important

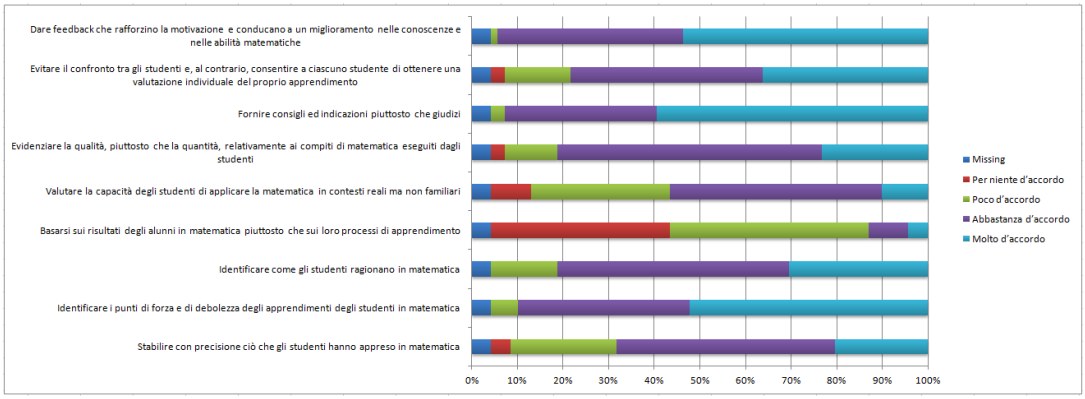
characteristic of assessment technique. Simultaneously, most of the teachers view themselves skilled to apply individual activities, oral questioning and classroom observation. In addition, most of the teachers support that providing examples of both weak and stellar mathematical work can improve the clarity of student learning targets. Current scores of the students are considered the main factor which forms teachers' expectations about their students' future assessment, while the curriculum workload seems to be the main factor which affects teachers' ability to apply different assessment methods. Moreover, most of the teachers support that high-quality formative assessment focuses on giving advice and guidance over giving grades. Regarding formative assessment results, most of the teachers claim that formative assessment provides feedback for helping students correct their errors. However, they believe that students' errors are primarily associated with their attitudes towards mathematics. Finally, the main reason why teachers use formative assessment is that it provides a tangible product that the teacher can share with students and parents.

3.1.3. The Teachers' Questionnaire in Swiss

Methodology and Sample. We asked to all teachers the middle school of Canton Ticino (227 teachers) to participate in the European project FAMT&L by filling in an online questionnaire. The request was submitted by e-mail through the director of UIM. Filling in the questionnaire required 15 minutes and consisted in expressing an opinion on a range of questions (especially structured type). We guaranteed the full respect of the privacy and that the collected data would be used only in an anonymous and aggregated form. The sample was voluntary. 69 teachers have joined the survey, coming in a balanced way by the different parts of Canton Ticino.

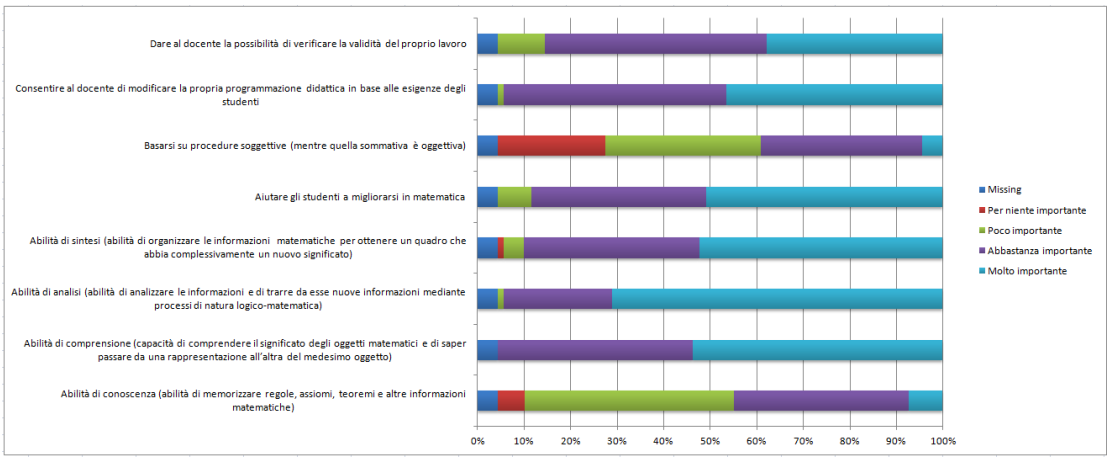
Results of the questionnaire

Graph 1: The formative assessment should:



Teachers affirm to be open to the formative aspects of the assessment and it seems they have well understood the basic aspects. In particular, they are more interested in the processes of the students, more than to products. 82,6% disagree with the affirmation that formative assessment should be based on the pupils' outcomes in math rather than on their learning processes. Teachers are less open to believe that an efficient formative assessment should assess the students' ability to apply mathematics in unfamiliar everyday situations (almost 40% disagree).

Graph 2: What is important to assess in math?

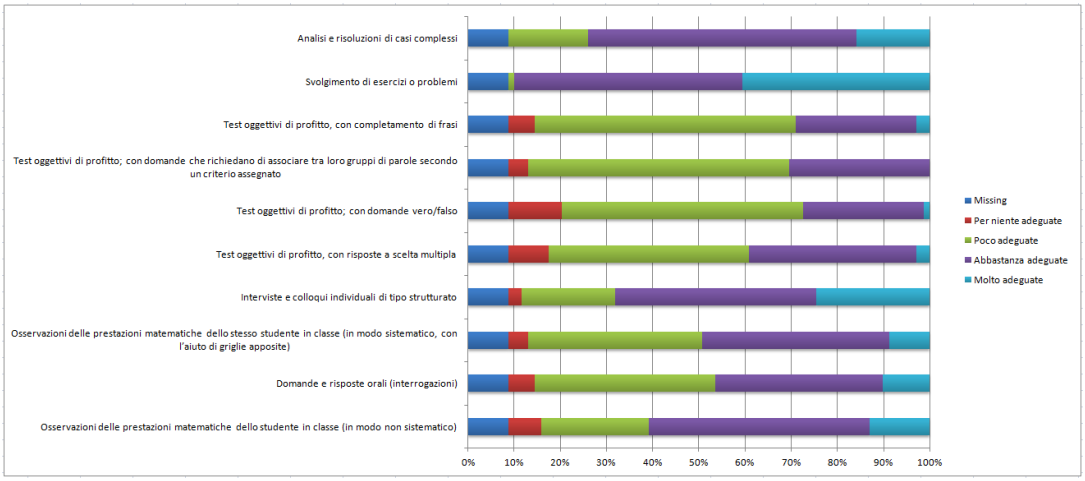


For teachers complex processes are important (ability of analysis, synthesis and comprehension) instead of knowledge ability (the ability to memorize rules, axioms, theorems and other mathematical information). It also appears that the teachers relies on the assessment also to check the validity of their work. 98% of the teachers declare that the student assessment gives information to themselves in order to modify instructional plan according to students' needs.

Teachers give also prominence to objective process (only 39,1% base on subjective process). However it is difficult to understand what teachers really mean when speaking about "objective" and "subjective" since the question has not been further deepened.

The techniques of the formative assessment

Graph 3: Which techniques are appropriate for the math learning?



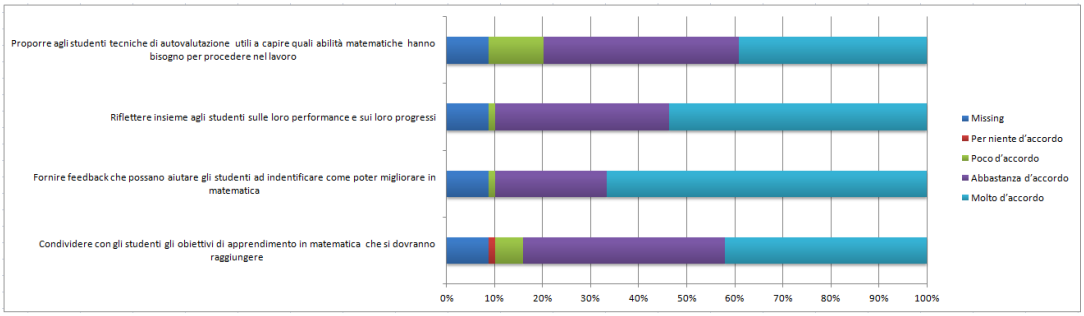
Almost all of the teaches believe that exercises or problems, followed by analysis and resolution of complex cases are the most appropriate tools of formative assessment.

It is a confirmation of the ordinary approach: but one might wonder how this tools are concretely used in order to carry out a formative assessment.

The observation of the math performances of the student in class (in a not systematic way) is considered, by 60,8% of teachers, an appropriate tool; while observation in a systematic way (with help of template), is considered an appropriate tool by only 49,3% of the teachers. The adequacy of oral question-and-answer is fifty-fifty, some consider it appropriate and others not.

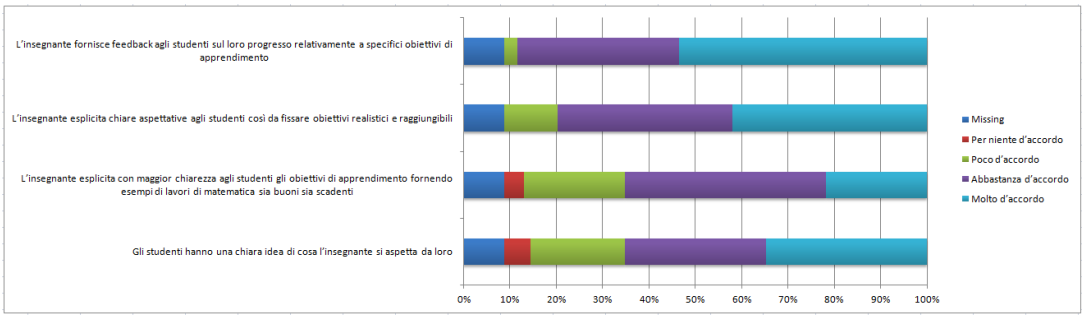
Compared to oral questions there is a greater preference towards interviews and individual structured observation (25% more), maybe considered more appropriate to identify the knowledge and the difficulties of the student. It is believed that True/False test are more appropriated compared to multiple choice test.

Graph 4: In order to be formative, an assessment requires from the teacher that: In order to obtain a formative assessment the teacher should ever:



Teachers mainly agree with the statements of the questionnaire; a formative assessment is linked with self-assessment process, continuous feedback that help students, and sharing learning mathematical goals with students.

Graph 5: The formative assessment is more efficient when:

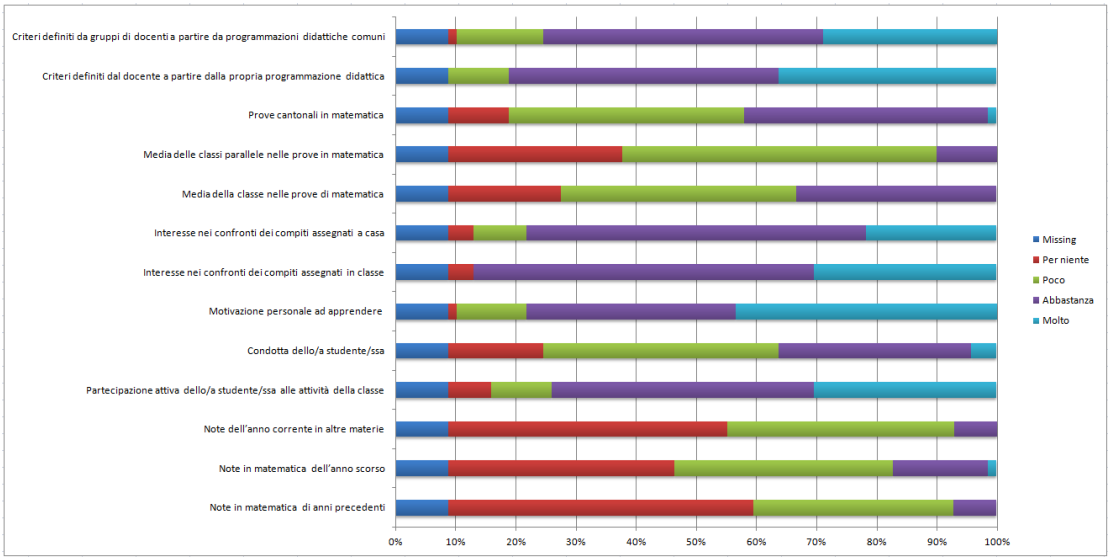


Teachers agree on how to make efficient the formative assessment; in particular on how to make students aware though self-assessment and on the importance of interaction between teachers and students on their works and processes.

Teachers agree on importance to clarify learning goals, but it seems that in the classroom they do it not very clear way: about the half of the students (49,1%) declare that, before an assessment, they have a clear idea of what the teachers expect of them (graph 15 of students).

Which assessment criteria

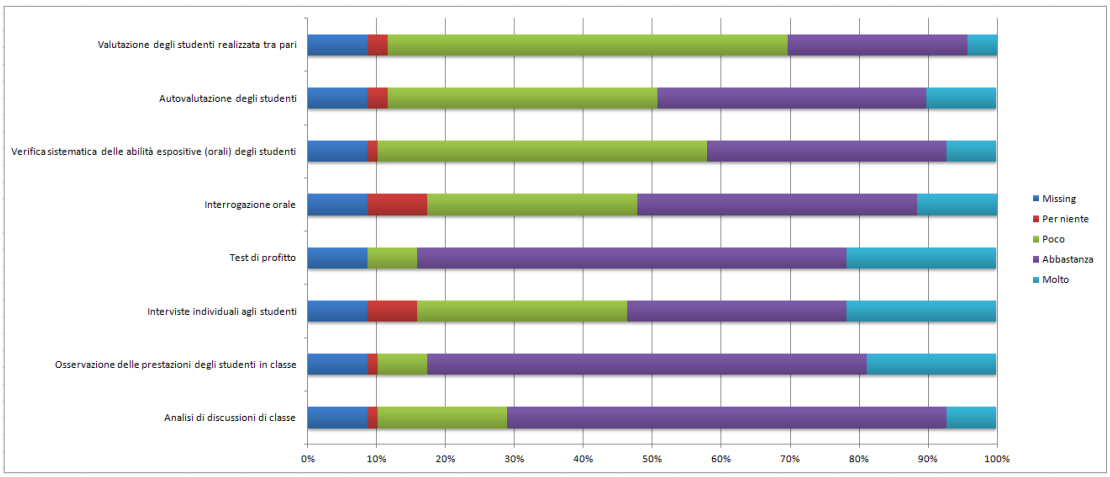
Graph 6: In your opinion, how much these elements should represent an important assessment criterion of math's students?



Assessment criteria defined within the educational context are considered more pertinent than external one (grades or external test). The teachers don't seem to want to use assessment from previous years or from others subjects. 46% of teachers fairly or completely agree to refer to the cantonal tests; an higher percentage compared to consider the class average in the math tests.

Teachers give great importance to active participation of the student in classroom (73,9%), same thing happens for students, indeed 72,7% of them affirm that the observation of student's participation is an important assessment tool. In addition, students affirm that only in the 57,4% of the cases it is used in class as assessment tool (graph n.2 student questionnaire). Homework or working in classroom are important assessment criteria as well as student motivation in the learning process.

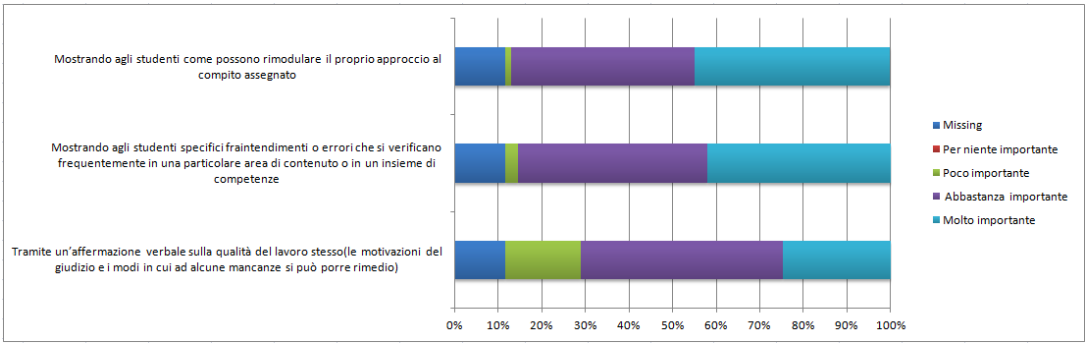
Graph 7: How skilled does the teacher think he is in applying the following assessment techniques?



The teachers consider themselves very competent in the procedures and assessment tools such as achievement tests, student observation and classroom discussions. Less in peer-assessment, self-assessment (although it has been considered important earlier), and in tests or oral interviews. Classroom observation, in teacher opinion, is not an appropriate assessment tool. This is demonstrated by the answers to previous questions in graph 3 (according to 42% of the teachers this an instrument not much appropriate); however almost every teachers consider themselves skilled on using it. 90% of the teachers declare to be competent on achievement tests, while 60% affirm that the following profit tests are not appropriate: sentence completion, matching questions, True/False questions and multiple choice questions (graph n.3). It is not a is not inconsistency in the thinking of the teacher's but depends on setting questions, where we talk about achievement tests followed by an explication of the type of test.

Feed-back to the students

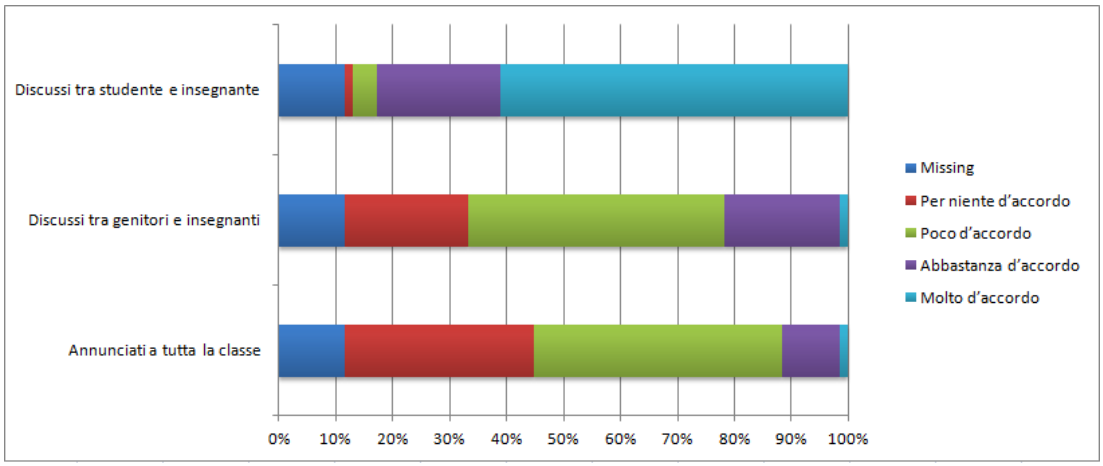
Graph 8: After a math assessment, how much important is the use of the following type of feedback?



It is pointed out a large agreement about the importance of the feedback in all its forms, with a low tendency for showing to the students how they can adjust their approach to the task.

Communication of results

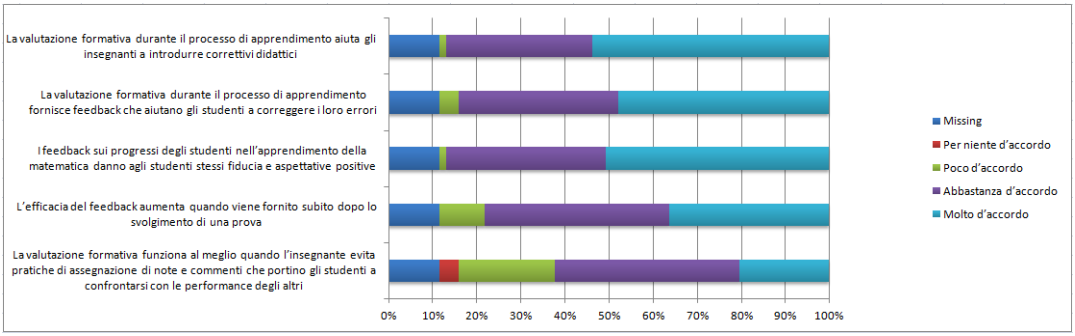
Graph n. 9: Formative assessment results should be:



According to teachers, the results of formative assessment should be discussed with the students but not communicated to the whole class; aware of the fact that maybe comparing math results with schoolmate involves for the student a sense of inadequacy and frustration (about 40% of the students prefer to avoid confrontation with classmates for not beeing laughted at, compare graph 14 of the student questionnaire). Moreover we observe a clear exclusion of the parents from the formative assessment process.

Which use of formative assessment

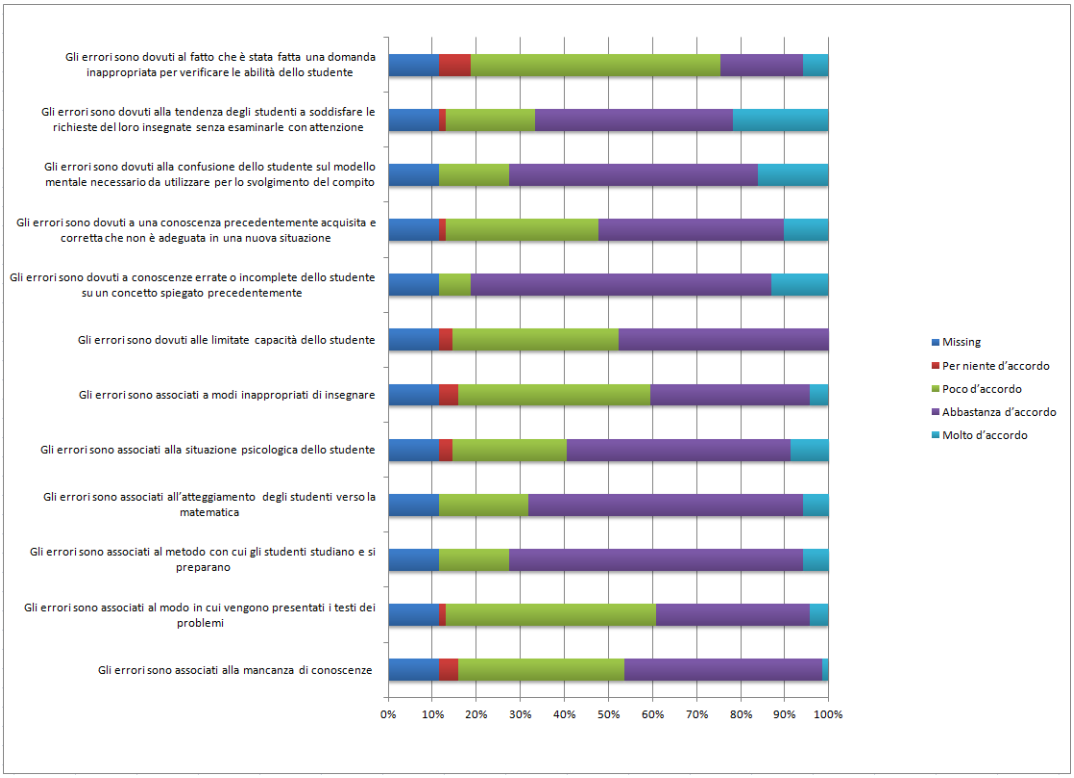
Graph 10: Express your level of agreement/ disagreement for each of the following statements about the use of the results of formative assessment



The use of the result of formative assessment in math turns out to be useful to teachers, but there is a lower agreement with the affirmation that the formative assessment function at its best when the teacher avoids assigning notes and writing comments, leading students to compare their performance with others.

Causes of difficulties and errors

Graph 11: Below are presented some widespread beliefs about cause of errors and learing difficulties of math's students. Based on your experience in the classroom, indicate your level of agreement or disagreement about following expression.

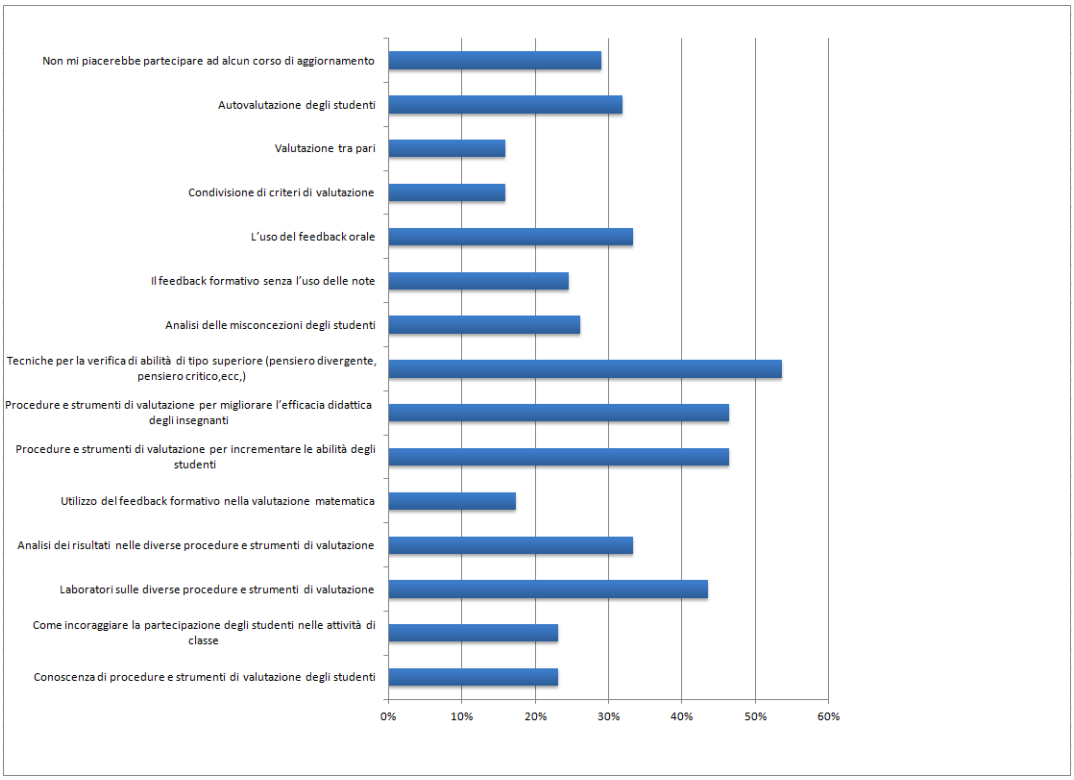


Errors are mainly attributed to reasons connected to students and in a smaller percentage to teacher's methods (for example inappropriate formulation or not appropriate method of teaching).

The error of the student is mainly associated to an inappropriate, shallow and incomplete knowledge rather than to a lack of knowledge. It is observed that in the questionnaire knowledge has not been indicated as the reason of the difficulty of the student even though it is an essential element to consider in the analysis of the missed learning opportunities.

Refresher courses for teachers

Graph 12: Concerning professional update in math, below are some arguments concerning assessment expertise. Please select the most important.



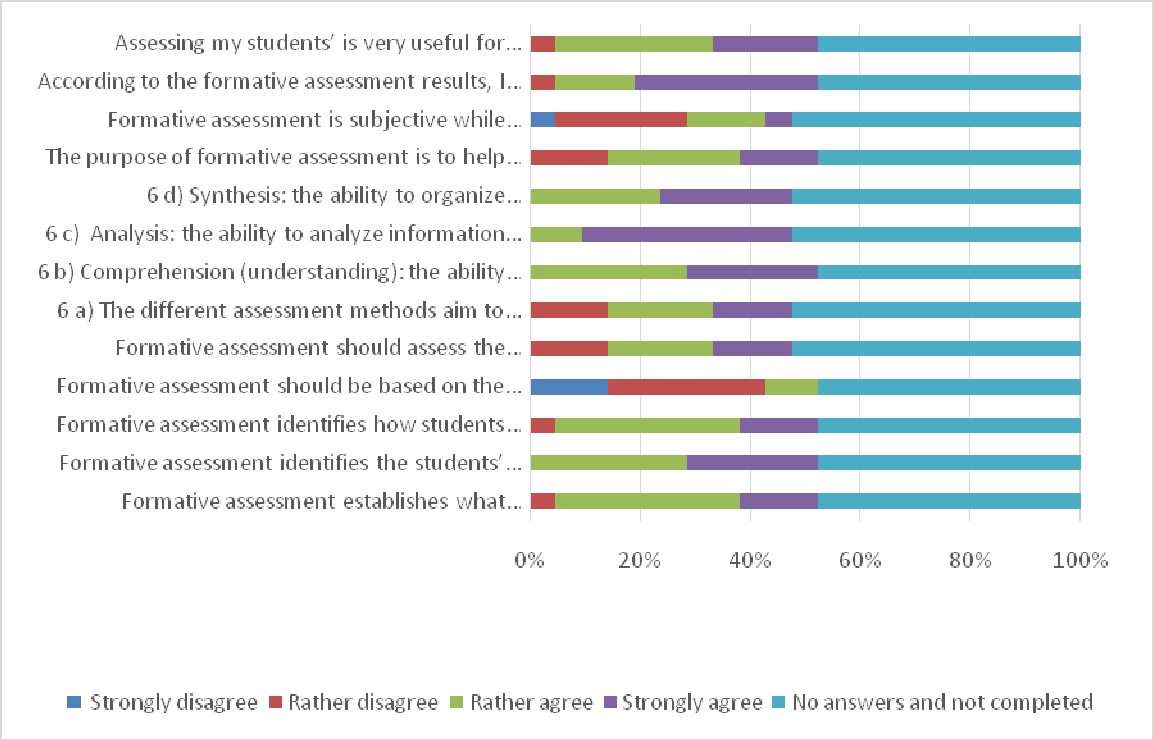
Percentages are generally low and highlight a lack of interest for a specific training. Considering that these answers are related to teachers who answered voluntarily (this is already a selected sample) it is important understand why the desire or need is so low.

Based on previous graphs, teachers affirms to be expert about the routine (profit tests, analysis of classroom discussions and observation of performance in the classroom). It doesn't seem to be much interest to test and verify other type of assessment, as peer assessment.

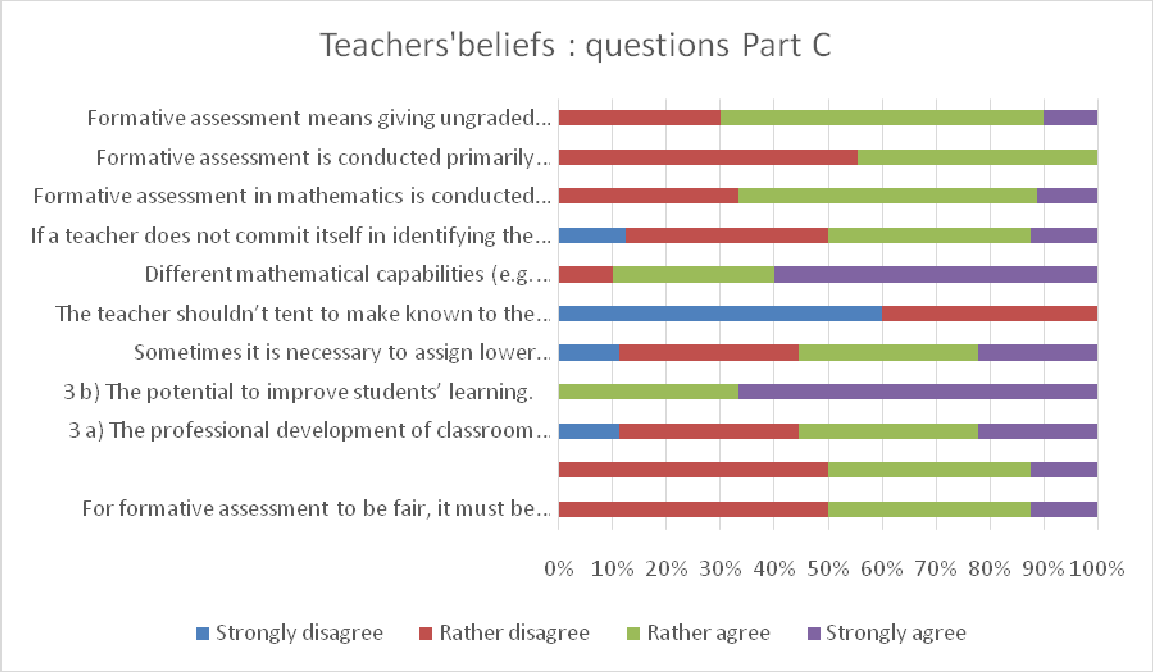
Teachers request a professional training concerning wide arguments and avoid specific arguments about assessment methods rarely used in class.

3.1.4. The Teachers' Questionnaire in France

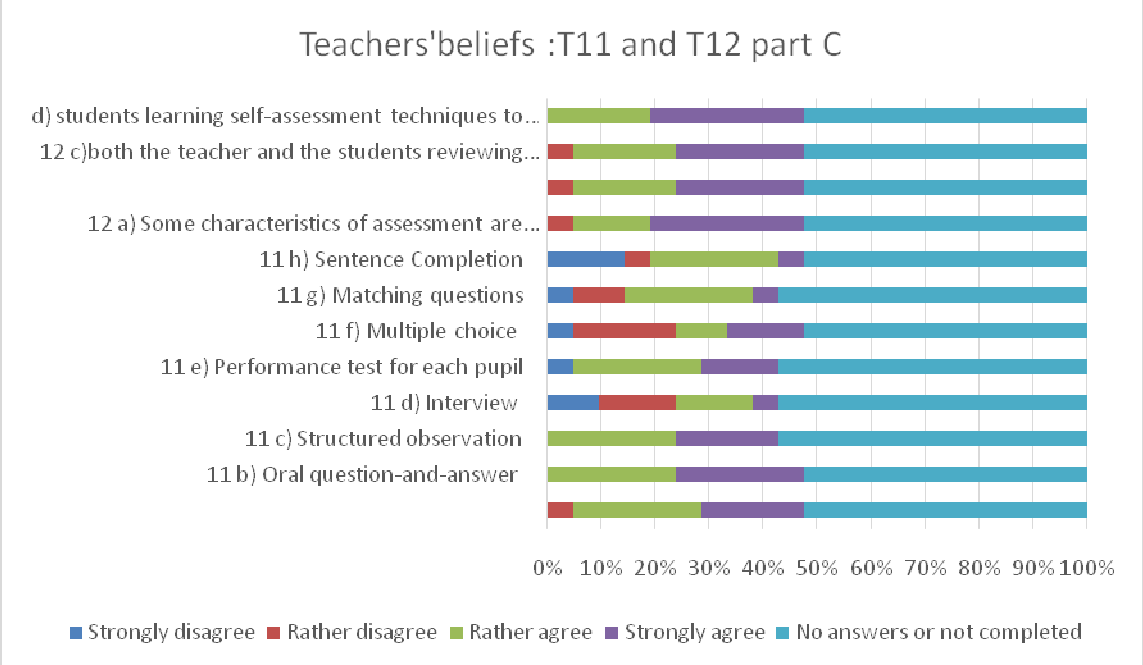
1. <u>All questions of PART B</u>



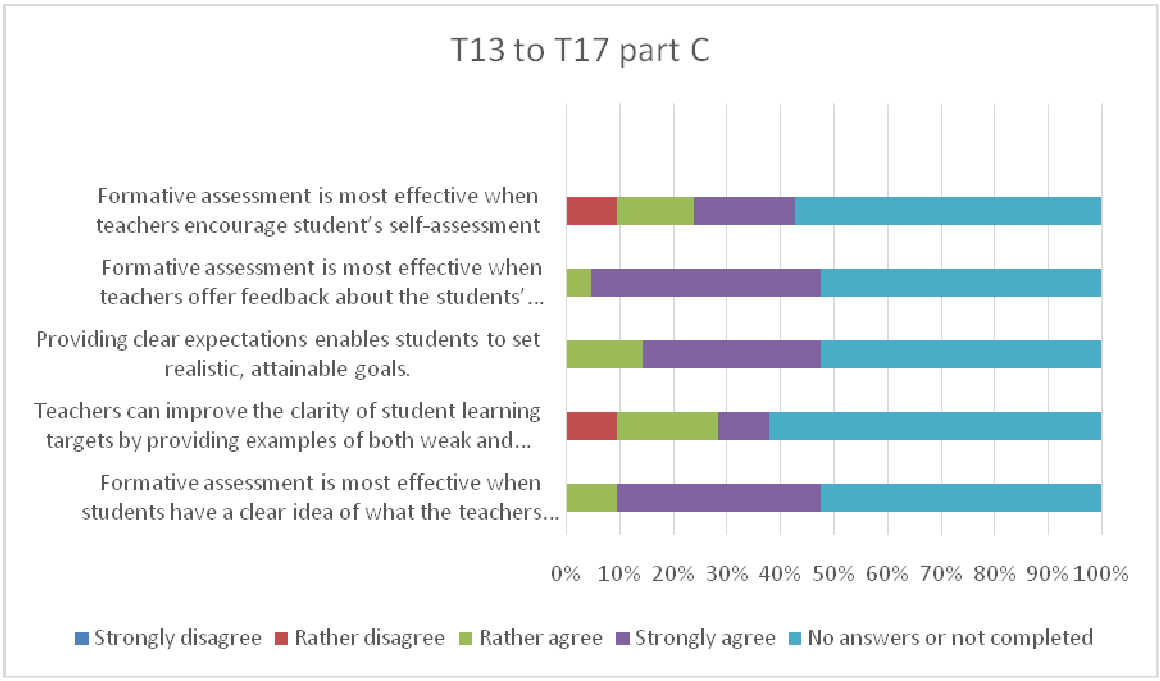
2. <u>Questions T1 to T10 of PART C</u>



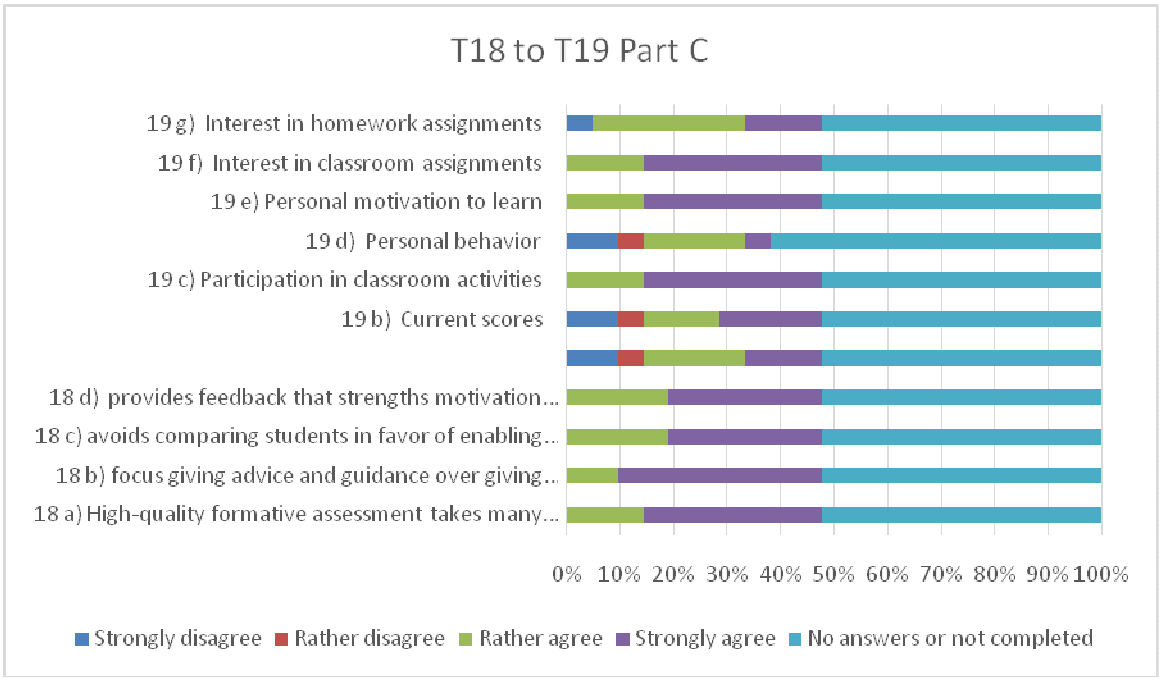
3. Questions T11 and T12 of PART C



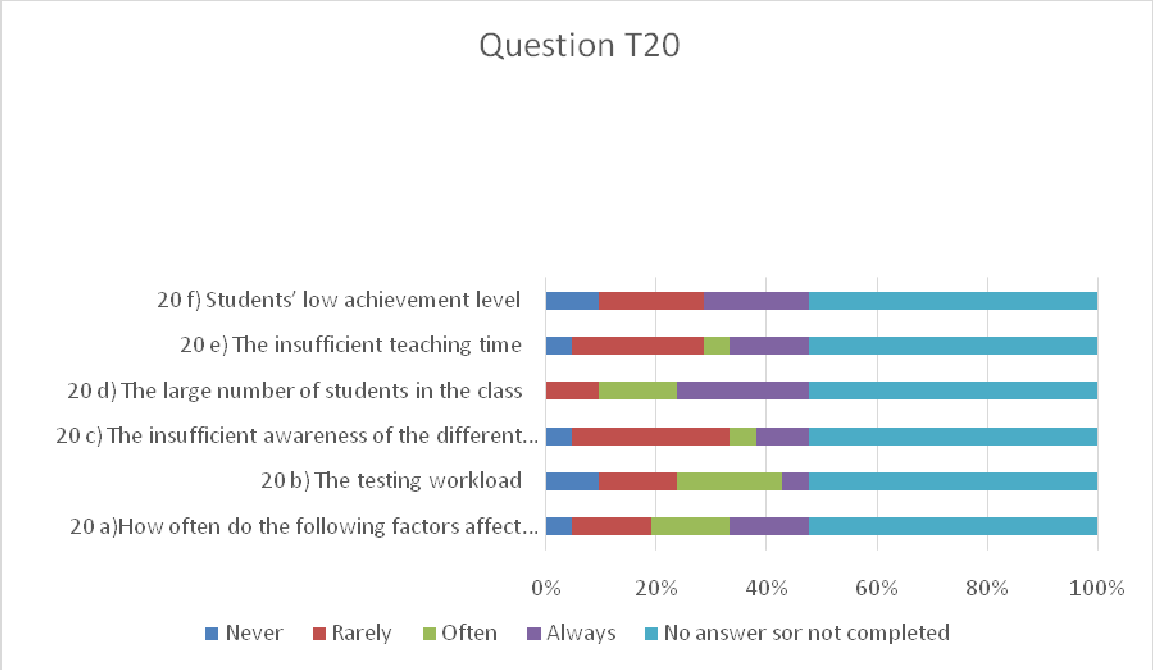
4. Questions T13 to T17 of PART C

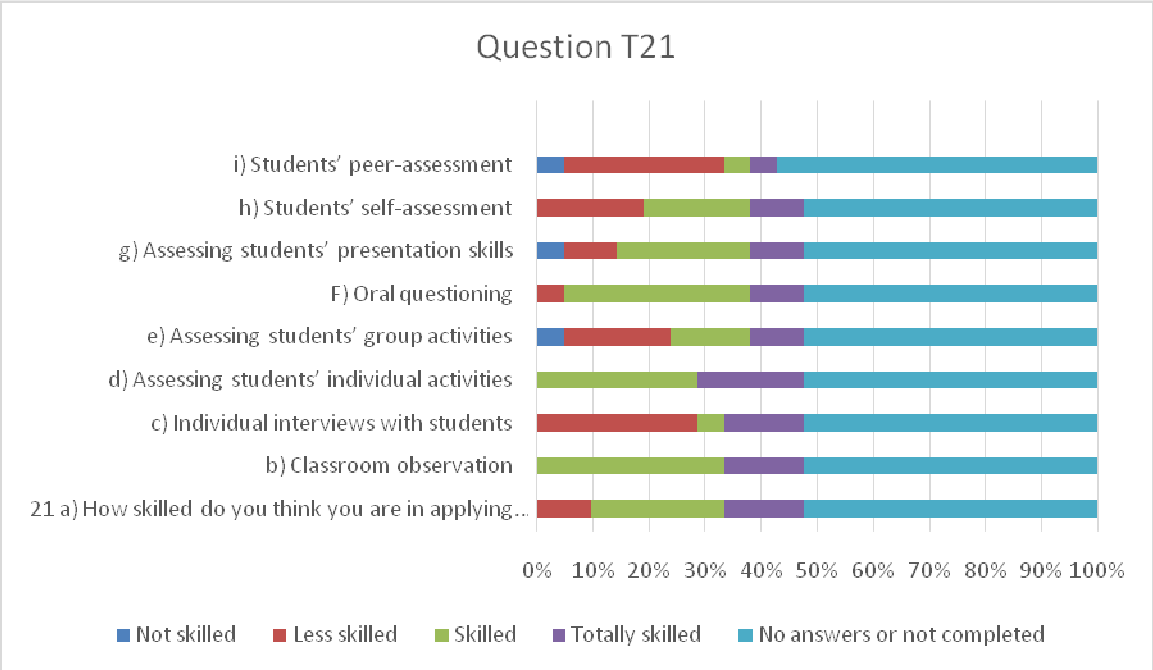


5. Questions T18 and T19 of PART C

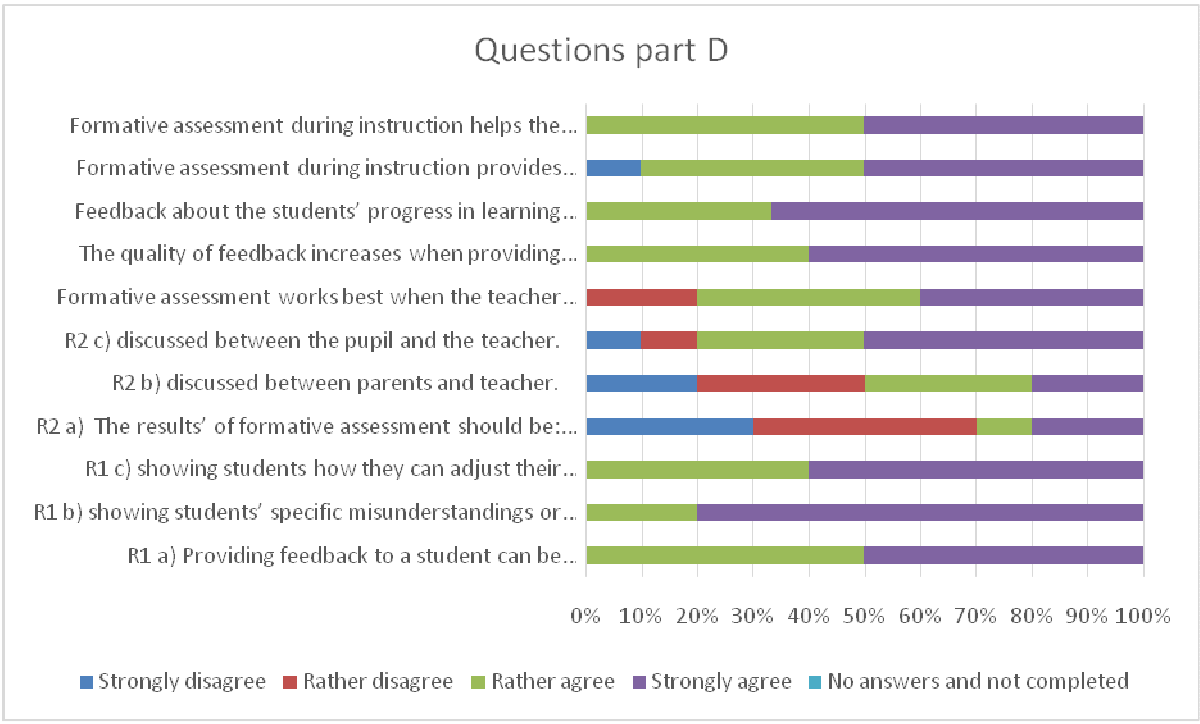


6. Questions T20 and T21 of PART C

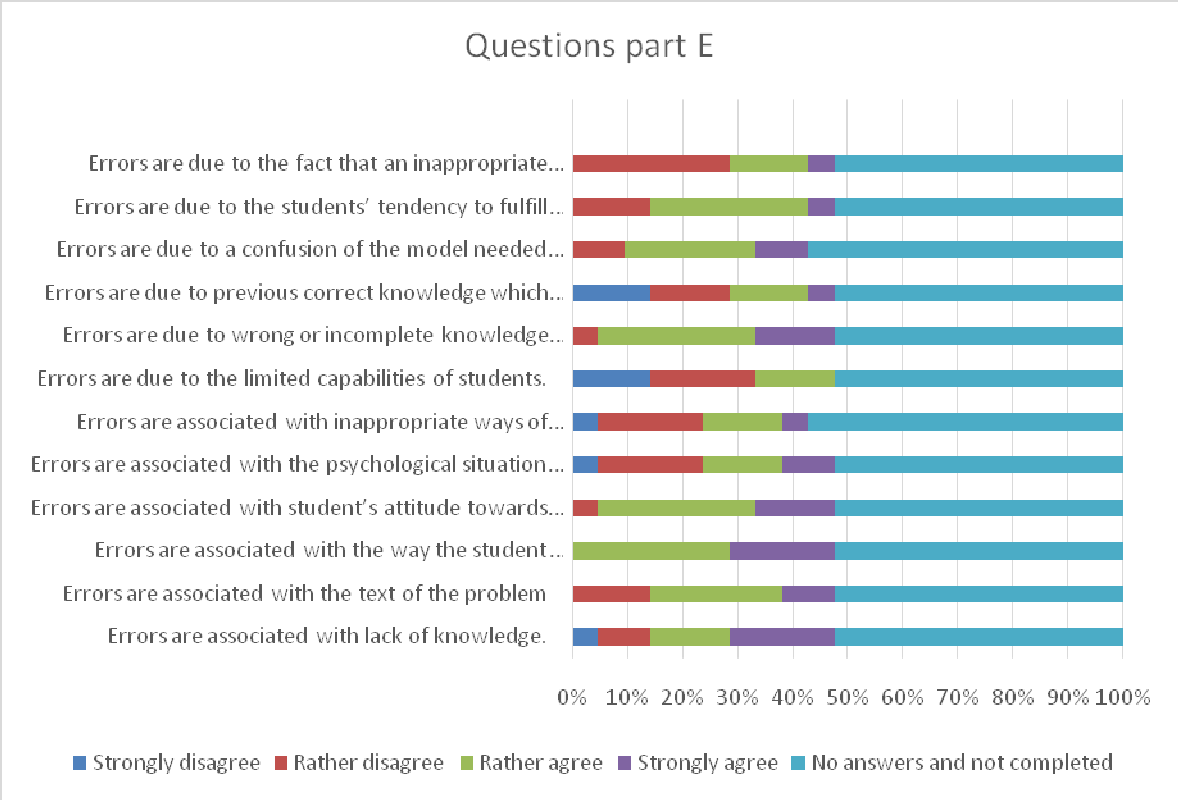




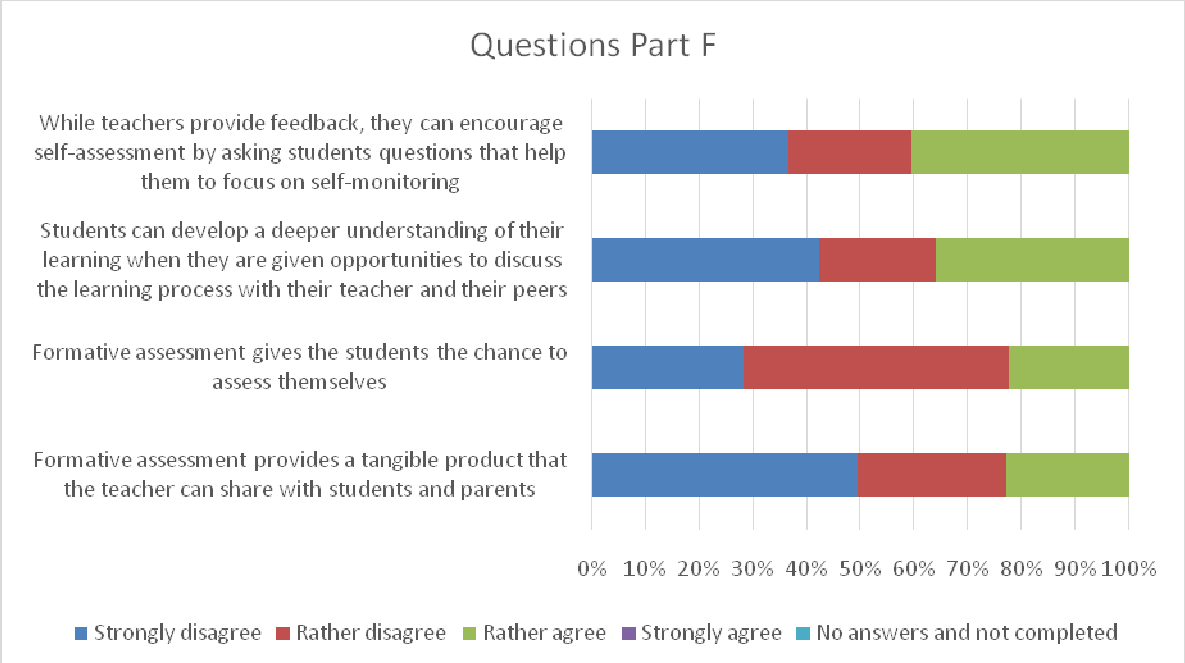
7. <u>All questions of PART D</u>


Questions part D
Formative assessment during instruction helps the...
Formative assessment during instruction provides...
Feedback about the students' progress in learning...
The quality of feedback increases when providing...
Formative assessment works best when the teacher...
R2 c) discussed between the pupil and the teacher.
R2 b) discussed between parents and teacher.
R2 a) The results' of formative assessment should be:...
R1 c) showing students how they can adjust their...
R1 b) showing students' specific misunderstandings or...
R1 a) Providing feedback to a student can be...
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Strongly disagree
Rather disagree
Rather agree
Strongly agree
No answers and not completed

8. All questions of PART E



9. All questions of PART F



Summary of observations about the graphs

Chart 8 : one point to keep in mind

It is essential for the teacher to have strong analytical skills to produce a correct assessment.

Chart 9 : one point to keep in mind

A strong didactic knowledge equips the teacher to have a correct assessment and that he/she considers correct.

Chart 10 : one point to remember

Several activities are structuring the assessment .

Chart 11 : one point to keep in mind

Reminding the student of his progress is not a guarantee of an effective assessment.

Chart 12 : one point to keep in mind

For the teacher, there is a difference between what is informal and individual, outside of the classroom and what is formal, happens in the classroom.

Chart 13 : one point to keep in mind

The environmental constraints are not blocking factors for the implementation of the assessment.

Chart 14 : one point to keep in mind

The teachers want to set differentiated modalities of activities.

Chart 15 : one point to keep in mind

For the teachers, it is important to establish a dialogue with parents.

Chart 16 : one point to remember

There are many sources of error and difficulties, and so are the answers.

Chart 17: one point to remember

Teachers lay noble intentions to the concept of formative assessment.

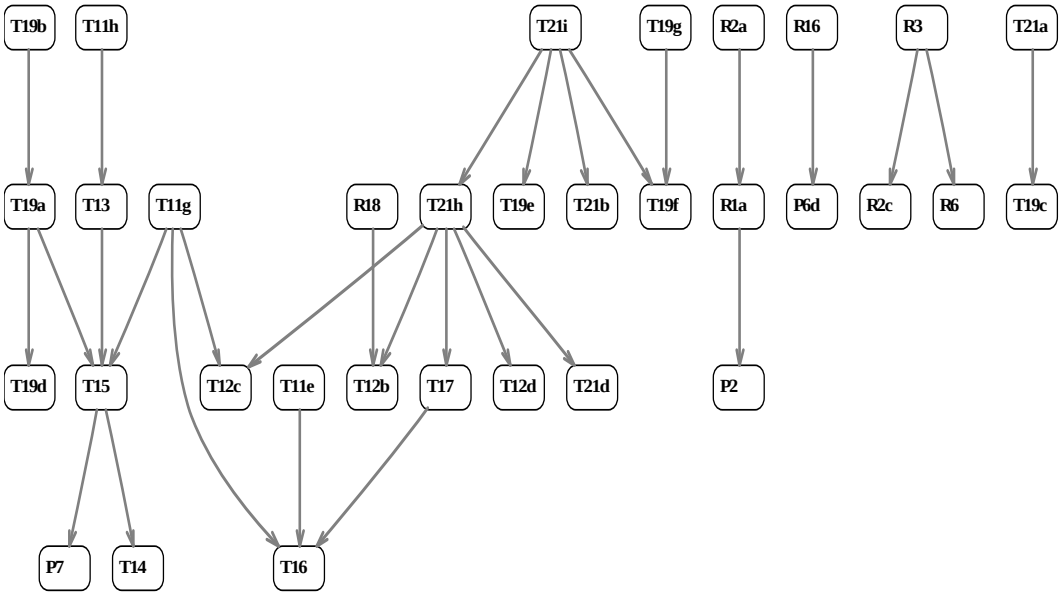
3.1.5. Implicative relations for the teachers' beliefs

3.1.5.1. The implicative analysis

For tracing the relations between the teachers' beliefs and the practices they use, the implicative statistical analysis was performed using the software CHIC (Classification Hiérarchique, Implicative et Cohésitive). The implicative statistical analysis aims at giving a statistical meaning to expressions like: *"if we observe variable A in a subject, then in general we observe variable B in the same subject"*. Thus, the underlying principle of the implicative analysis is based on the quasi-implication: *"if A is true, then B is more or less true"*. An implicative diagram represents graphically the network of the quasi-implicative relations among the variables of the set V.

In this study the implicative diagrams present the implications between particular statements of the questionnaire, either expressing a belief or a practice. These relations provide indications about the importance or influence of particular factors on the construction of positive beliefs about the application of assessment.

3.1.5.2. Implicative relations for the teachers from Italy



In the implicative diagram of the Italian teachers' beliefs we can distinguish three implicative chains.

The first implicative chain contains beliefs mainly/mostly about the formative assessment techniques. The first relation is observed between three variables related to the factors that affect teachers' expectations about their students' future assessment. Students' *current scores* (T19b) related with their *previous certificates* (T19a) and both above techniques are related with the students' *personal behavior* (T19d). Another important relation is noticed between five variables in the same chain. This relation starts with the belief that the technique of *sentence completion* (T11h) *is appropriate to be used in the teaching of mathematics.* This statement influences teachers' beliefs about the effectiveness of formative assessment. More specifically, the statement T11h is related to the belief that *formative assessment is most effective when students have a clear idea of what the teachers expect of them* (T13) and the belief that *providing clear expectations enables students to set realistic, attainable goals* (T15). The statement T11h is also related with the belief that *teachers can improve the clarity of student learning targets by providing examples of both weak and stellar mathematical work* (T14). All the above opinions about the students' improvement through clear goals influence teachers' belief about the purpose of formative assessment. In specific, the aforementioned formative assessment techniques influence the belief that *the purpose of formative assessment is to help students improve themselves in mathematics* (P7).

The second implicative chain contains statements also mainly about formative assessment techniques. This chain can be considered as divided in two parts.
The first part contains seven variables regarding to the formative assessment techniques. As it shown, teachers' belief about their *skill to apply students' peer-assessment* (T21i) is related with their belief to apply *students' self-assessment* (T21h) and *classroom observation* (T21b). The statement T21i is also related with the teachers' belief that the *personal motivation to learn* (T19e) and *the interest in classroom assignments* (T19f) are considered as factors that form their expectations about their students' future assessment. Another relation is observed between the statement T19f and the statement T19g which supports the *interest in homework assignments* as another factor which forms teachers' expectations about their students' future assessment. Therefore, teachers' beliefs about their skills to apply formative assessment techniques influence their beliefs about the factors which form their expectations about their students' future assessment.

The second part includes eight variables. At a first glance, the most important relation emerges between different techniques of formative assessment. In particular, teachers' belief about their *skill to apply students' self-assessment* (T21h) is related with their skill to apply *individual activities* (T21d). Teachers' ability to apply students' self-assessment is also related with their beliefs about the following statements: some characteristics of assessment are embodied in a number of processes like *providing feedback that helps students to identify how to improve in mathematics* (T12b), *both the teacher and the students reviewing and reflecting on their performance and progress* (T12c) and *students learning self-assessment techniques to*

discover mathematical abilities they need to further work on (T12d). The same statement (T21h) is associated with the teachers' belief that *performance test for each pupil* (T11e) is an appropriate technique to be used in the teaching of mathematics and the belief that *formative assessment is most effective when teachers encourage student's self-assessment* (T17). In addition, teachers' belief that the *errors are due to the students' tendency to fulfill their teacher's wishes without examining them* (R18) is related with the statement T21b. The statement T11e and T17 are related with the teachers' belief that *formative assessment is most effective when they offer feedback about the students' progress toward meeting particular learning targets* (T16).

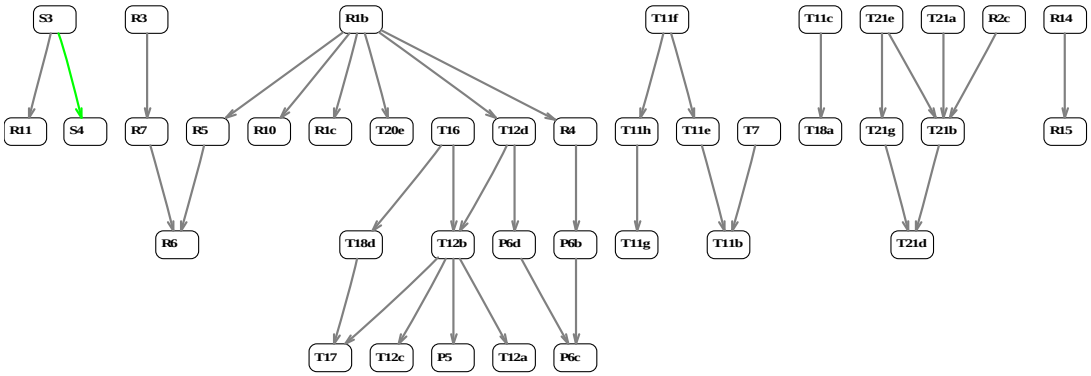
The third implicative chain formed by four separate relations.
The first one shows that teachers' beliefs about the formative assessment results influence their beliefs about the purpose of formative assessment. In particular teachers' belief that *the results' of formative assessment should be announced to the whole class* (R2a) related with their opinion that *providing feedback to a student can be achieved by providing a verbal statement about the quality of work itself (the reasons for the judgment and ways in which some of the shortcomings could be remedied)* (R1a). These statements influence teachers' beliefs that *formative assessment identifies the students' strong and weak abilities in mathematics* (P2). Therefore, the feedback should be focused on students' strengths and weaknesses in mathematics.

The next implicative relation is observed between the statement which supports that *errors are due to previous correct knowledge which is not appropriate in a new situation* (R16) and the belief that *the different assessment methods aim to assess the students' ability to organize mathematical ideas altogether to form a complete image that has meaning (synthesis*) (P6d). This relation shows that teachers' beliefs about the results of formative assessment affect their opinions about the purpose of formative assessment.

The third implication relationship includes three variables related with formative assessment results. This part starts with the belief that *formative assessment works best when the teacher avoids grading practices and comments that show students how their performance compares to other students* (R3). This statement related with the belief that *the results' of formative assessment should be discussed between the pupil and the teacher* (R2c) and with the belief that *formative assessment during instruction provides feedback that help students correct their errors* (R6.) Thus, the assessment without grades aims to a discussion between the student and the teacher, providing formative feedback.

The last relationship is noticed between the following techniques: *classroom discussion* (T21a) and *participation in classroom activities* (T19c). In particular, teachers' belief about their skill to apply classroom discussion is related with their belief that the participation in classroom activities is a factor which forms their expectations about their students' future assessment.

3.1.5.3. Implicative relations for the teachers from Cyprus



In the implicative diagram of the Cypriot teachers' beliefs we can distinguish five implicative chains.

The first implicative chain is formed by three variables. At the top of this chain there is the teachers' belief that *students can develop a deeper understanding of their learning when they are given opportunities to discuss the learning process with their teacher and their peers* (S3). This belief is related to the belief that *while teachers provide feedback, they can encourage self-assessment by asking students questions that help them to focus on self-monitoring* (S4). So this relation reveals the important relations between teachers' and peer feedback, which also develop the students' abilities for assessing themselves. The second relation in this chain is between the statement S3 and a belief about the source of errors. In fact this belief express that *errors are associated with student's attitude towards mathematics* (R11). Thus, this relation indicates that by providing between teachers' and peer feedback can have an influence on the students' beliefs about mathematics.

The second implicative chain contains beliefs about the results of formative assessment and particularly about the dimension of providing feedback to students. The chain starts with the belief that *formative assessment works best when the teacher avoids grading practices and comments that show students how their performance compares to other students* (R3). This statement relates with the belief *that formative assessment during instruction helps the teachers identify and implement instructional correctives* (R7). Thus, this relation relates use of formative assessment as a mean for modifying learning with the use of qualitative feedback. The next relation is also about the use of feedback in the same sense, as teachers express that *formative*

assessment during instruction provides feedback that help students correct their errors (R6). The influence of feedback is not only revealed to be on modifying teaching and improving the students' knowledge, but also on the students' affective domain, as *feedback about the students' progress in learning mathematics gives hope and positive expectations for themselves* (R5). Therefore, this implicative chain highlights the importance of feedback for formative assessment, which is related to positive influence on the teaching process, but also on the students' cognitive and affective domain.

The third implicative chain contains statements also mainly about feedback. This chain can be considered as divided in three parts. The first part of this chain reveals some important aspects about the purpose and the characteristics of good feedback, whereas the second part highlights some techniques for giving feedback. Regarding the first chain, it starts with the belief about using errors for providing feedback (R1b: *Providing feedback to a student can be achieved by showing students' specific misunderstandings or errors that frequently occur in a particular mathematical content area or a skill set*). Using errors is related to the positive influence on the students' affective domain, as mentioned in the statement R5, but also to the belief that *errors are associated with the way the student studies and prepares himself/herself* (R10). Feedback through *showing students how they can adjust their approach to the task* (R1c) is also related to statement R1b. Thus, we can see that when teachers use their students' errors for providing them feedback, they also consider that this can help the students study and prepare themselves in a more effective way for improving their understanding and eliminating their errors. The statement R1b is also related to statement T20e, revealing a limitation for teachers for providing feedback based on their students' errors. In fact the teacher express that *the insufficient teaching time* is a factor that affect your ability to apply different assessment methods, feedback in this case. The influence of time to the use of feedback is also evident by a next relation between the statements R1b and R4, according to which *the quality of feedback increases when providing feedback right after a submission* (R4). A last relation found in the first part of this implicative chain is between the use formative use of errors for feedback and students' self-assessment (T12d). Thus, feedback based on the students' errors helps them develop their self-assessment *techniques to discover mathematical abilities they need to further work on.*

This part of the implicative chain ends us with implication with statements expressing the teachers' beliefs about the purpose of assessment in mathematics. According to these statements the different assessment methods aim to assess the students' *comprehension and understanding* (*the ability to perceive mathematical meaning and to transform mathematical ideas from one form to another* – P6b), *Analysis* (*the ability to analyze information and to arrive to mathematical conclusions* – P6c) *and Synthesis* (*the ability to organize mathematical ideas altogether to form a complete image that has meaning* – P6d). Thereafter, these implications show that for the

teachers the use of formative feedback in relation to the formative use of the students' errors and students' self-assessment are important aspects for the students' assessment of their conceptual understanding and not their procedural knowledge and memorization. Thus, thus the teachers that focus on the development of conceptual understanding of mathematics seem to be considering more important providing high quality feedback to the students, using the students' errors for improving their learning and letting the students assess themselves.

The second part of this chain reveals the importance of basing feedback on predefined criteria. According to the teachers beliefs *formative assessment is more effective when teachers offer feedback about the students' progress toward meeting particular learning targets* (T16) and this leads to the students' improvement, as it is related to the statements that express that formative assessment *provides feedback that strengths motivation and leads to improvement in mathematical knowledge and abilities* (T18d) and *helps students to identify how to improve in mathematics* (T12b). This last statement is also related to another four statements, which reveal the relation of providing feedback for improving students in mathematics with other important aspect of formative assessment, such as self-assessment and sharing learning goals. Actually, statement T12b is related to the belief that *formative assessment is more effective when teachers encourage student's self-assessment* (T17), as a processes embodied in formative assessment is *both the teacher and the students reviewing and reflecting on their performance and progress* (T12c). *Another related process is sharing learning mathematical goals with students* (T12a). Feedback in relation to particular goals is related to the belief that *formative assessment should assess the students' ability to apply mathematics in unfamiliar everyday situations* (P5). Thus, the goals of mathematics learning should be related to everyday life and the ability to apply mathematics in real life should be also assessed.

The fourth implicative chain is formed by implications between different assessment techniques that teachers were asked to define their importance. These implications are actually between the use of *multiple choice tasks* (T11f), *sentence completion* tasks (T11h), *matching questions* (T11g), *performance test for each pupil* (T11e) and *oral questions and answers* (T11b). In fact, the use of *oral questions and answers* (T11b) is related to the statement that *if a teacher does not commit itself in identifying the weakness and strengths of the students since the beginning of the school year, then he/she cannot certainly fill in the students' gaps* (T7). Therefore, oral questioning appears as a technique for diagnostic assessment of the students at the beginning of the school years. It is interesting that these techniques, which are mainly related to tests, are discriminated from other forms of assessment, such as self-assessment or observation.

In fact the use of *structured observation* (T11c) is found in another relation outside the previous implicative chain, in which it is related to the statement T18a*: High-quality formative assessment takes many forms, but it always emphasizes to the*

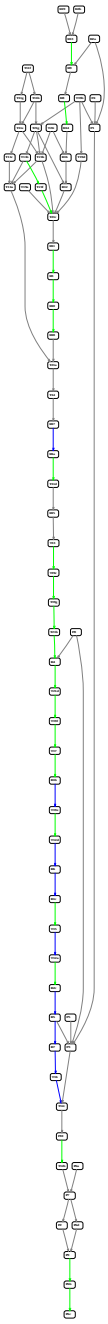
quality rather than the quantity of student mathematical work. Thus, teachers relate the use of structured observation as a mean to assess the students' quality of work.

A fifth implicative chain is distinguished, which is mainly formed by relations between the teachers' skills in using different assessment techniques. These relations reveal that when the teacher fell skilled in *assessing students' group activities* (T21e) they also fell skilled in *assessing students' presentation skills* (T21g), *students' individual activities* (T21d) and also in using *classroom observation* (T21b). Teachers express that they feel able to assess through classroom observation also when they fell skilled in assessing through *classroom discussions* (T21a). Furthermore the teachers' belief that *the results' of formative assessment should be discussed between the pupil and the teacher* (R2c) is related to assessment through *classroom observation* (T21b).

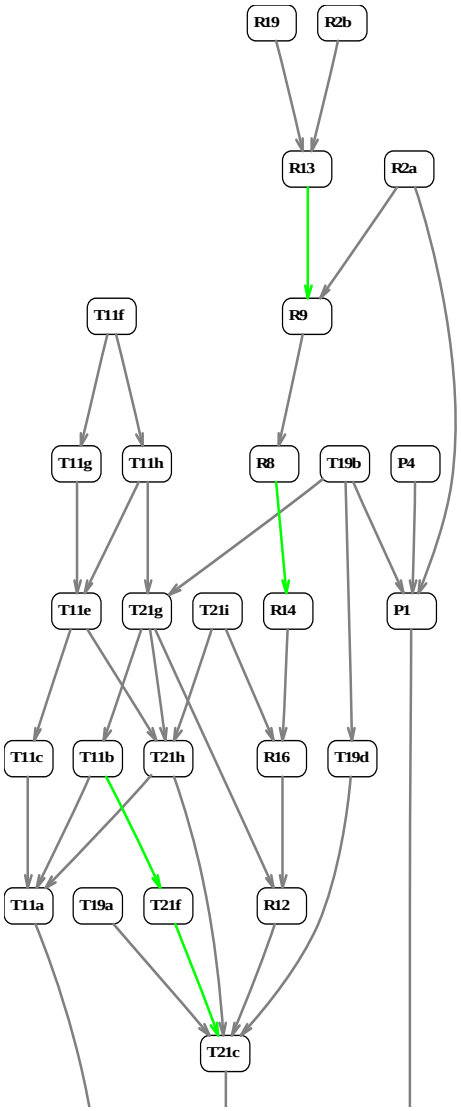
A last relation is found in the end of this implicative diagram, between two statements expressing the teachers' beliefs about the source of their students' errors. Actually when teachers believe that *errors are due to the limited capabilities of students* (R14) they also believe that *errors are due to wrong or incomplete knowledge about a concept taught previously* (R15). It is thus obvious that these teachers manly attribute errors to the factors related to the students, such as their capacities in learning.

3.1.5.4. Implicative relations for the teachers from Swiss

The implicative diagram of the Swiss teachers' beliefs is a very large diagram, including a big number of implications between the different statements of the teachers' questionnaires. To be easy to elaborate it and discuss these relations, we divided this large diagram into four parts.



Part 1



This first part of the implicative diagram of the Swiss teachers' beliefs about assessment includes two groups of statements, which reveal relations between their beliefs about the use of assessment techniques and the use of the results of formative assessment.

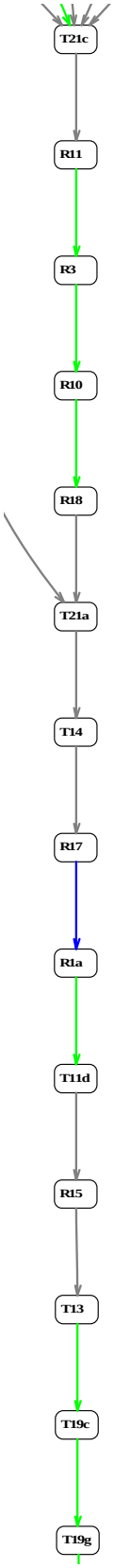
In fact the first group of statements is formed by implicative relations between statements that reflect the teachers' beliefs about the importance of using particular assessment techniques and statements about how skilled they feel in using these techniques. In this group the teachers' beliefs about factors that influence their expectations about their students' future assessment are also found.

Regarding the assessment techniques which are considered to be important, implications are found between the use of multiple choice tasks, matching questions, performance tests for each pupil, structured and unstructured observation in classroom. Furthermore, the teachers who feel skilled in assessing their students' presentations skills and in applying students' peer-assessment, they also feel skilled in applying students' self-assessment.

In addition, the teachers that consider important the use of oral questioning, they feel skilled in using this technique, but also in assessing students through individual interviews. Teachers' expectations about their students' future assessment are formed by the students' current scores and the students' behavior in the classroom.

The second group of implications is formed by statements expressing the teachers' beliefs about the source of their students' error. In this group the relations reveal the teachers' beliefs about their teaching and the students' knowledge and capabilities as sources for the students' mathematical errors. Factors related to teaching are the use of inappropriate questions for the students' abilities, inappropriate ways of teaching and the texts of the problems. Regarding the students' knowledge and capabilities, errors are related to students' lack of knowledge, to their limited capabilities, to their previous knowledge, but also to the psychological situation of the students

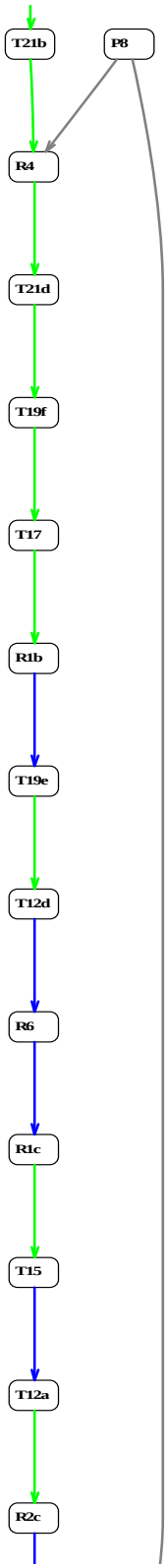
Part 2



In the second part of this implicative diagram, implicative relations about the source of mathematical errors are also found. These statements express the teachers' beliefs about the errors that are related to the students' affective domain. Specifically, these factors are the students' attitude towards mathematics, the students' way of preparing themselves for the lessons and the students' tendency to fulfill their teachers' wishes. Teachers that attribute the students' mistakes to these factors believe also that formative assessment works better when the teacher avoids grading practices and comments that show students how their performance compares to other students.

In this part of the chain the use of qualitative feedback in relation to predefined learning goals and clear expectations and assessment criteria is highlighted. The use of feedback as verbal comments about the students' quality of work, in relation to the learning goals, is related to the teachers beliefs that a source of students' errors is the use of an inappropriate model for completing a task and to the students' incomplete previous knowledge about a concept. Therefore, for these cases od errors the use of qualitative feedback based on predefined criteria can be helpful.

Part 3

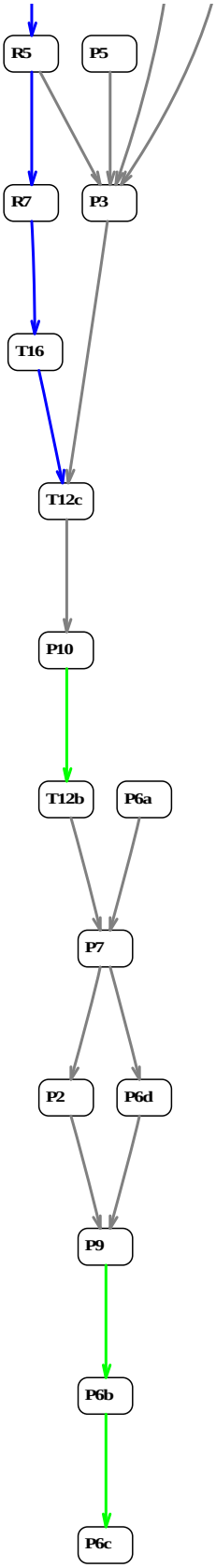


In the third part of this implicative diagram the relations reveal that the teachers who feel skill in assessing through class observation consider important to give feedback right after the collection of the information about the students' performance. Furthermore, if the teachers feel skilled in assessing the students' individual activities, their expectations about the students' future assessment are formed by the students' interest in homework assignments.

When the teachers have such beliefs, they also encourage students' self-assessment, thus they believe that feedback should include information about the students' errors and misunderstandings. Therefore, these teachers belief that a characteristic of formative assessment is learning through self-assessment techniques and that provides feedback for correcting the students' errors and for adjusting the students' approach to the tasks.

The use of feedback is again related to providing clear expectations for enabling students setting new goals, as they also believe that a characteristic of assessment is sharing mathematical learning goals to the students. When the teachers have these beliefs, they also believe that the results of formative assessment should be discussed between the pupils and the teachers.

Part 4



The first relations in part 4 reveal teachers' beliefs about benefits of feedback on the students' affective domain (e.g it gives them hope and positive expectations), thus the teachers believe formative assessment is most effective when teachers offer feedback about the students' progress toward meeting particular learning targets. These teachers believe also that formative assessment during instruction helps the teachers identify and implement instructional correctives and that assessing their students is very useful for them, because it gives them a chance to verify the validity of their work.

The last part of this implicative diagram includes implicative relations between the teachers' beliefs about the purpose of assessment.

When the teachers believe that the different assessment methods aim to assess the students' knowledge and memorization (the ability to memorize rules, axioms, theorems and other mathematical information) they also believe that the purpose of formative assessment is to help students overcome improve themselves in mathematics.

Furthermore, when they believe that the different assessment methods aim to assess the students' analysis (the ability to analyze information and to arrive to mathematical conclusions), synthesis (the ability to organize mathematical ideas altogether to form a complete image that has meaning) and comprehension-understanding (the ability to perceive mathematical meaning and to transform mathematical ideas from one form to another), they also believe that according to the formative assessment results, they should modify their instructional plan according to their students' needs.

3.1.5.5. Implicative relations for the teachers from France

Same as in the previous implicative diagram, the implicative diagram of the French teachers' beliefs is a very large diagram, including a big number of implications

between the different statements of the teachers' questionnaires. Due to the big numbers of these implications it is difficult to present and interpret all of them. Therefore, the most important relations we be presented and interpreted.

Regarding the teachers' beliefs about the purpose of assessment, when teachers believe that formative assessment should be based on the pupils' outcomes in math

rather than on the process they also believe that formative assessment is subjective while summative assessment is objective. These teachers think also that the insufficient awareness of the different assessment methods affects their ability to apply different assessment methods and that also the results of formative assessment should be announced to the whole class. Therefore the limited teachers' knowledge about assessment methods is related to negative beliefs about the purpose of formative assessment.

Another important relation is about students' self-assessment. The belief that formative assessment is more effective when teachers encourage student's self-assessment leads to the belief that the aim of assessment in mathematics is examining the students' knowledge (memorization), thus their ability to memorize rules, axioms, theorems and other mathematical information and that also formative assessment gives the students the chance to assess themselves. Therefore the important role of using self-assessment techniques is highlighted from these relations.

The teachers' belief that formative assessment should assess the students' ability to apply mathematics in unfamiliar everyday situations is related to feeling skilled in the use of in oral questioning and classroom discussion. Thus they agree that the students' interest in homework assignments form their expectations about their students' future assessment. They also consider structured observation as appropriate to be used in the teaching of mathematics. When teachers have such beliefs, they attribute errors to the students' attitude towards maths and to wrong or incomplete knowledge about a concept taught previously.

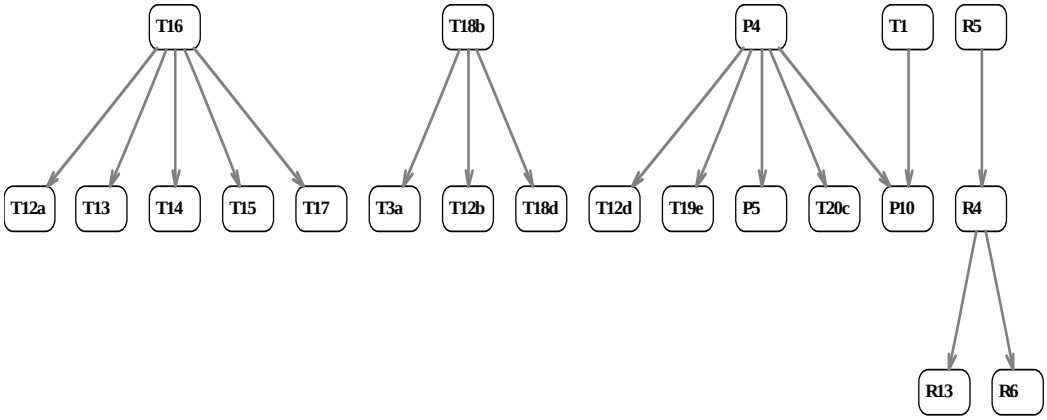
At a lower part of the implicative chain relations are traced between the teachers' beliefs about the purpose of formative assessment. These teachers' beliefs put on the centre the role of feedback mainly for improving the students at a cognitive and an affective level. In fact these relations include the teachers' beliefs that some characteristics of assessment are embodied in a number of processes like providing feedback that helps students to identify how to improve in mathematics and both the teacher and the students reviewing and reflecting on their performance and progress.

Next, many implications are observed between the teachers beliefs about the characteristics of formative assessment, the way of using the information collected through formative assessment and factors that affect the teachers' future expectations about their students' assessment. Some of these factors are the students' participation in classroom activities, their personal motivation to learn and their interest in classroom assignments.

A final important relation at the end of this diagram shows that the teachers that modify their instructional plan according their students' needs, believe that formative assessment is most effective when teachers offer feedback about the students' progress toward meeting particular learning targets. Therefore setting particular goals

help the students modify their lesson and set new goals, more based on the students' needs.

3.1.5.6. Implicative relations for the teachers from Netherland



In the implicative diagram of the Dutch teachers' beliefs we distinguish four implicative chains.

The first implicative chain is formed by six variables. At the top of this chain there is the teachers' belief that *formative assessment is most effective when teachers offer feedback about the students' progress toward meeting particular learning targets* (T16). This belief is related with other five beliefs about the formative assessment technique. The first relationship is observed between the statement T16 and the belief regarding *the sharing learning mathematical goals with students* (T12a). The second relationship is identified between the statement T16 and the beliefs that *formative assessment is most effective when students have a clear idea of what the teachers expect of them* (T13). Another implicative relation is noticed between the statement T16 and the belief that supports that *teachers can improve the clarity of student learning targets by providing examples of both weak and stellar mathematical work* (T14). Additional relation in this chain is observed between the statement T16 and the belief regarding *providing clear expectations enables students to set realistic, attainable goals* (T15). The last relation is between the statement T16 and the belief that refers that *formative assessment is most effective when teachers encourage student's self-assessment* (T17). Thus, the relations in this chain indicate that by providing feedback and sharing the learning goals can have influence on teachers' beliefs about formative assessment techniques.

Similar to the first implicative chain, the second one contains beliefs about the formative assessment techniques. In particular, this chain shows the belief that *high-quality formative assessment takes many forms, but it always focus giving advice and guidance over giving grades* (T18b) can have in impact on teachers' belief about the following formative assessment techniques: *the professional development of classroom formative assessment practice requires the teachers to understand the potential for the social construction of knowledge* (T3a), *some characteristics of assessment are embodied in a number of processes like providing feedback that helps students to identify how to improve in mathematics* (T12b) and *high-quality formative assessment takes many forms, but it always provides feedback that strengths motivation and leads to improvement in mathematical knowledge and abilities* (T18d).

In the third implicative chain seven variables are found. At the top of this chain there is the teachers' belief that *formative assessment should be based on the pupils' outcomes in math rather than on the process* (P4). This belief is related to the belief that *some characteristics of assessment are embodied in a number of processes like students learning self-assessment techniques to discover mathematical abilities they need to further work on* (T12d). Another relation in this chain is between the statement P4 and another belief about the purpose of formative assessment. In fact this belief about the purpose of formative assessment expresses that *formative assessment should assess the students' ability to apply mathematics in unfamiliar everyday situations* (P5). Furthermore, the statement P4 seems to be related with the following beliefs about the formative assessment techniques: *personal motivation to learn is a factor which forms your expectations about your students' future assessment* (T19e) and *the insufficient awareness of the different assessment methods is a factor which affects teacher's ability to apply different assessment methods* (T20c). Thus, the relations in this chain indicate that teachers' beliefs about the purpose of formative assessment influence their techniques using in their lesson. Another important implicative relationship is observed in this chain. In specific, both statement P4 and T1 influence teachers' belief that *assessing students is very useful for them, because it gives them a chance to verify the validity of their work* (P10). The statement T1 refers that *for formative assessment to be fair, it must be uniform through the use of standardized the tasks.*

The last implicative chain includes four variables related with the results of formative assessment and particularly about the dimension of providing feedback to students. The chain starts with the belief that *feedback about the students' progress in learning mathematics gives hope and positive expectations for themselves* (R5). This statement related with the belief that *the quality of feedback increases when providing feedback right after a submission* (R4). Thus, the feedback influences students' affective domain and then the quality of feedback is affected. The next relation is also about the use of feedback and its relation with the students' errors. Teachers express that *formative assessment during instruction provides feedback that help students correct their errors* (R6). They also *associate the errors with inappropriate ways of teaching*

(R13). Therefore, this implicative chain highlights the importance of feedback for formative assessment, which is related to the students' cognitive and affective domain.

3.2. PART B: STUDENTS' QUESTIONNAIRE RESULTS

3.2.1. The Students' Questionnaire in Italy

The construction of the Student Questionnaire (SQ) has been shared among all partners which are members of the project, but each country then decided to decline it and structure it according to the specific needs of its own context.

At the common level, the SQ is built on five main axes of investigation, which are in turn subdivided into subcategories:

Axis 1: Assessment Practices

- During the formative evaluation
- After the formative evaluation
- Differentiation of evaluation practices

Axis 2: Participation in the evaluation

- Self Assessment
- Peer review
- Parental involvement

Axis 3: Awareness about the evaluation criteria

- Awareness of teachers
- Awareness on the part of the students (definition and clarification of the criteria ..)
- Comparison among the students

Axis 4: Results and benefits of the evaluation

- From the point of view of knowledge

- From the emotional point of view

- From the point of view of motivation

Axis 5: Using the errors

- By teachers

- By students.

In detail, the structure of the Student Questionnaire proposed to Italian students, is as follows:

- *Part A:* Information related to gender, and class/school membership;

- *Part B:* opinions on the importance of assessment tools in mathematics (on the one hand, the importance that students attach to different assessment tools in mathematics and on the other, the opinions on the actual use made in the classroom);

- *Part C:* personal experiences of students (divided into three blocks with respect, for example, to their relationship with grades in mathematics, with the ways of teacher evaluations, with the self-assessment and peer assessment, with the habits of their teachers in mathematics about evaluation, The following table shows how the Axes were declined inside the Italian SQ.

Tab.1: Declination of the Axes of investigation within the Italian SQ.

Sections of Italian SQ	**Shared Axes of investigation**
part A	/
part B	Axis 2, Axis 3
part C	Axis 1, Axis 3, Axis 4 Axis 5

The administration of the SQ in Italy

In total 460 secondary school students of first degree partecipated to the survey in Emilia Romagna, in the provinces of Bologna and Modena (IC 15 of Bologna, IC "Gasparini" of Novi di Modena, IC "Bassi" Castel Bolognese, school "Ungaretti" Solarolo). This is obviously a sampling given by the choice of expanding the knowledge of specific contexts (and related training needs of teachers) among the schools which partecipate to FAMT & L as Associated Partners.

In detail, the questionnaire was completed by 247 students of the first year of secondary school in first grade, by 139 of the second year and by 74 of the third year.

To facilitate both the administration and the subsequent analysis of the data, students completed the questionnaire online. The instrument that was used is the platform Lime Survey, an open source application that allows users to develop and publish surveys, to collect responses and to have some statistics in real time. In order to monitor the operations of compilation by students, some project researchers have always been in the classes at the moments dedicated to writing the surveys. The online tool also allowed to collect the responses anonymously and to collect data in an aggregated form. Almost all the questions were structured as multiple choice questions (Likert scale) and the tool set so as to require the completion of each part of the questionnaire (to pass to the next section is possible only after the full compilation of the previous parts).

PART B - Opinions on the importance of evaluation tools in Mathematics

The analysis of students' responses provided in Part B of the Student Questionnaire is taken from the article[1]:

In Part B:

9. The first question is aimed at investigating the importance attributed by the students to the different assessment tools;

10. The second one detects the presence or absence of these assessment tools in the experience of the students at school.

[1] *Ferretti, F., Lovece, S., (under review).* ***La valutazione formativa per la didattica della matematica nell'ambito del progetto FAMT&L. Le concezioni degli studenti "di scuola media" nei confronti degli strumenti di verifica utilizzati in classe.*** Ricerche di Pedagogia e Didattica – Journal of Theories and Research in Education.

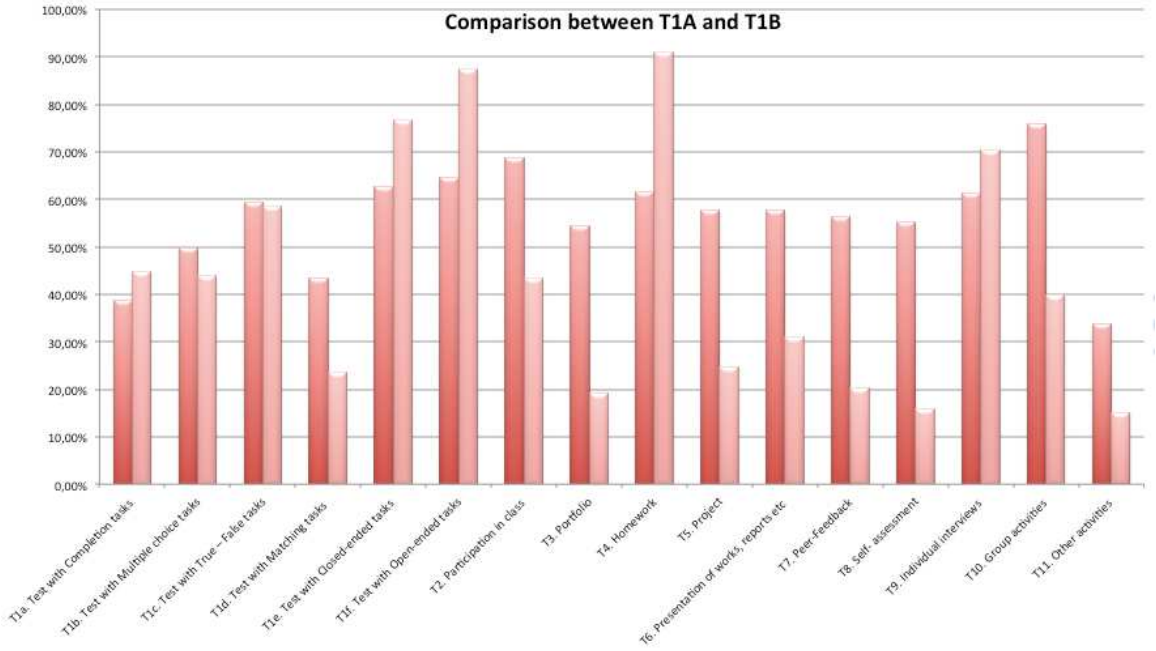
11. The following tables show the results (expressed as a percentage) for each individual item. The right column in the first table shows the sum of the percentages of response to options 3 and 4 (extremely important).

How much important do you think the following methods of assessment in math are? Put in order of importance the following methods for your assessment in mathematics. ****Note:* The number 4 represents the highest degree of importance.***	
T1a. Test with Completion tasks	38,7 %
T1b. Test with Multiple choice tasks	49,8 %
T1c. Test with True – False tasks	59,5 %
T1d. Test with Matching tasks	43,3 %
T1e. Test with Closed-ended tasks	62,6 %
T1f. Test with Open-ended tasks	64,6 %
T2. Participation in class	68,7 %
T3. Portfolio	54,4 %
T4. Homework	61,7 %
T5. Project	57,8 %
T6. Presentation of works, reports etc	57,6 %
T7. Peer-Feedback	56,3 %
T8. Self- assessment	55,2 %
T9. Individual interviews	61,3 %
T10. Group activities	75,9 %
T11. Other activities	33,7 %

Tab. 2. Results, in percentage, to the first question of "Part B" of the Student Questionnaire

Select from the list the assessment tools that your math teacher uses more frequently	
T1a B. Test with Completion tasks	44,8 %
T1b B. Test with Multiple choice tasks	43,9 %
T1c B. Test with True – False tasks	58,5 %
T1d B. Test with Matching tasks	23,7 %
T1e B. Test with Closed-ended tasks	76,7 %
T1f B. Test with Open-ended tasks	87,4 %
T2 B. Participation in class	43,5 %
T3 B. Portfolio	19,3 %
T4 B. Homework	91,1 %
T5 B. Projects	24,8 %
T6 B. Presentation of works, reports etc	31,1 %
T7 B. Peer-Feedback	20,2 %
T8 B. Self- assessment	15,9 %
T9 B. Individual interviews	70,4 %
T10 B. Group activities	39,8 %
T11 B. Other activities	15 %

Tab. 3. Results in percentage for the second question of "Part B" of the Student Questionnaire



We get a first interesting observation, from the previous data, by doing a simple comparison between the sums of the overall percentages; summing the percentages of the first table we get 901.1, while adding the percentage of the second table we obtain 706.1. From this first and general comparison we can already deduce that students perceive much more the importance of a wide "palette" of assessments with respect to what they see carried out by their teacher.

In line with the theoretical framework, students show that they value their active participation in the evaluation process; in fact they attach much importance to the very instruments that emphasize their role in the formative assessment: tools "peer assessment" and "autoassessment" (T7 and T8); "Observation of student participation in the classroom" (T2) and "group activities" (T10). In the meanwhile, the assessment tools that students perceive to be used more often by teachers are "homework" (T4B) and "test with open-ended tasks" (T1fB).

In addition to these rankings, it is interesting to see for which items the result in the first question is even further from the result in the second question.

Looking at the response rates, the items:

- T3-T3B: Portfolio of the student (collection of the work done during school);
- T5-T5B: Conducting project work on concrete situations;
- T7-T7B: Mutual evaluation between peers;
- T8-T8B: Self-assessment (i.e. each student assesses whether knows what he has learned);
- T11-T11B: Group activities.

differ by at least 30 percentage points (the difference between the response rates in the first question and the response rates in the second question, in reference to the same assessment tools, is greater than 30 percentage points).

Furthermore, for the items:

- TID - T1dB: Test-match (two lists of concepts to be connected to each other);
- T2-T2B: Observation of student participation in the classroom;
- T6-T6B: Reporting on research and personal work

the difference between the response rates between the first block and the second item is about 20 percentage points.

In contrast, the response rates to the first question are significantly lower than the response rates in the second question for the items:

- T1f -T1fB: Test with open-.ended tasks;
- T4-T4B: Homework.

Analysis of results

In the reading and interpretation of the data it must be remembered that, having worked on a non-representative sample of students, any kind of wide generalization is not allowed. The results are therefore a useful and important starting point (and appeal) to build and define some hypotheses about the practice and the training needs of teachers that has to be explored further in subsequent investigations.

The fact that students give much importance to most assessment tools even if they do not see them actually used in the classroom by their teachers may be indicative of the different visions of students and of teachers about perceptions of formative assessment. If the students perceive the lack of many assessment tools in classroom situations, it can be a symptom of the absence, from their point of view, of the will, on the part of the teachers, to investigate the causes of their difficulties. This also implies the perception of the lack of data necessary for the teacher to be able to make an assessment of what students are able to do at some point in the process of teaching/learning: one of the functions in the recognized good practices of evaluation.

Peer review and self-assessment (instruments considered important by students, but not very much used by teachers in valuation practice) are considered as essential assets of the practice of formative assessment. In fact, during activities of peer assessment, students must be able to acquire the knowledge and skills necessary to be

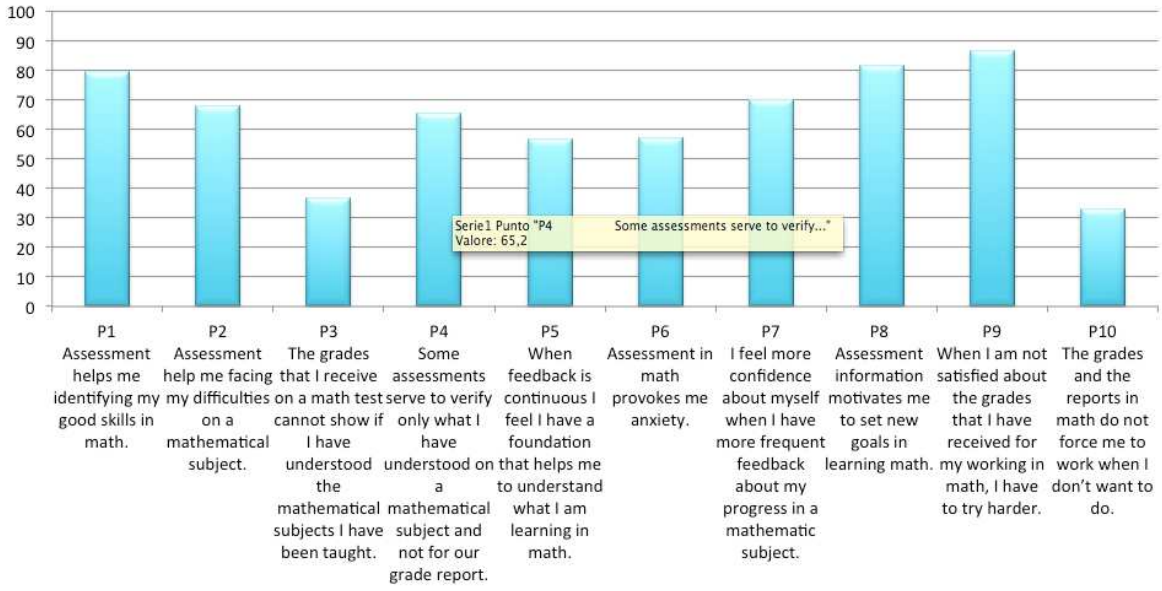
able to "assess the others" and, during the evaluation phase, the learning achievements are made explicit, making it even better "evaluable" by of teachers. Moreover, also the students under evaluation, helped by the discussion among peers, will try to defend their ideas and arguments, so they will openly describe them. The peer assessment often leads naturally the students to reflections related to self-evaluation, and this is useful not only for the learning phase, but also to provide meaningful feedback to the teacher when the process is discussed with the student.

The data show that students feel much more important, rather than what it is actually used in the classroom, the use of tools such as "group activities", "portfolio of the students", "observation of students' participation in the classroom". Within a vision of evaluation aimed at guiding students toward a greater awareness of their own learning, it is essential that the teacher, while students perform mathematics activities, observes them and asks explanations, so that they can gain information not only about their skills, but also about the mental processes they put in place and about their attitudes. In addition the use of "group activities" for FA is the tool that can better foster discussions between students and the teaching technique of classroom discussion, which proved to be very effective not only during teaching situations in class, but also for the detection of evaluative information about individual students. In fact, during the group activities the students defend their ideas, make them explicit and openly expose them, thus making them more identifiable by the teacher (who may also adopt simple observation instruments for systematic data collection). The high presence of "test with open-ended tasks" among the assessment tools used by teachers is a very positive fact, as it is very important, in matters of evaluation, to privilege the process rather than the product, enhancing and evaluating each step of the process of solving problems, in order to evaluate well the different strategies used by the students.

PART C- Your experiences

1) In the questions P emerge another links between students' answers and our theoretical framework.

P- According to your experience in classroom, express your opinion about the following statements (PERCENTAGE SUM "AGREE PLUS STRONGLY AGREE").



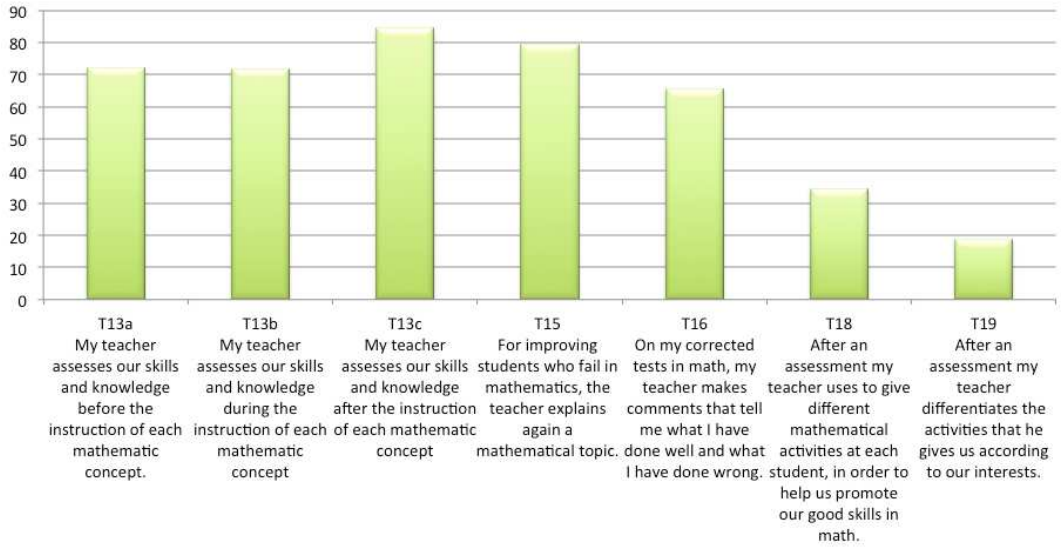
The high percentage in item P4 highlights how children explicitly emphasize the importance of non-summative assessment.

We can also observe that one of the highest rates of "Strongly Agree" is in item P8 (and this indicates

a strong link between assessment and motivation). This is confirmed by the result in the item P9,

which underlines the close link between assessment and engagement.

2) **According to your experience in classroom, express your opinion about the following statements (PERCENTUAGE SUM "AGREE PLUS STRONGLY AGREE").**



The items T13a-b-c refer to the use of evaluation before, during and after an educational activity. As shown response rates, with a gap of more than 10% compared both to "before" and "during", more than 80% of students said that usually the teacher evaluates what they learned after introducing a new topic.

From item T16 emerges a bad information: over one third of the children said that when correcting homework, the teacher does not say what has been done well. Evidently, in Italian teaching practices, teachers simply put a number (i.e., the assessment often takes only a summative function).

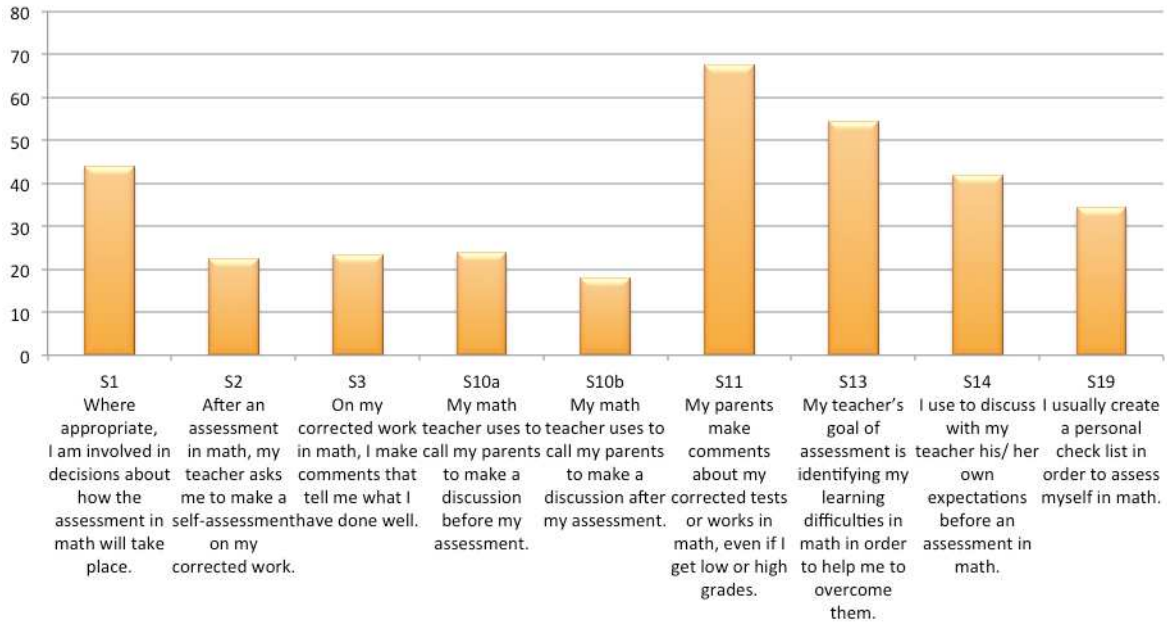
In line with our theoretical framework, the item T18 and T19 show another critic about the function of the formative evaluation: the difficulty in differentiating tasks according to the skills and interests.

3) **According to your experience in classroom, express your opinion about the following statements (PERCENTUAGE SUM "AGREE PLUS STRONGLY AGREE").**

R4 My math teacher uses our mistakes and interests to plan the next mathematics lesson	**47,1**
R5 My math teacher wants to be with me while I am correcting my mistakes.	**28,1**

The items R4-R5, in which we investigated the attitude of the teacher perceived by students at the time of teaching (R4) and learning (R5). The answer do not reach the 50% of positive feedback. The very negative percentage in item R5 (below 30%) indicates that most of the teachers do not follow students while they correct their mistakes.

4) **According to your experience in classroom, express your opinion about the following statements (PERCENTUAGE SUM "AGREE PLUS STRONGLY AGREE").**



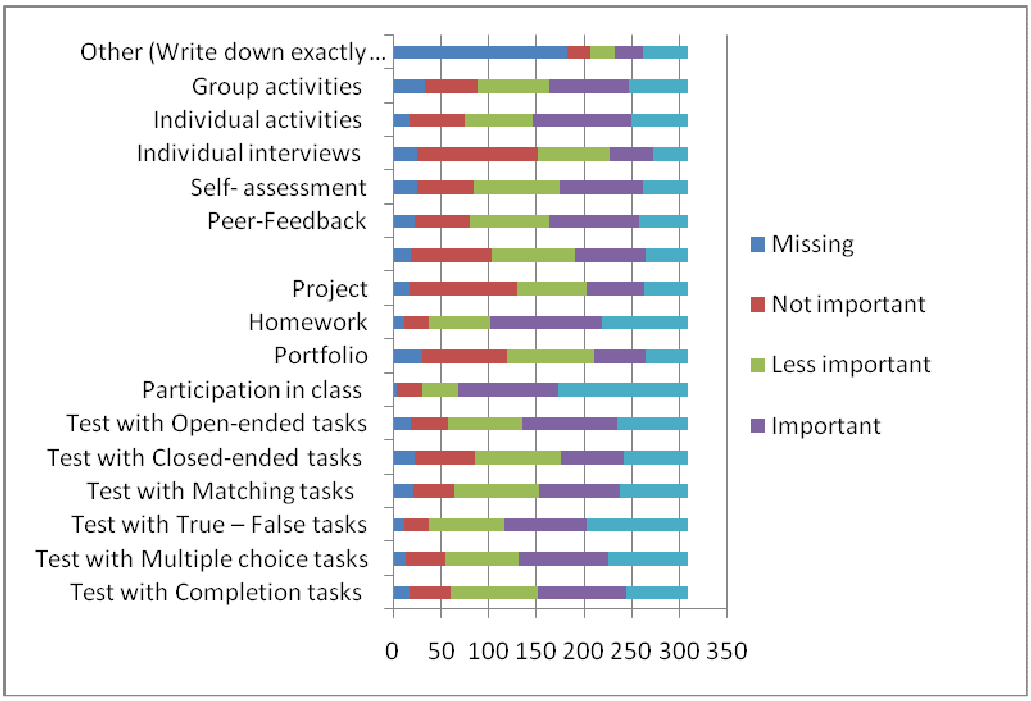
In our theoretical framework the importance of sharing criteria of assessment is explicit. As we can see in the figure above (Item S1), more than half of the children said that they are almost never involved in decisions about how the assessment in math will take place. To confirm this, we can analyze the responses to the item S14 and we can see that less than 50% of students say that they discuss with they teacher his/ her own expectations before an assessment in math.

The items S1 and S2 still investigate the self-assessment and in both of them the percentage of positive responses is very low.

The analysis of the answers to item S12 shows that more than half the pupils declare not to know what is expected by them in her/his work, and the high percentage of positive answers to item S16 underlines that clarity about aims yields a greater motivation for the students.

3.2.2. **The Students' Questionnaire in Cyprus**

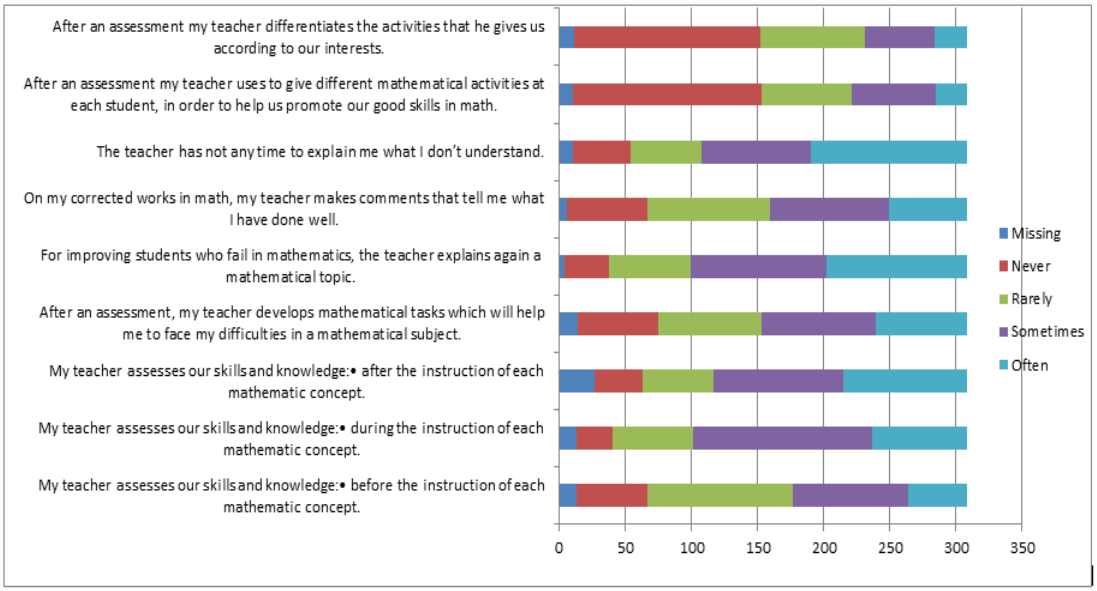
1. Questions of Part B



Graph 1

Graph 1 presents students' opinions about the importance of some specific techniques/methods of assessment in mathematics. At a first glance, participation in class is considered as the most important method of assessment in mathematics. Homework seems to be the second important method for the students, while the test with true-false tasks is the third. Similar, more than the half sample of the research argues that the test with multiple choice tasks, open-ended tasks or completion tasks are also important methods of assessment. This view prevails for the individual activities. In contrast, the method of individual interviews stands out for its negative aspect. Similarly, the method of portfolio is considered less or not important. Regarding to the rest of the suggested methods, students' opinions about their importance in the assessment of mathematics are not clear.

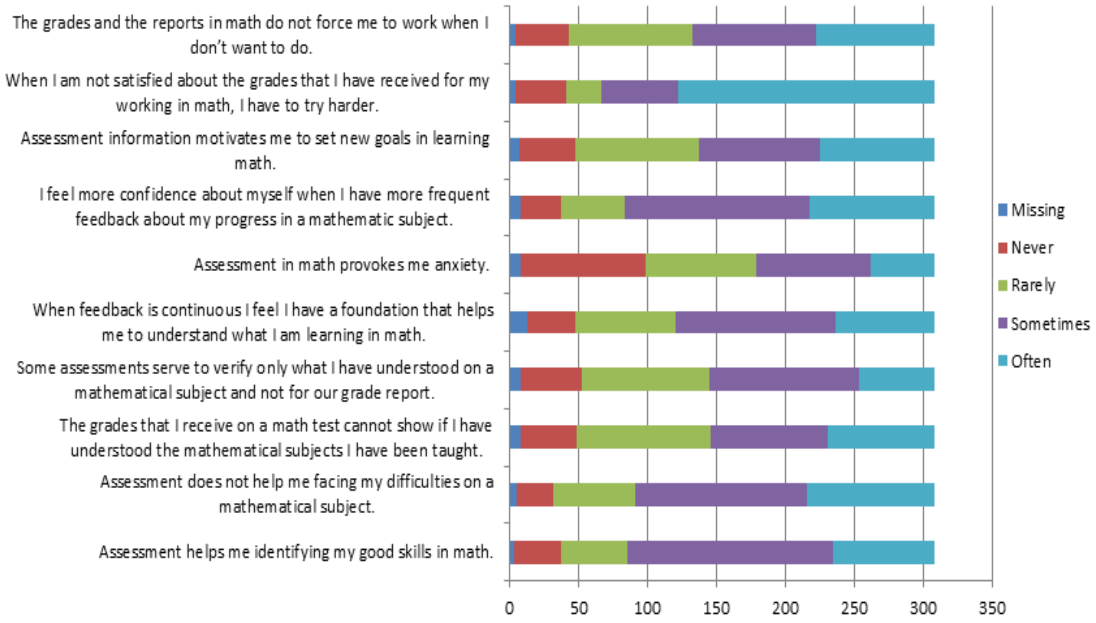
2. Questions T13 to T19 in Part C



Graph 2

Graph 2 refers to students' opinions about the techniques and methods applied by their teacher. As the graph shows more than the 2/3 of the sample claim that their teacher assesses their skills and knowledge during the instruction of each mathematic concept. The assessment after the instruction of each mathematic topic also happens frequently, in contrast to the assessment before the instruction of each mathematic topic. Similarly, a large proportion of students argue that their teacher explains again a mathematical topic to students who fail in mathematics in order to help them to be improved. However, a contradiction is observed between this argument and students' opinion that their teacher has not any time to explain students what they don't understand. In specific, the two third of the students argue that the teacher has not any time to explain them what they don't understand, but at the same time, almost the two third of them support that the teacher explains again a mathematical topic for improving students who fail. It is noteworthy that the most of the students declare that after an assessment their teacher not differentiate the activities that he/she gives them according to their interests, as well they claim that after an assessment their teacher don't give different mathematical activities at each student, in order to help them to promote their good skills in math.

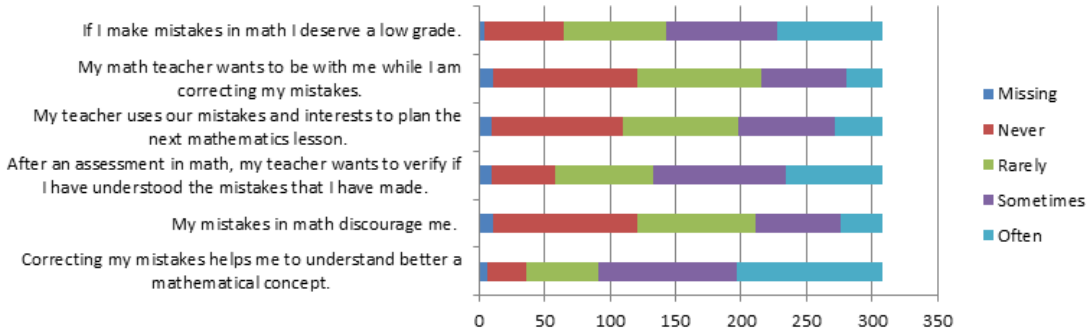
3. Questions P1 to P10 in Part C



Graph 3

Graph 3 gives information about students' beliefs about the purpose of formative assessment. As it is clear from the graph, the most of the students support that when they are unsatisfied about the grades that they have received for their working in math, they have to try harder and they, also argue that the more frequent feedback about their progress enhances their confidence in math. Furthermore to the affective domain, the graph indicates that less than the half students feel anxious when they are assessed in mathematics. As regard students' opinions about the purpose of assessment, it is observed that the main purpose of the assessment is to identify students' good skills in math. However, at about the same proportion of the sample argues that assessment doesn't help students facing their difficulties on a mathematical subject. Regarding the above statements, we could therefore say that the majority of students consider that the formative assessment help them to identify their good skills, feel more confidence about themselves and gives them an incentive to try harder. However, at the same time, students declare that formative assessment don't help them realize their difficulties. For the remaining statements, the results do not give us a strong indication, since the average of their response varies in the middle.

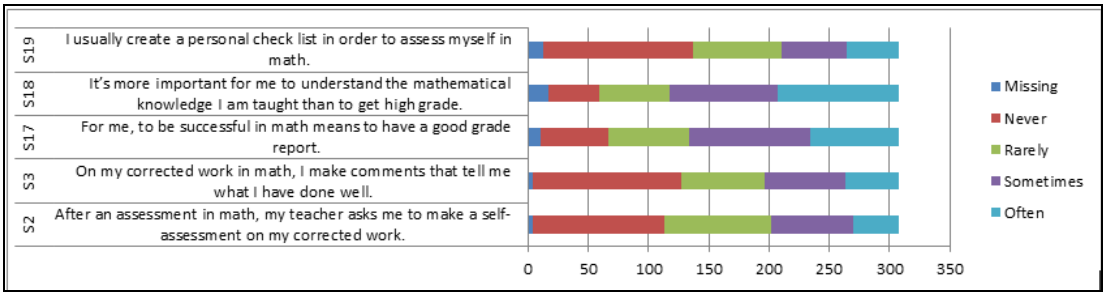
4. Questions R1 to R6 in Part C



Graph 4

Graph 4 represents students' beliefs about the results of formative assessment. In this graph, three positive opinions are distinguished. Similarly, three negative opinions stand out. More specifically, most of the students argue that correcting their mistakes helps them to understand better a mathematical concept. Next they support that after an assessment in math, their teacher wants to verify if they have understood the mistakes that they have made, as well as they consider that if they make mistakes in math they deserve a low grade. In contrast, most of the students claim that their teacher doesn't want to be with them while they are correcting their mistakes and he/she also doesn't use their mistakes and interests to plan the next mathematics lesson. However, a small proportion of the participants seem to be discouraged by the mistakes in math.

5. Questions S2, S3, S17, S18, S19 in Part C (about self-assessment)

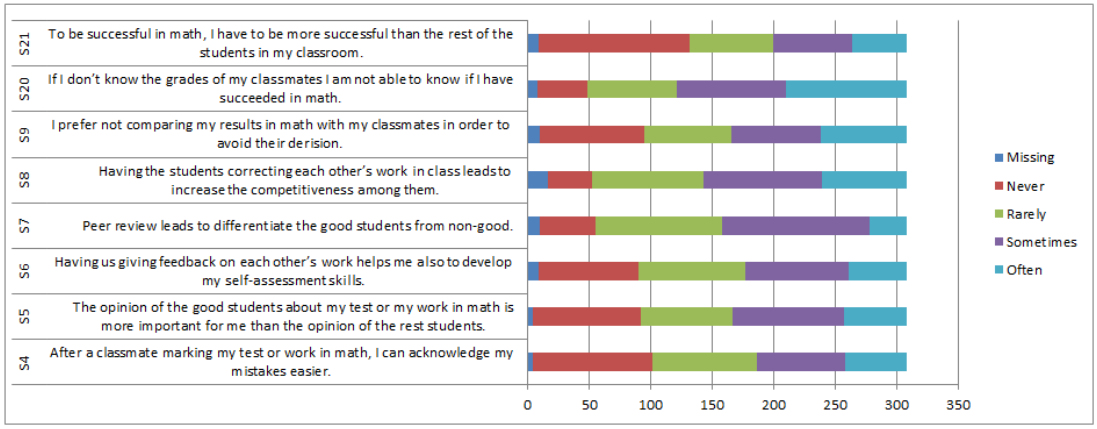


Graph 5

Graph 5 includes five statements which refer to self-assessment technique. What it is observed in this category is that most of the students respond negatively. Especially most of the students don't create a personal checklist in order to assess themselves in math nor make comments that tell them what they have done well in their corrected work in math. In addition, their teacher doesn't ask them to make a self-assessment on

their corrected work, after an assessment in math. In contrast, for the most students, the graph shows that to understand the mathematical knowledge they are taught is more important than to get high grade. Most of the students also argue that to be successful in math means to have a good grade report.

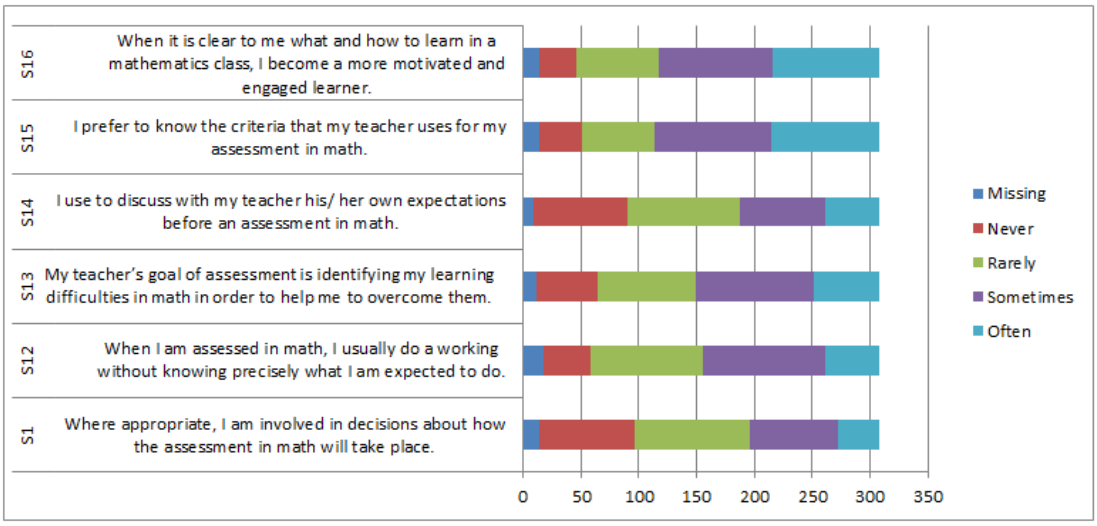
6. Questions S4, S5, S6, S7, S8, S9, S20, S21 in Part C (about peer-assessment)



Graph 6

Graph 6 refers to peer-assessment technique. As the graph shows, more than the half students argue that if they don't know the grades of their classmates they are not able to know if they have succeeded in math. In addition, more than the half participants believe that correcting each other's work in class leads to increase the competitiveness among them. In contrast, regarding to the rest of the statements, more than the half students have negative stance for the written statement.

7. Questions S1, S12, S13, S14, S15, S16 (about the awareness of assessment criteria)



Graph 7

Graph 7 refers to the awareness of assessment criteria. More than the half students declare that they prefer to know the criteria that their teacher uses for their assessment in math, because as they argue, they become more motivated and engaged learners when it is clear to them what and how to learn in mathematics class. In contrast, a very small proportion of the participants say that they are involved in decisions about how the assessment will take place or they discuss with their teacher his/her own expectations before an assessment in math. Finally, with respect to the other two statements the results are not clear again, because students' responses are in the middle.

Concluding Remarks about Students' Beliefs

Students consider the participation in class and the homework as the most important assessment techniques in math, while the individual interviews seem to be the least important for them. In addition, according to students' responses, the teacher assesses their skills and knowledge particularly, during the instruction of each mathematic concept. It is noteworthy that the teachers don't differentiate their activities according to their interests in order to help students to promote their good skills in math. As regard students' beliefs about the purpose of formative assessment, they consider that the main purpose of the assessment is to identify students' good skills in math. Furthermore, most of the students argue that correcting their mistakes helps them to understand better a mathematical concept. Regarding to self-assessment technique most of the students respond negatively, indicating that students are not severely dealt with self-assessment. At the same time their statements show that neither the teachers emphasize on their self-assessment. An important point for peer-assessment techniques is that the students are not able to know if they have succeeded in math if they don't know the grades of their classmates. Finally, as for the awareness of assessment criteria, students' answers show that they prefer to know the criteria that

their teachers use for their assessment in math, however their teachers don’t involve them in the decisions about how assessment will take place.

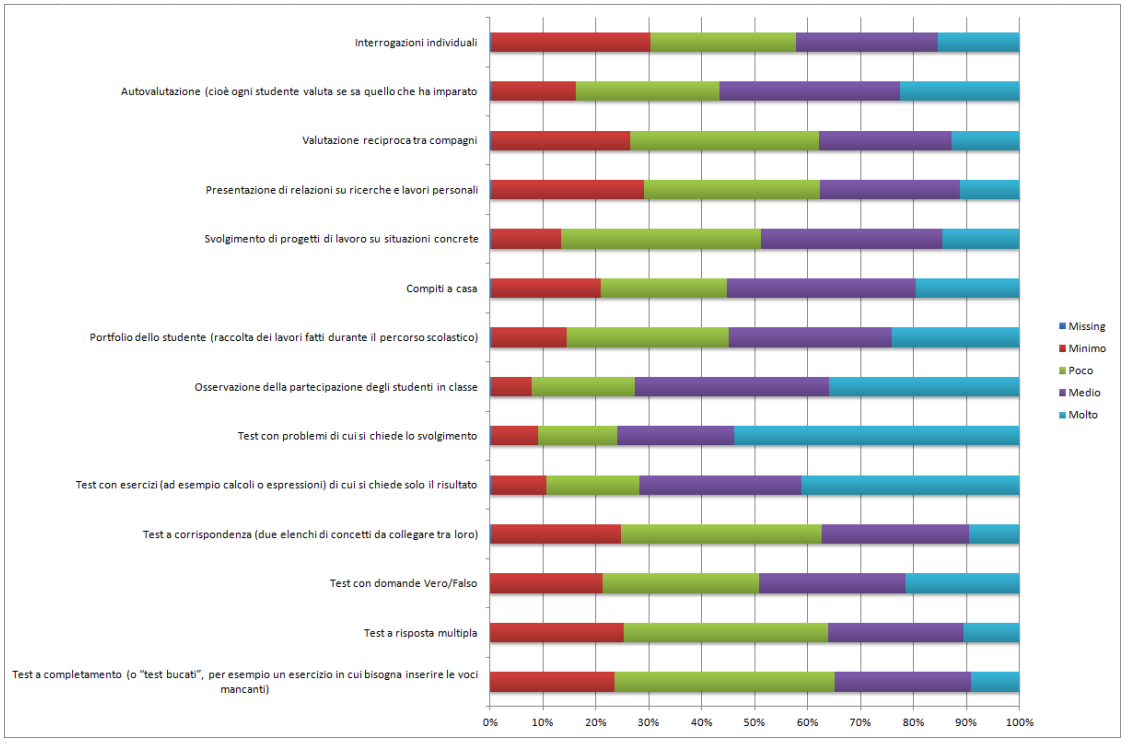
3.2.3. The Students' Questionnaire in Swiss

Sample

The questionnaire has been submitted to 340 students in Canton Ticino distributed as follows: 72 students in the first form of middle school, 67 students in the second form of middle school, students in the third form of middle school: 78 (base course), 49 (aptitude course); students in the fourth form of middle school: 17 (base course), 57 (aptitude course). Males represent 47,6% and females 52,4%. The students belong to the schools of Cadenazzo, Gravesano, Minusio, Ambrì and Locarno.

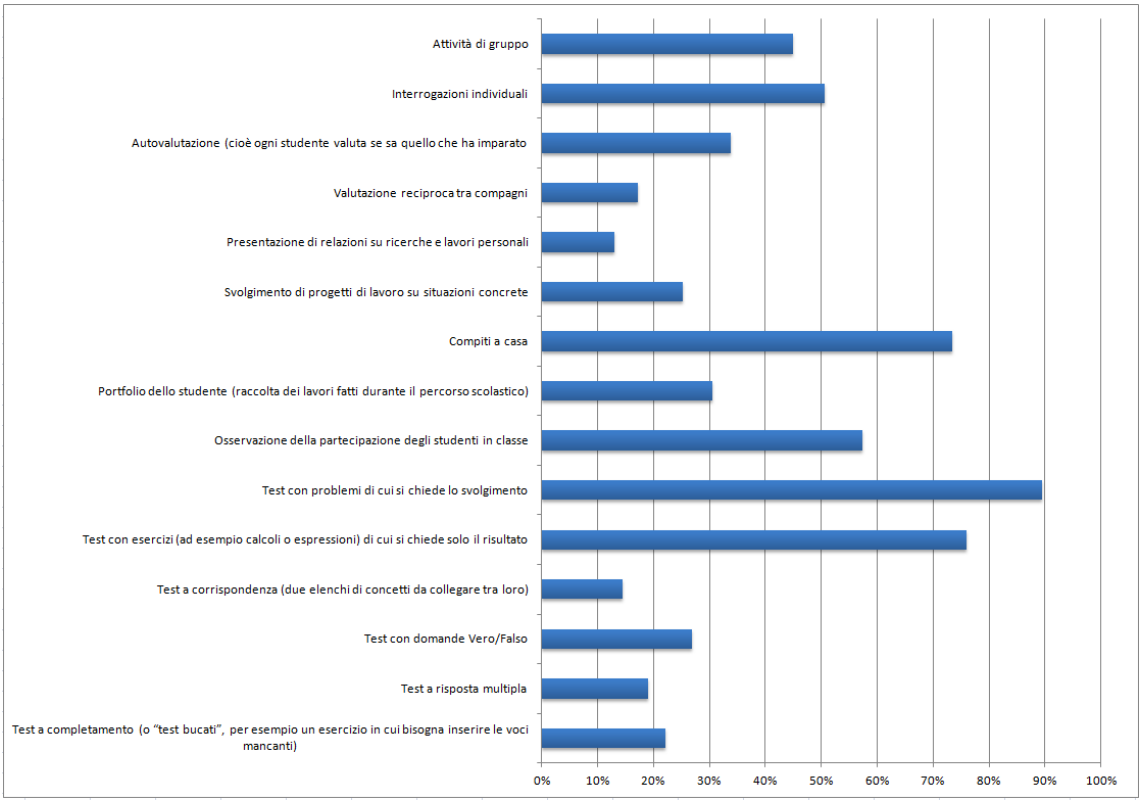
How important are for you these assessment methods in math to evaluate the learning of the students?

Graph 1: Student's beliefs concerning the importance of the assessment methods in math to evaluate their own learning



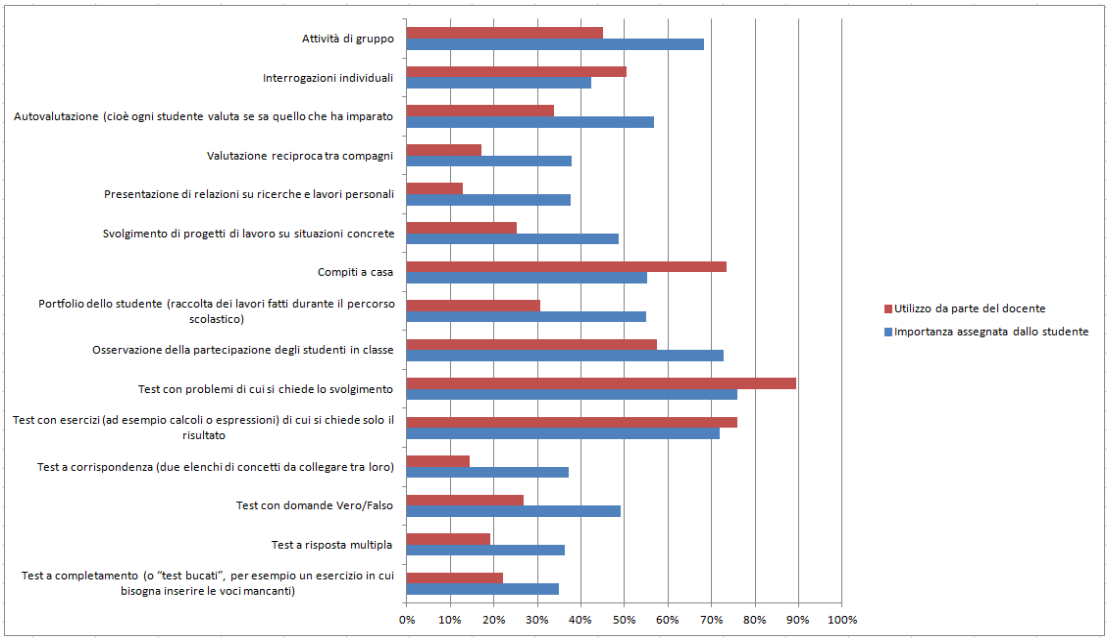
Select from the list below the assessment method frequently used by your math teacher

Graph 2: Frequently assessment methods used by teachers in the opinion of students



Comparing graph 1 and 2 comes to light very high percentage referring either to pertinence and the effective use of test with open-ended tasks or test with closed-ended tasks (eg calculations or expressions) that you is only claiming result. Analyzing graph n.1 it emerges that students give high importance to participation in class. Peer-Feedback, reporting on researches and personal works , and test with multiple choice tasks or with true – false tasks are not recognized as assessment methods used by the teachers.

Graph 3: Comparison between the importance given by the students to the various assessment methods and the actual us of them done by the teacher



Overall it appears a correlation between the student's perception of the importance of formative assessment methods and the effective use by the teacher. 11 out of 15 items show a more important perception by the students respect to the effective use by the teacher; just the opposite for test with open-ended tasks, individual interviews, test with open-ended tasks or homework assignment where the strongest gap is detected. Lowest gap becomes visible on test with closed-ended tasks.
Strong gap becomes visible for these items: reporting on researches and personal works, conducting working project on concrete situations, self-assessment (the student evaluate it own learning), group activities, test with Matching tasks, student's portfolio, considered quite important for the students, but little used by the teachers.

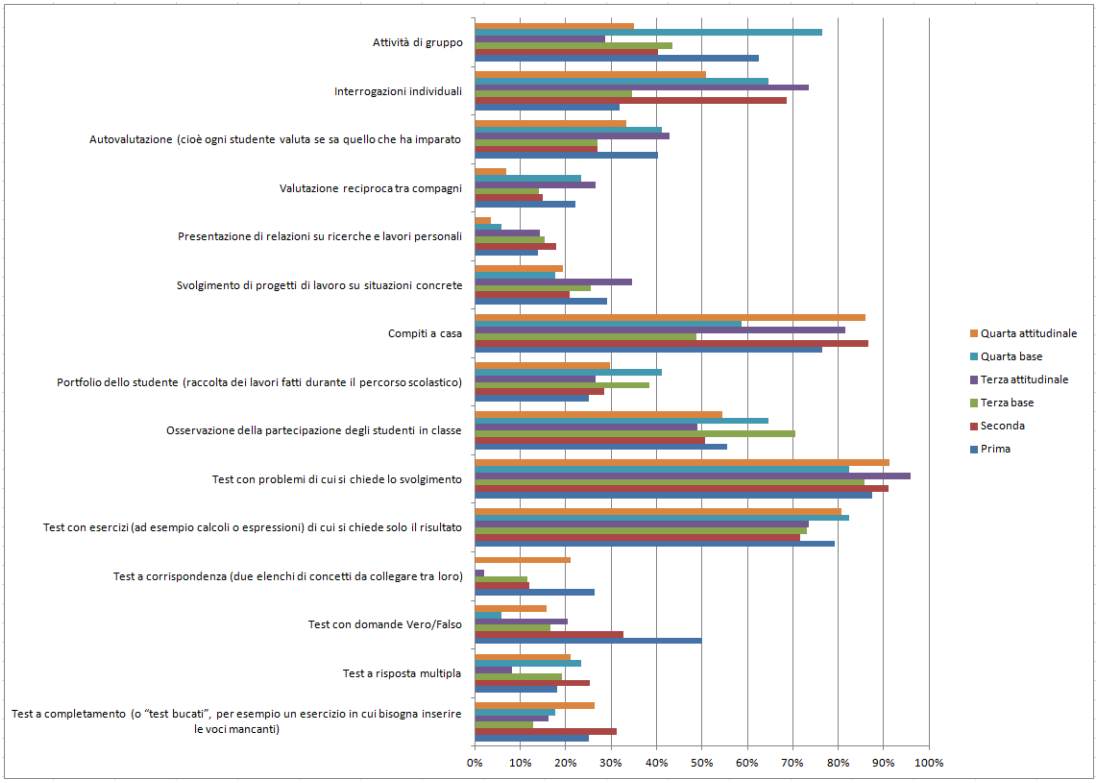
On the item "other", not included in the graph and chosen by 11,5% of the students, are included these elements: "blitz tests with problems with only answer", "unexpected small tests, where the assessment is express in words (excellent/very good/good…) instead of numbers (6/5.5/…) twosome exercises, group oral examination, short test based on the last argument, "first work alone and then correct together", works on the blackboard, classroom behavior, "single expression problems".

Specifically the report highlights that concerning homework we have the strongest gap between the student's perception of its importance and the effective use of it made by the teacher; less than 20% of the students think that homework are an important instrument and more than 70% of the teachers are using it.

According to the students there is a preponderance of activities such as test with closed-ended tasks, test with open-ended tasks, homework, rather than methods that

require learning communicative (reporting on researches and personal). Personal interpretation of a problem (conducting working project on concrete situations). On the other hand, as shown in Graph 1 students, experience a discreet importance of these aspects under assessment.

Graph 4: Assessment methods and relative classroom partitions



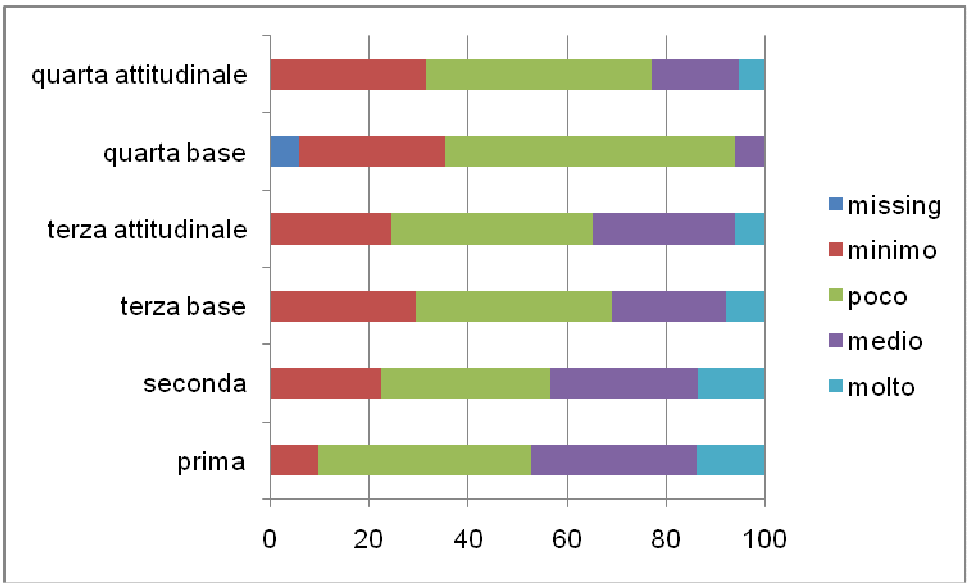
A high discrepancy appears on the True/False tests; it seems that in the first form of middle school this type of test is a frequently used tool while this importance tend to decrease in the further classes. An opposite trend appears towards individual interviews in which more than 30% of the students of the first form of middle school declare to use it in the classroom, while in the second and third form of middle school it exceeds 60%

In certain cases, as homework and group activities, we observe that the answers of the students of the base course (of the third and the fourth form of middle school) diverge from those of the aptitudinal course .

We show below some graphs that highlight the most interesting cases of differences between answers of students from the first to the fourth form of middle school:

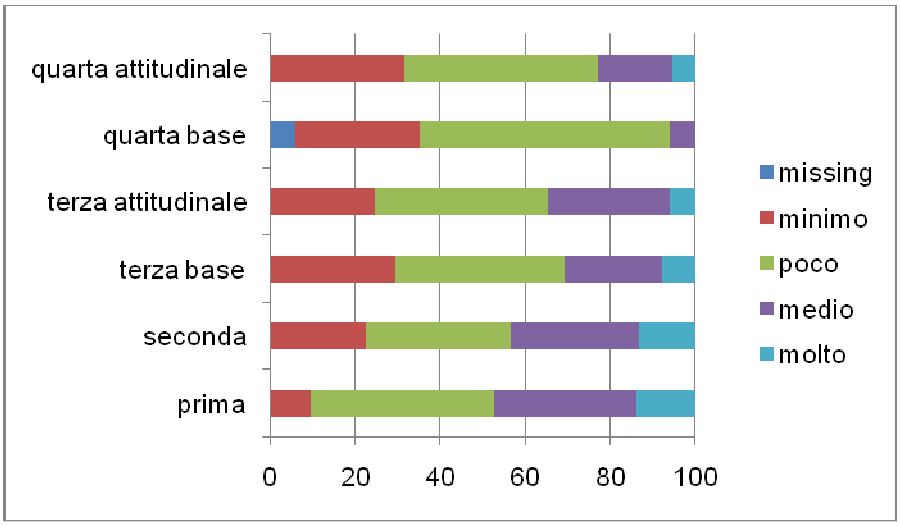
Graph 5: Test with completion tasks (exercise in which you have to fill in the missing word)

From the first to the fourth form of middle school there is a progressive increased number of students that consider not important this type of assessment method.



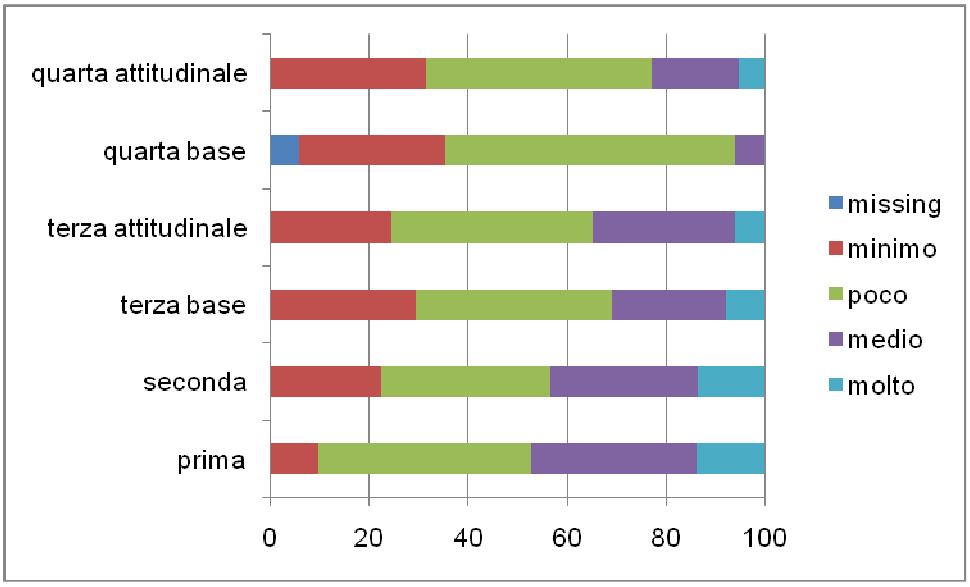
Graph 6: Reporting on researches and personal works

There is a substantial gap between the opinions of the students of the first and those of the fourth form of middle school about the importance of this instruments, probably due to the / fact that for several years the students are not compared to this istrument/lack of use of this instruments during the first years.



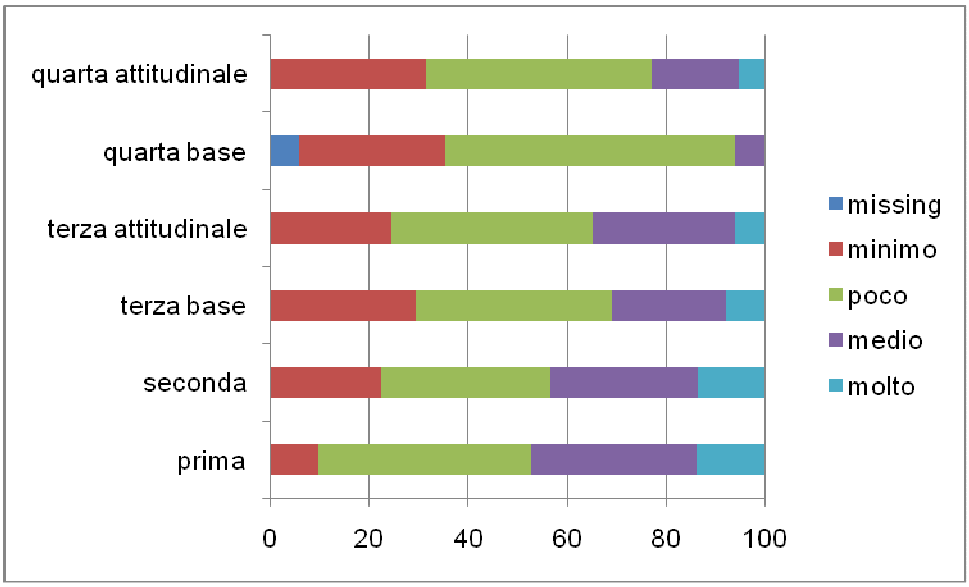
Graph 7: Peer-Feedback

There is a difference between students in the first form of middle school and students in the fourth middle school about the importance of peer-feedback. The importance decreases with advancing years.



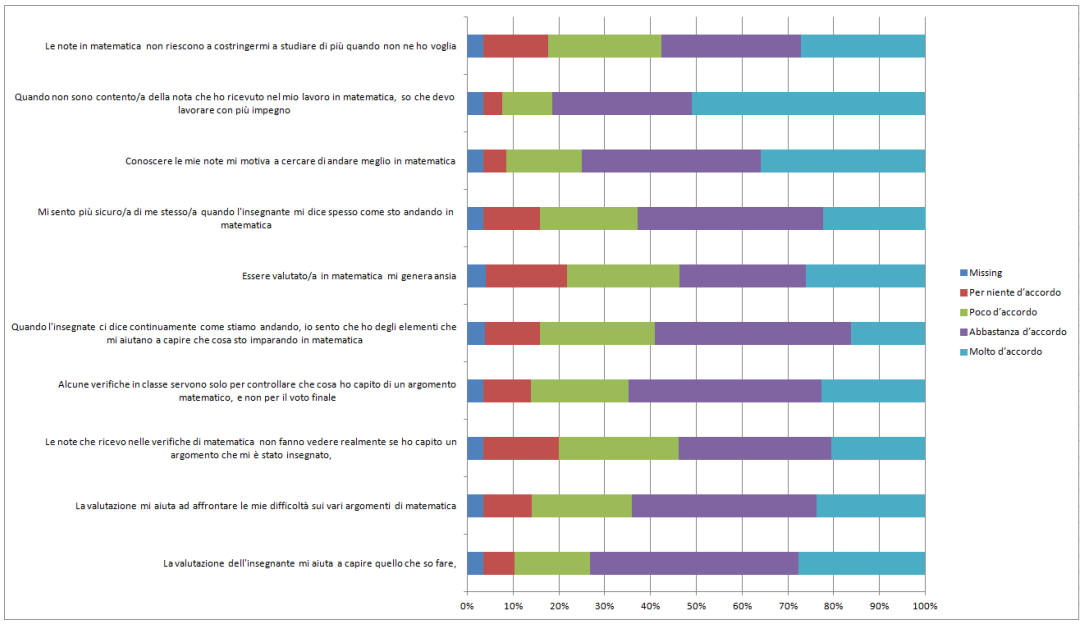
Graph 8: Student's portfolio

Similarly a difference appears between students opinion of the first and the fourth form of middle school concerning their portfolio, and education data collection.



PART C

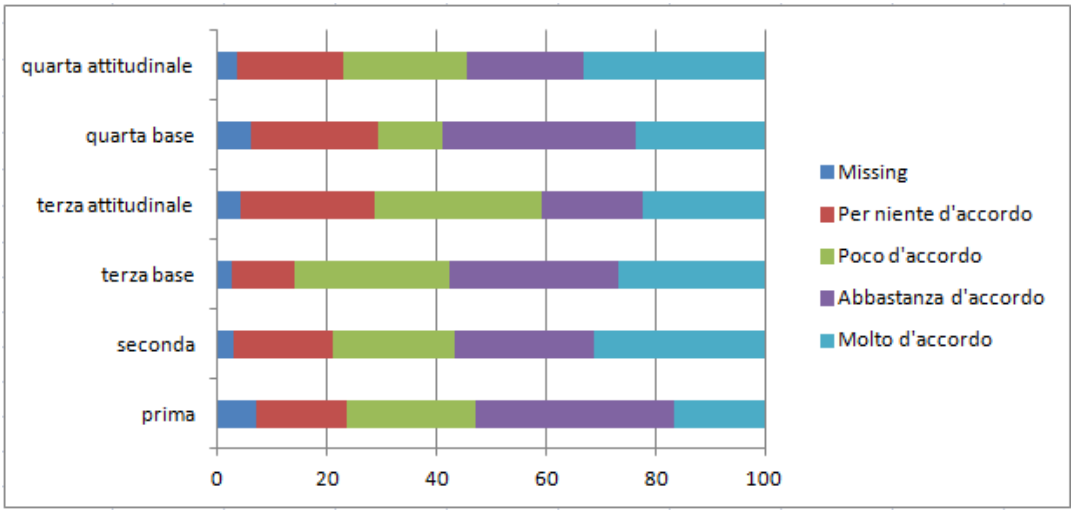
Graph 9: ***According to your experience in the classroom, give your opinion on the following sentences indicating your degree of agreement***



Students give high importance to the role of the assessment that helps them to understand their personal capabilities and to face difficulties. Taking grades is an important part of the life of every student. For them grades have motivational role to try harder and do better. For 50% of students, grades in math don't show the learning ability; there are other instruments useful in determining the learning. A continuous feedback from the teachers is essential. 53,5% of the students declare an assessment anxiety in math and the 57,7% of students declare that "The grades and the reports in math do not force me to work when I don't want to". This shows the importance for the teacher to urge volition and motivation of the students to take them to get involved in its role as a student.

Graph 10: Assessment gives me anxiety

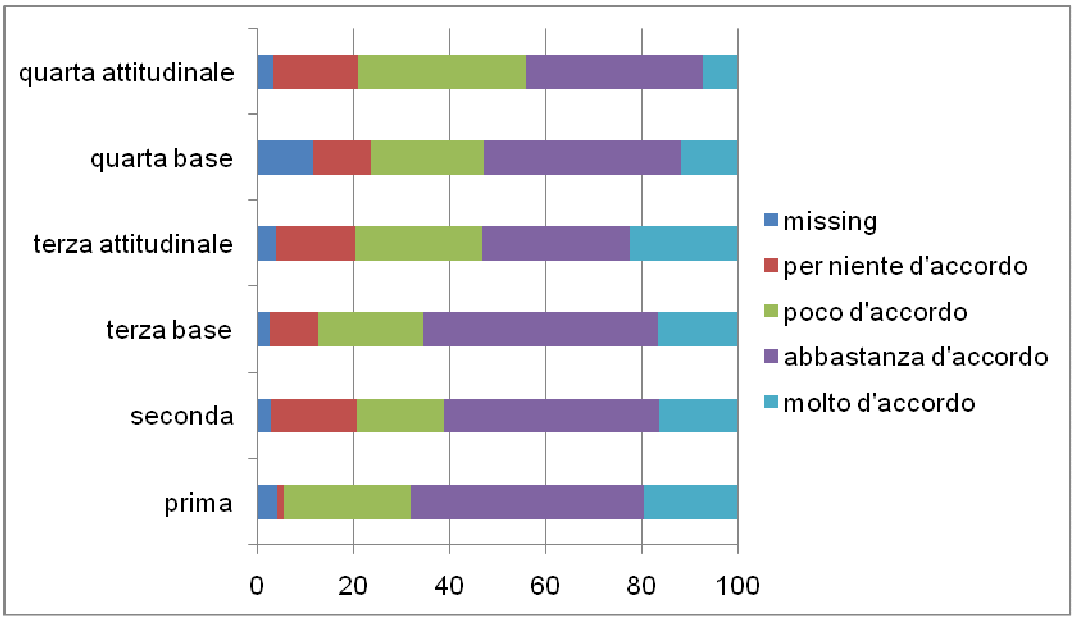
The graph shows that 1 out of 2 students (52%-56%) from from the first to the fourth form of middle school is anxious about an upcoming math assessment. Some small differences emerge between student of third form of middle school aptitudinal, where the percentage is around 40%.



More than 60% of the students declare to feel more confidence about himself when he has more frequent feedback from the teacher about his progress in a mathematic subject and to have usefull elements to understand what they are learning .

Graph 11: I feel more confidence about myself when I have more frequent feedback from the teacher about my progress in a mathematic subject.

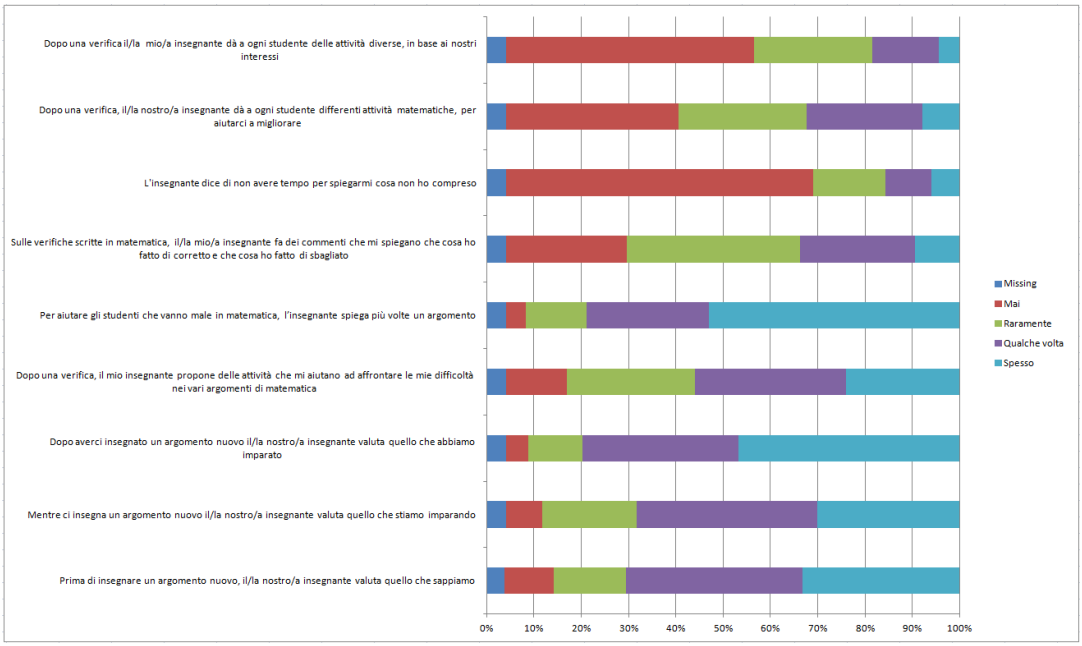
The following graph shows that this approach is more present in the first form of middle school rather than in the fourth form of middle school.



It is worth noting that an high percentage of students (64,7%) in some cases connects assessment with formative and not only summative value. (Some assessments serve only to verify what I have understood on a mathematical subject and not for the grade report), graph n.9.

Overall it appears that students show confidence into teacher's assessment. Although, around 50% of the students declare that the grades on a math test cannot demonstrate the real comprehension of a mathematical subjects, 73,2% affirm that the teacher assessment helps identifying good skills in math.

Graph 12: ***According to your experience in the classroom, give your opinion on the following*** **expression. Indicating if these situations happens often, never, sometimes or rarely.**



The results reveal that a good percentage of teachers assesses student's skills and knowledge before, during and after the instruction of each mathematic concept, but above all after a mathematical activity, according to the traditional approach "explanation-exercises-assessment". The teacher, only in the 55,9% of the cases, after an assessment, develops mathematical tasks to help student to face difficulties in a mathematical subject.

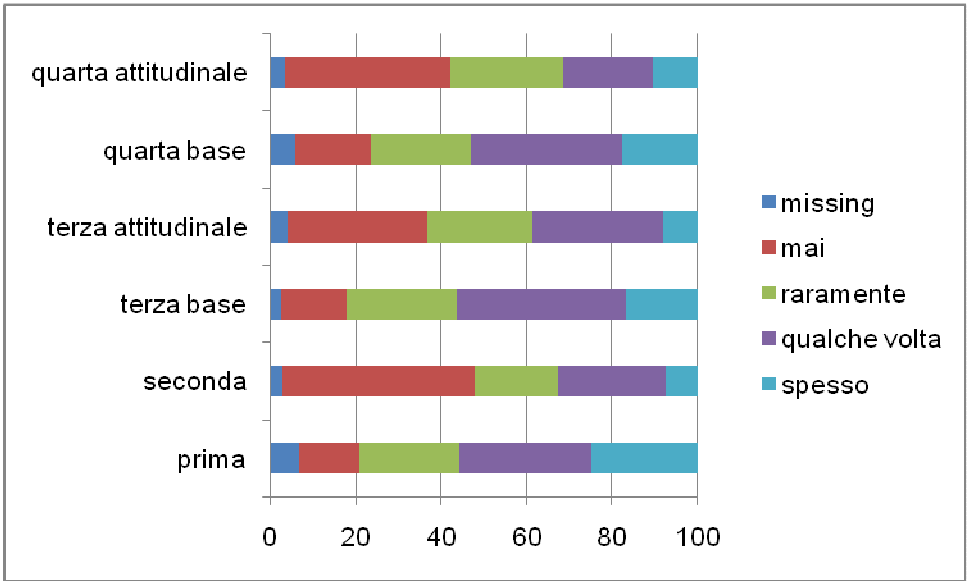
Teachers are available to help students according to aid strategies most widespread (i.e. re-explain) while the use of differentiated activities seems sporadic. Indeed 32,3% of the students affirm that the teacher uses these practices at least sometimes after an assessment, giving different mathematical activities to each student, to promote good skills in math. Another 18,5% affirm that the teacher differentiates the activities according to students personal interests. 33,8% of the students declare that at least sometimes on corrected works in math the teacher makes comments that tell students what they have done well or not, revealingthat often the teacher does not review the strengths and weaknesses with the student This information can reveal a lack of appropriate tools by the teacher, especially considering that the teacher rarely abstain from explaining to the student what he did not understand.

Grafico 13: After an assessment my teacher uses to give different mathematical activities at each student, in order to help us promote our good skills in math.

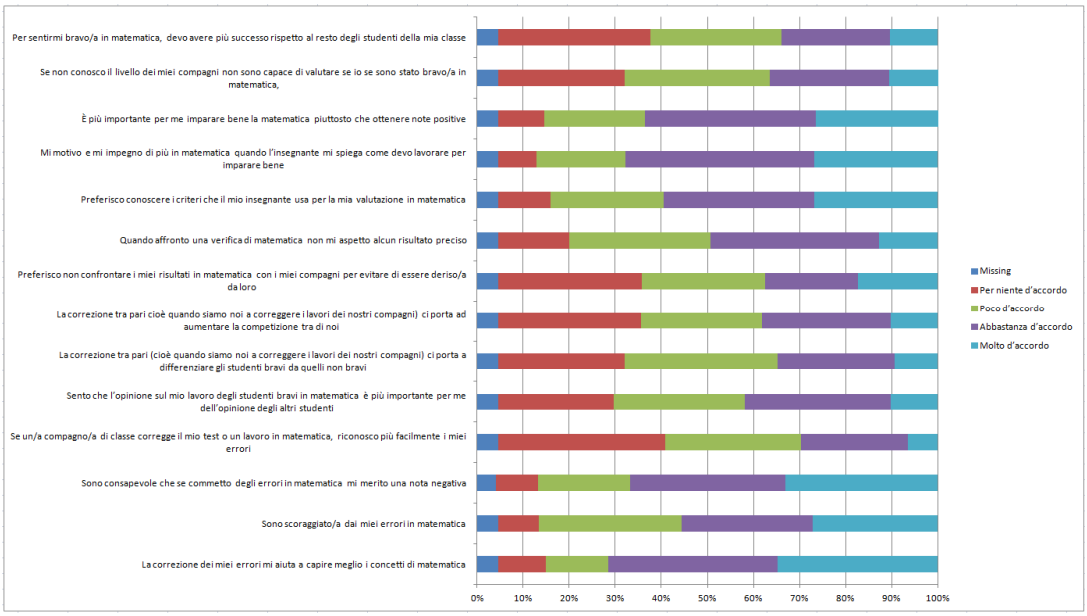
Analyzing student answers from first to fourth of middle school, we can observe some differences between base course and aptitudinal course (which is in the third to

fourth) that at least sometimes, after examination, the teacher gives each student a different mathematical activities, to help improve. In the base course (third and fourth of middle school) a double number of students declare that the teacher, sometimes and often, gives different math activities to improve learning skills.

In prima class, unlike quarta, there are a lot of students that affirm teacher often ready to give different activities. It seems that this practice slows down with the passage of time.



Graph 14: ***Based on your classroom experience, give your opinion about following expression. Indicate your level of agreement or disagreement***



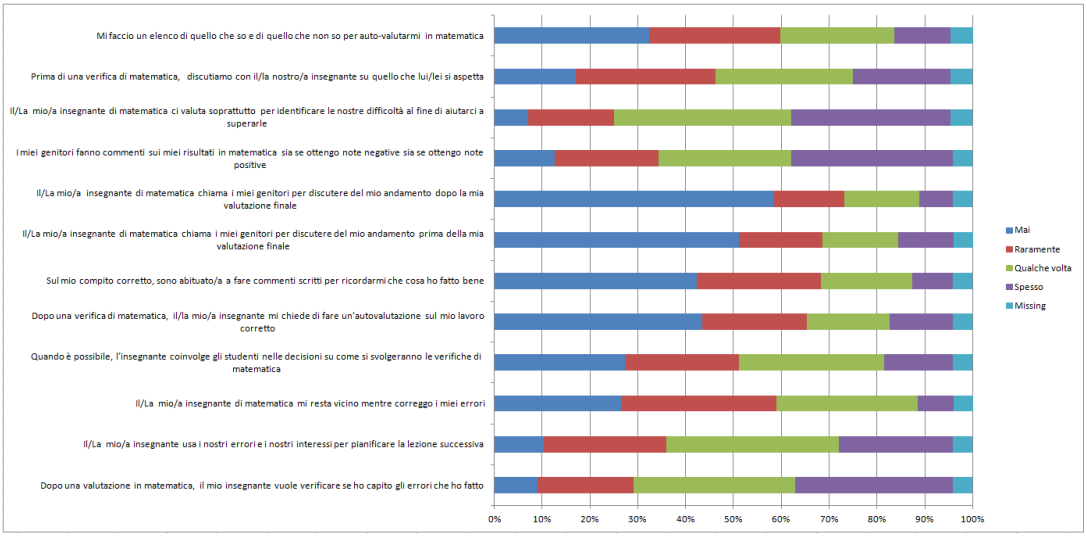
Concerning the relation between students and mistakes, 55,6% of students affirm to feel himself sufficiently or too much discouraged cause mistakes in math. More than 50% of the students think that the correction of math test, done by a classmate, does not represent a resource to understand mistakes. Peer assessment is not appreciated. 37,4% of the student don't want compare results with a classmate to avoid being ridiculed. Only 29,7% of the students easily recognize mistakes if a classmate corrects the work. Interesting things to observe is the fatalism and uncertainty of the assessment, in fact 49,1% of students, after a math test, does not expect a clear result.

Self assessment and peer-assessment, not only aren't carry out by teachers (result of the previous questions) but this creates embarrassment between students. 31,8% of the students declare that is most important the grades rather than learn well math.

35,9% of the students is disinterested to know the criteria used by teacher during the assessment. On the other hand 67,7% declares to be more motivated and engaged when the teacher explains how to work to improve learning; this means that explaining criteria help motivation.

The result of the previous question demonstrats that teachers often do only assign a mark to the task done without commenting, discussing or explaining the mistake made by the students, who instead, as shown in this query, feel the need of a comparison after the assessment. 71,5% of the students declars that correction of the mistakes helps to better understand the concept of mathematics.

Graph 15: Based on your classroom experience, give your opinion about following expression. Indicate the frequency of the situation (never, rarely, sometimes or often).

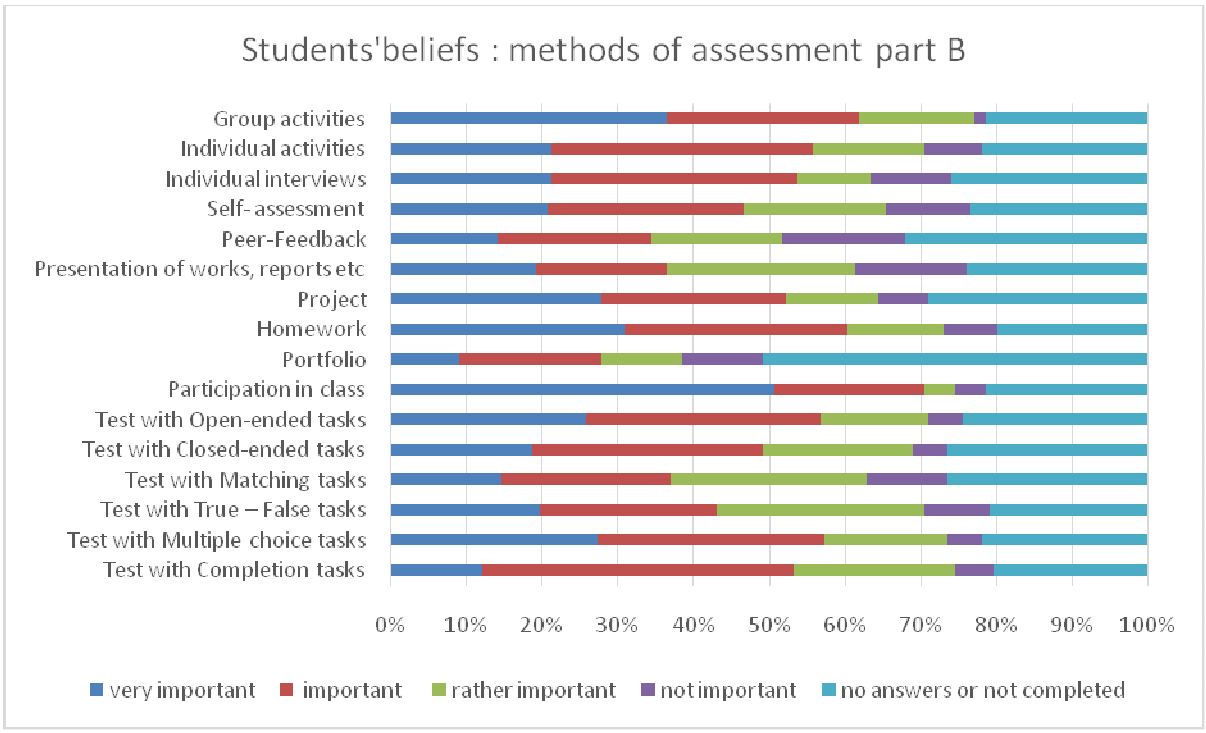


Only 30,6% of the students affirm that sometimes, after an assessment, the teacher ask a self assessment of the corrected work. 27,1% of the students affirm that sometimes he is called to give written comments on the corrected work to remember what has been done well. It has not been observed a great communication between teachers and parents about the performance of the students.

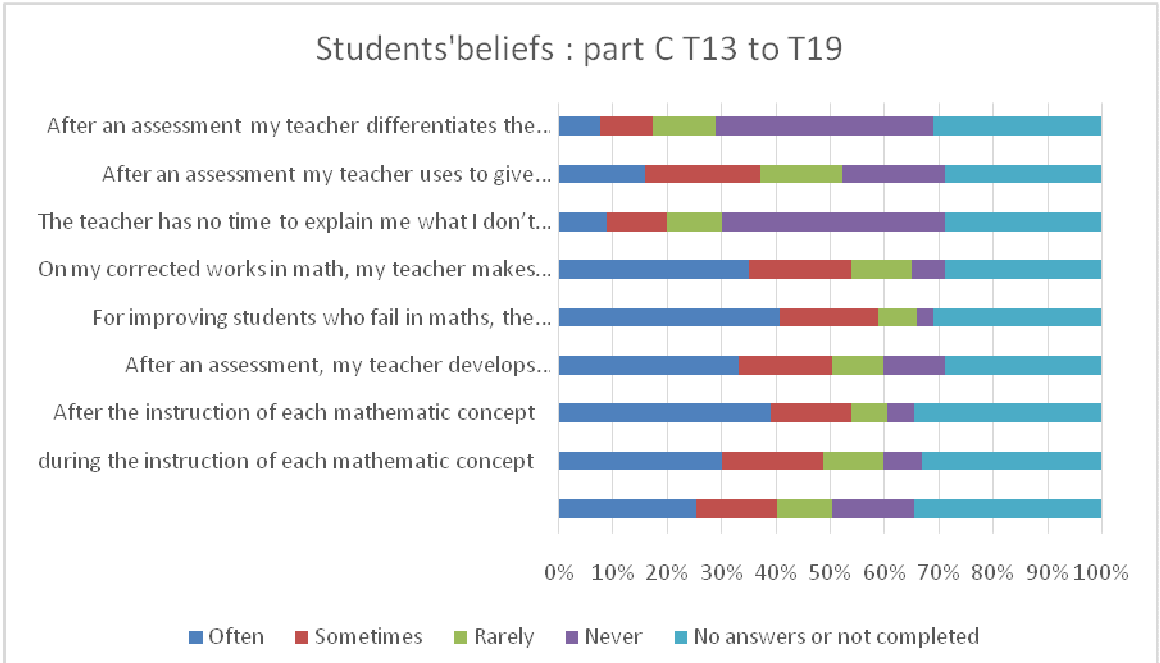
Only 49,1% of the students declare that at least sometimes, before assessment, they speak with the teacher about his expectations. Once more the criteria seems not to have been shared.

3.2.4. The Students' Questionnaire in France

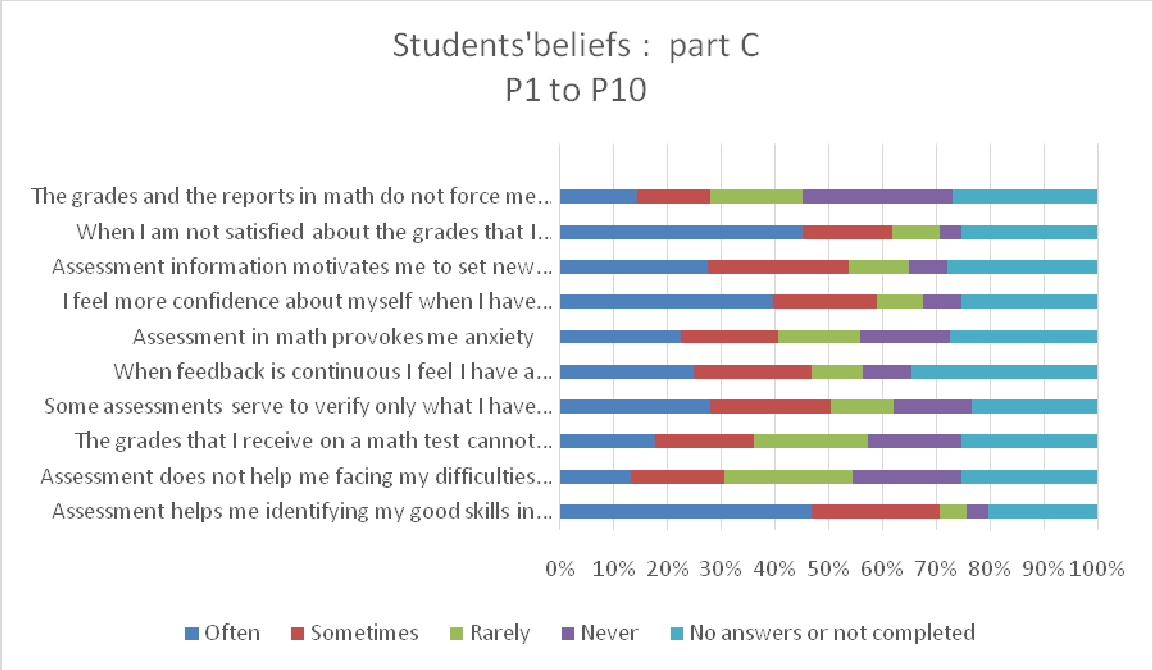
1. **<u>Question of Part B</u>** (How important do you think are the following methods of assessment in math? Put in order of importance the following methods for your assessment in mathematics).



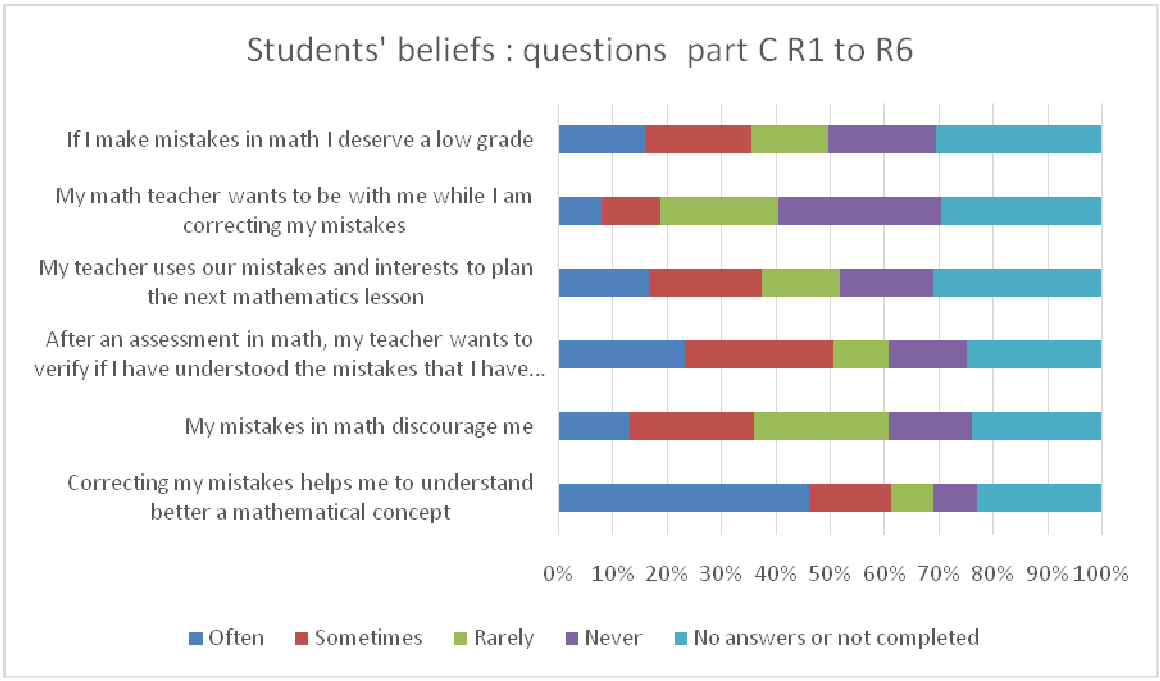
2. Questions T13 to T19 in Part C



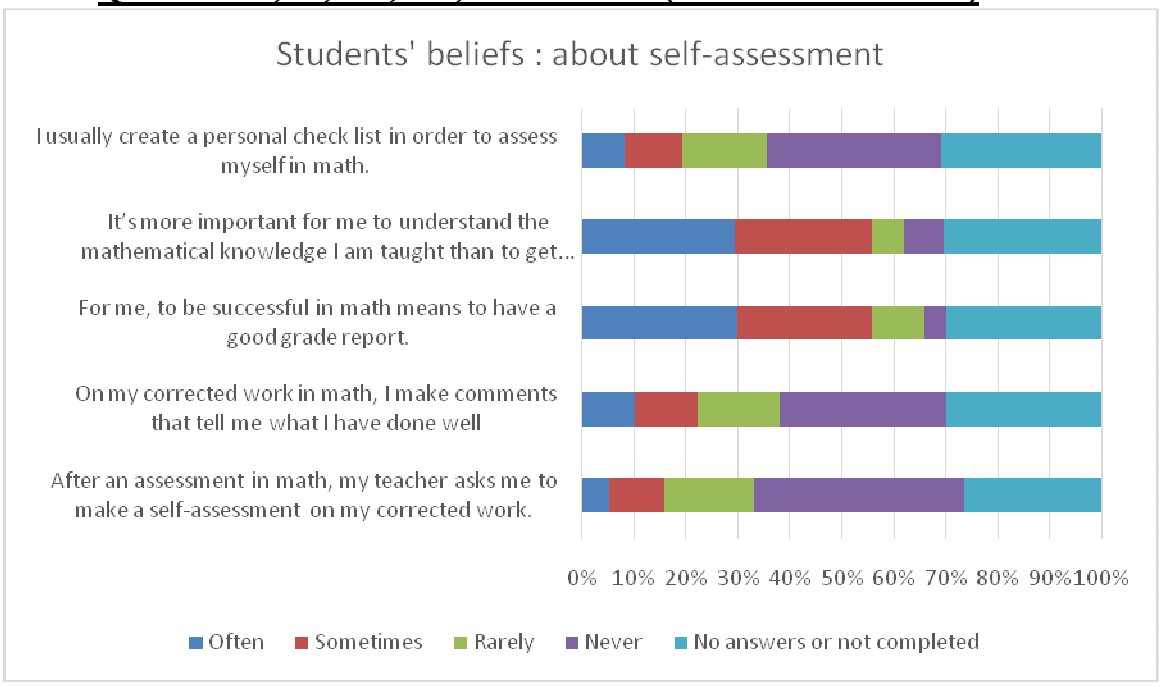
3. Questions P1 to P10 in Part C



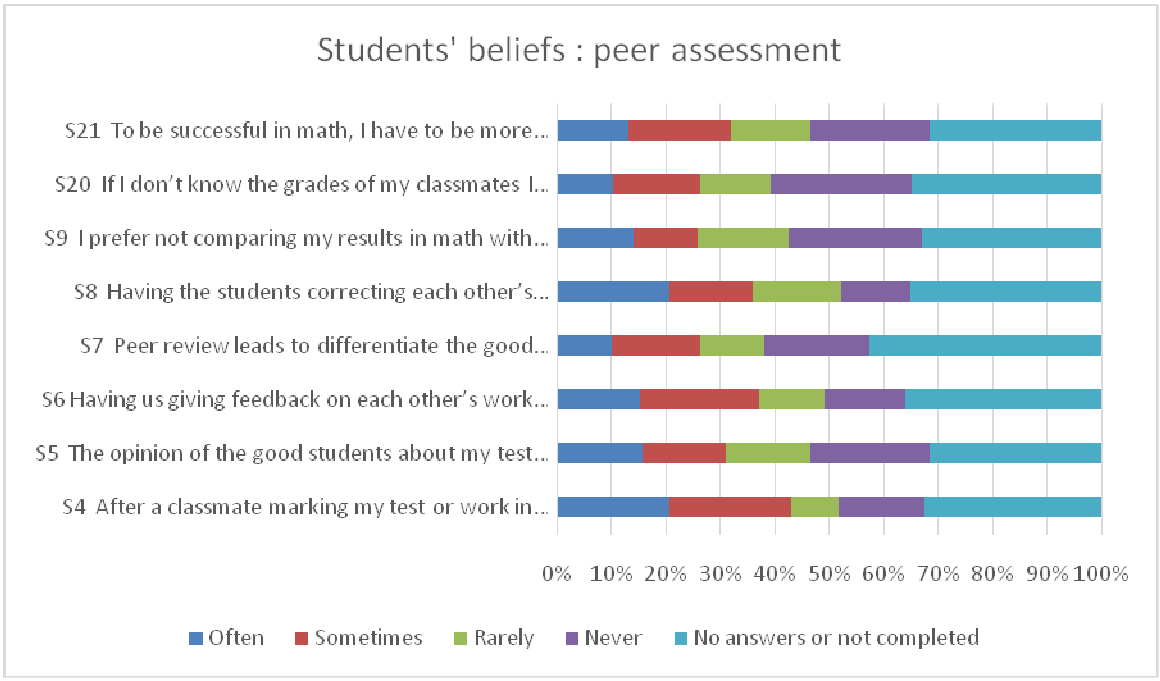
4. Questions R1 to R6 in Part C



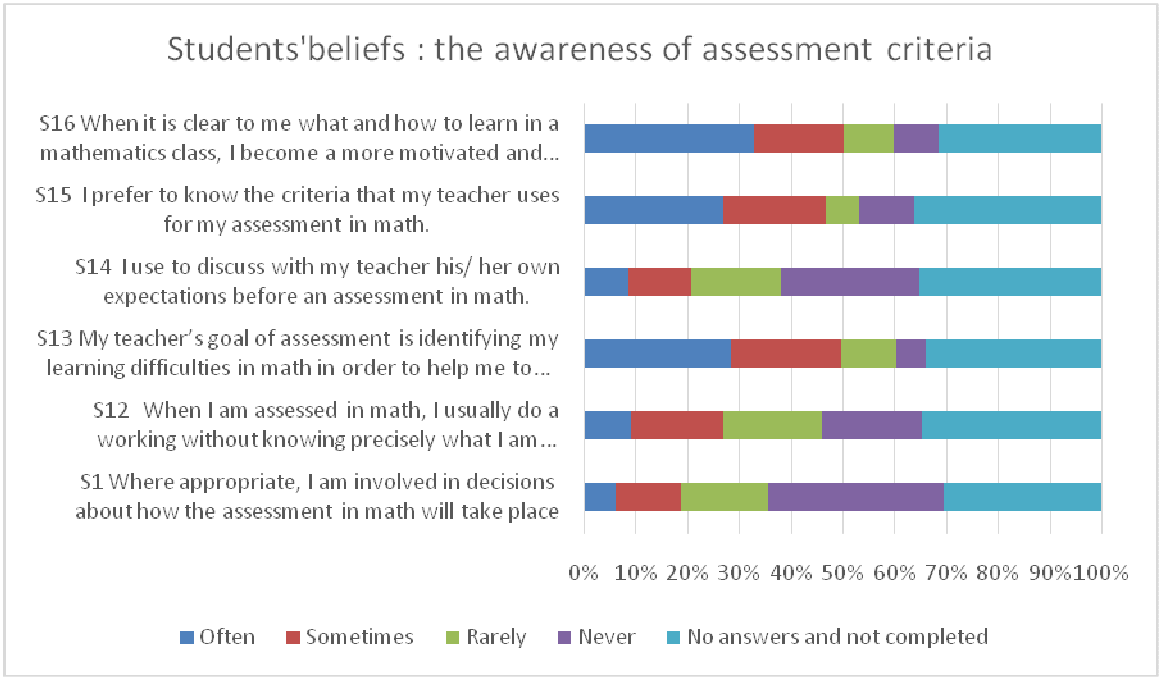
5. **Questions S2, S3, S17, S18, S19 in Part C (about self-assessment)**



6. **Questions S4, S5, S6, S7, S8, S9, S20, S21 in Part C (about peer-assessment)**



7. **<u>Questions S1, S12, S13, S14, S15, S16 (about the awareness of assessment criteria)</u>**



<u>Chart 1: Three things to remember :</u>

- What are very important (for the students) :
  - Modalities for real activities => type of activity and type of feedback

    - The organization of activities => in group (peers work) or alone
- Students are not interested in the concept of portfolio.

Finally, students are interested in what they know and what they are sensitive, that is to say , how they work (individual or group), what types of work (alone or in group) do not retain their attention to the concept of portfolio, which is a teacher's concept who wants to keep track of what they learn and his/her modalities. This is not the issue here for the students. This is the importance of the explanation of the framework and objectives of the activities that are at stake. "We need to tell what we are going to do and do what we said".

Chart 2 : a point to keep in mind

The students find that the teacher has not enough time for a constructive feedback on the work that the student has just done. It is necessary to provide feedback, focusing on the knowledge and the examples and the content but also time in order to be not only a correction phase, but a phase of construction and validation of knowledge learn. This is an important point to remember but it can be very difficult to do in real situation : how managing time, teaching and learning, with a non-homogeneous student together?

Chart 3 : two points to keep in mind

Two sets appear to be important to the students: anxiety generated by the assessment and the lack of help generated by the assessment in order to exceed students' difficulties . The term of this assessment in the didactic contract is still not part of the construction and learning process. This formative assessment is still seen as a penalty and scary assessment.

Chart 4 : one point to keep in mind

The student feels the importance of the role of the teacher in the error correction, so there is no room for the proper correction of the student. Errors recognized by the student, obstacle he has to solve are still a challenge for him. Because of the share didactic contract, he lacks of confidence. There is no room for self-assessment and auto correction because of the teacher.

Chart 5 : 2 points to keep in mind

Two points seem to make a big difference :

- It is important for students to know and understand what they are learning and have a positive feedback on what they learned or what

they know at the time of assessment, such as climbing stairs or passing obstacles.

- It is necessary that the teacher allows the student to make a self-assessment of what took place: from the point of view of knowledge acquired as difficulties passing.

Chart 6 : 1 point to keep in mind

From the peer assessment, overall appreciated by the students, it should not be judgment on the quality of good or bad student. So the difficulty in the peer assessment of the concept of judgment of the person and not the academic performance that is at stake here.

Chart n°7 : 1 to keep in mind

It is necessary for the student to know the assessment's criteria.

3.2.5. The Students' Questionnaire in Netherlands

School characteristics

Two schools participated in the questioning of students: Compean VMBO (Zaandam) and DaVinci SG (Leiden).

Compean VMBO(Zaandam)
Students at Compean VMBO are between 12 – 16 years old. The primarily follow a professional education with common subjects like mathematics, Dutch and English languages. There is practical approach towards the content of the subjects that is educated. There is a high variety of professions that is trained for, from technical to health. Students follow education in their chosen profession for a maximum of 4 years.

DaVinci SG (Leiden)
Students at DaVinci SG are between 12 – 18 years old. They follow education in preparation for college (HAVO, total of 5 years) and university VWO, total of 6 years. The first three years in HAVO and VWO they follow a broad variety of subjects. In the last two years of HAVO and the last three years of VWO students choose a profile from four possible:

1. Cultural
2. Economical
3. Health
4. Science.

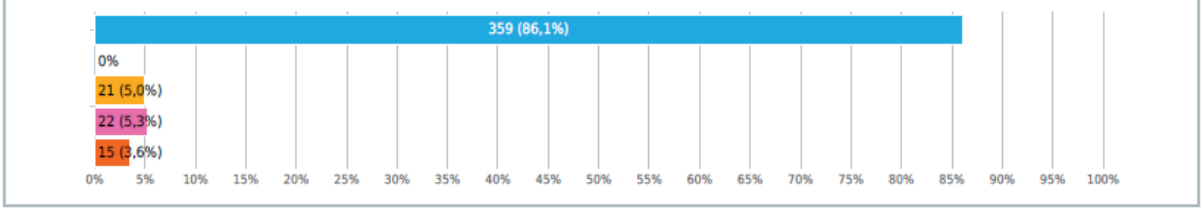
Depending on their chosen profile they have mandatory subjects like mathematics, Dutch and English language. Besides the mandatory they have subjects based on their profile. There is theoretical approach towards the content of the subjects that is educated.

On average in the Netherlands 60% of students follow education at VMBO, 20% at HAVO and 20% at VWO.

Response

The response is not characteristic to the average percentages of student at the three different levels of education in the Netherlands. This is cause by the fact that the participating teachers at Compean all have classes at the level VMBO , there is no other level taught at this school. The participating teacher at DaVinci only teaches a few classes at the level of HAVO and VWO. One class is mixed HAVO/VWO. For these student (12 – 13 years old) it is not yet clear at what level they will do exams.

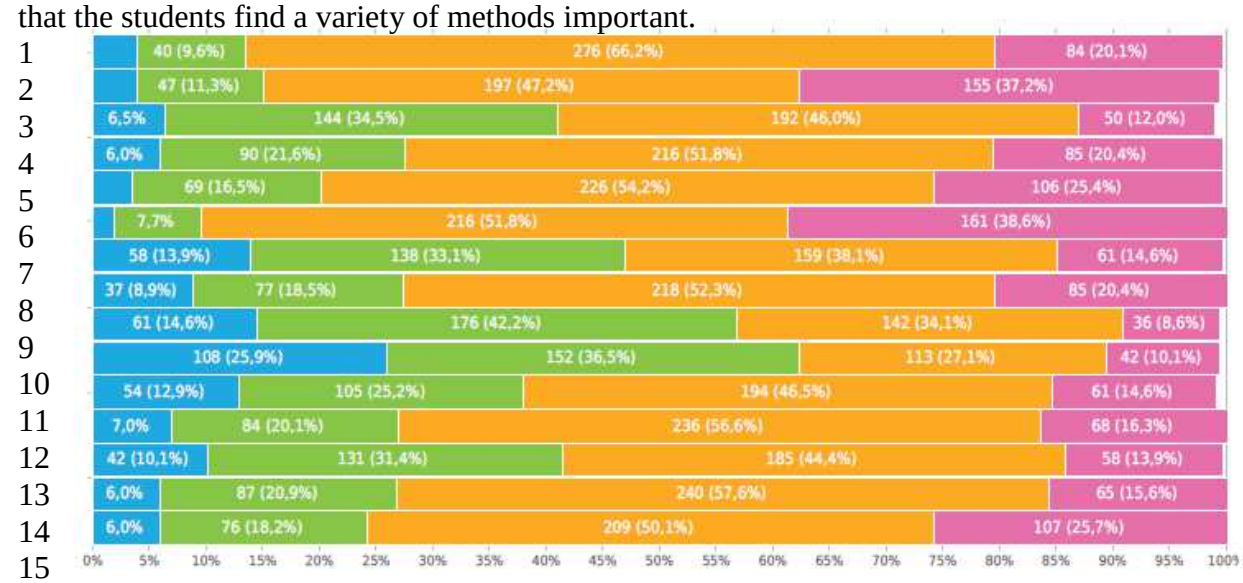
VMBO	359	86,1 %
VMBO/HAVO	0	0 %
HAVO	21	5,0 %
HAVO/VWO	22	5,3 %
VWO	15	3,6 %



Methods of assessment

All mentioned types of assessment are used by the teachers. Some are more useful in theoretical education (HAVO and VWO) while others more practical (VMBO). Portfolio is the least used method (9,4%). Students find homework the most used form of assessment. The traditional methods (assessment with open (73%) and closed ended tasks(77,6%)) are widely used

The results don't give a clear picture what method of assessment students find more important. With all methods scores of 3and 4 are more than 50%. On may conclude that the students find a variety of methods important.



1 very unimportant
2 unimportant
3 important
4 very important

Answers with high scores:

4: Very important	
2 Multiple choice	Students might prefer tests with multiple choice
6 participation in class	Student want their participation to be taken into consideration. Question is if the conclusion is justified that if they try their best and still the test result is negative, they want some sort of positive feedback for their effort.
15 group activities	Traditionally in working in class in education students work together whilst studying. Also, practical education in VMBO focusses on working together because this is an important competence working in everyday jobs for which they are prepared.
1: very unimportant	
10 presentations	The majority of students don't want to be assessed with presentations. This can have various reasons. It might be tradition, this is not a very much used form of assessment. Experience also teaches us that many students are afraid to present their achievements in front of the class and so they don't want to be assessed in this manner.

Other types of assessment

The remarks made here gives room for the interpretation that most of the students did not understand this question. A lot made silly remarks. The serious ones were not an answer to the question but remarks of what they find important, in summary:

- Feedback on (summative) tests, what was wrong and how should I do better
- It is important that the teacher is very able to explain theory and ways of answering problems
- Differentiation: students who are good in Mathematics should not have to do the same as the ones who need more time and help
- Teachers should check more if students understand theory and problems
- The use of blended learning

Correlation between used methods and importance

Although no statistical method is used to find significant correlation between the use of forms of assessment and the opinion of importance, the following can be concluded:

form of assessment	used	level of importance	conclusion
Test with completion tasks	83,9%	important: 66,2% very important: 20,1%	The methods used in tests are also the ones found (very) important by the students
Closed-ended tasks	77,6%	important:	

		51,8% very important: 20,4%	
open-ended tasks	73,0%	important: 54,2% very important: 25,4%	

form of assessment	used	level of importance	conclusion
participation in class	71,1%	important: 51,8% very important: 38,6%	The methods used in class are also the ones found (very) important by the students
Homework	94,2%	important: 52,3% very important: 20,4%	

Statements about assessment

Statements about purpose of assessment

Assessment helps me identifying my good skills in math.	
Assessment does not help me facing my difficulties on a mathematical subject.	
The grades that I receive on a math test cannot show if I have understood the mathematical subjects I have been taught.	
Some assessments serve to verify only what I have understood on a mathematical subject and not for our grade report.	
When feedback is continuous I feel I have a foundation that helps me to understand what I am learning in math.	
Assessment in math provokes me anxiety.	

I feel more confidence about myself when I have more frequent feedback about my progress in a mathematic subject.	
Assessment information motivates me to set new goals in learning math.	
When I am not satisfied about the grades that I have received for my working in math, I have to try harder.	
The grades and the reports in math do not force me to work when I don't want to do.	

1 never
2 rarely
3 sometimes
4 often

The student does agree in majority that assessment helps the mto identify their good skills but almost 50% state that assessment does not help them facing their difficulties. Half of the students believe their grades do not show their capabilities. If students are not satisfied with their grades their conclusion is that they have to work harder, but grades do not force them to do so if they don't want to.

Statements about techniques in assessment

	never	rarely	sometimes	often
My teacher assesses our skills and knowledge:				
• before the instruction of each mathematic concept.	26,5%	32,6%	30,7%	10,0%
• during the instruction of each mathematic concept.	21,3%	24,1%	39,3%	15%
• after the instruction of each mathematic concept.	22,2%	28,9%	35,9%	13,0%
After an assessment, my teacher develops	60,0%	17,6%	18,9%	3,5%

mathematical tasks which will help me to face my difficulties in a mathematical subject.				
For improving students who fail in mathematics, the teacher explains again a mathematical topic.	18,7%	22,8%	32,0%	13,9%
On my corrected works in math, my teacher makes comments that tell me what I have done well.	31,1%	22,8%	32,0%	13,9%
The teacher has not any time to explain me what I don't understand.	51,1%	19,3%	21,5%	8,0%
After an assessment my teacher uses to give different mathematical activities at each student, in order to help us promote our good skills in math.	41,3%	25,2%	27,6%	5,9%

A majority of students state their teacher doesn't test the skills of their students before they start the teaching of a new mathematical concept, and only half of them state that the skills and knowledge are teste during or after the instruction. This in combination with the fact that the students state that the teacher almost never (41,3%) gives different mathematical activities tot students leads to the conclusion that teachers do not differentiate in their way of teaching. It seems like they hop from concept to concept and do not use the results to change the way they teach.

Statements about results of assesments

Correcting my mistakes helps me to understand better a mathematical concept.	
My mistakes in math discourage me.	
After an assessment in math, my teacher wants to verify if I have understood the mistakes that I have made.	
My teacher uses our mistakes and interests to plan the next mathematics lesson.	
My math teacher wants to be with me while I am correcting my mistakes.	

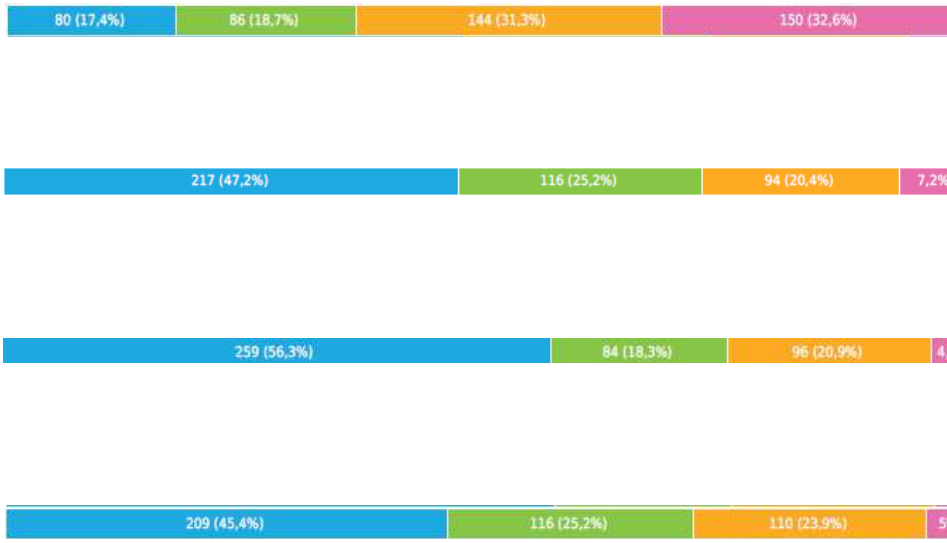
If I make mistakes in math I deserve a low grade.

1 never
2 rarely
3 sometimes
4 often

Students state that assessment and correcting mistakes help them to do better. Mistakes also discourages them, which would imply that it is important for the teacher to work on self-confidence with students by showing them what they can do, what kind of mistakes they make and how they can prevent these mistakes. Students are mostly given the responsibility to correct their own work. In this way there is now interaction between student and teacher and the teacher cannot work on the self-confidence of the student after he or she has made mistakes.

Statements about stakeholders in assessment

Where appropriate, I am involved in decisions about how the assessment in math will take place.
After an assessment in math, my teacher asks me to make a self-assessment on my corrected work.
On my corrected work in math, I make comments that tell me what I have done well.
After a classmate marking my test or work in math, I can acknowledge my mistakes easier.



1 never
2 rarely
3 sometimes
4 often

Students are almost never asked to reflect on their work, to think about what they have done wrong and how they can improve.

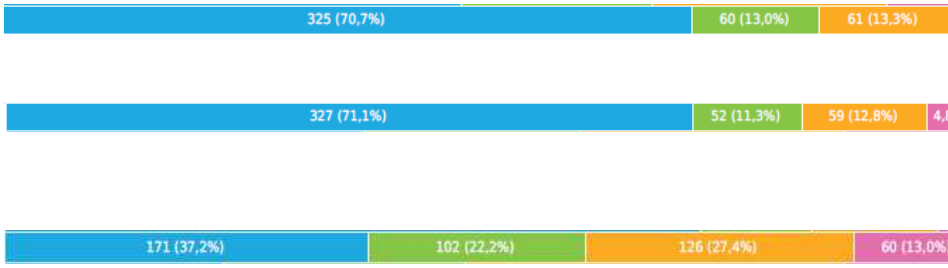
The opinion of the good students about my test or my work in math is more important for me than the opinion of the rest students.

Having us giving feedback on each other's work helps me also to develop my self-assessment skills.	
Peer review leads to differentiate the good students from non-good.	
I prefer not comparing my results in math with my classmates in order to avoid their derision.	

1 never
2 rarely
3 sometimes
4 often

From feedback we know students had a lot of difficulty understanding these questions. Most of the students don't know what is meant by feedback, peer review or self-assessment. Therefore they don't have an idea what is meant by the statements.

My math teacher uses to call my parents to make a discussion:
• *before* my assessment.
• *after* my assessment.
My parents make comments about my corrected tests or works in math, even if I get low or high grades.



There is hardly any communication between teachers and parents. Students state that their parents do in some degree discuss the results of tests with them.

Taken into account that in most cases the results of assessments is also not used for feedback or used for changes in teaching by the teacher with the students it seems that only summative assessment is used. Teachers need to be taught how to analyse and use results of tests to adapt their educational content to the needs of (individual) students.

When I am assessed in math, I usually do a working without knowing precisely what I am expected to do.
My teacher's goal of assessment is identifying my learning difficulties in math in order to help me to overcome them.
I use to discuss with my teacher his/ her own expectations before an assessment in math.
I prefer to know the criteria that my teacher uses for my assessment in math.
When it is clear to me what and how to learn in a mathematics class, I become a more motivated

and engaged learner.
For me, to be successful in math means to have a good grade report.
It's more important for me to understand the mathematical knowledge I am taught than to get high grade.
I usually create a personal check list in order to assess myself in math.
If I don't know the grades of my classmates I am not able to know if I have succeeded in math.
To be successful in math, I have to be more successful than the rest of the students in my classroom.

Students state that most of the time they do not know what precisely is expected from them when tested. The expectations of the teacher are rarely discussed with the students. Students do want to know what kind of questions they can expect. It motivates them more if these expectations are made more clear. There seems a lot to be gained with preparing students on test by making clear what is expected of them.

The test are in 51,9% used to diagnose problems with students. The higher the grade, the more you understand the mathematical concepts. Almost 56% of the students state they find understanding more important than a high grade.

The students don't seem to need to know grades from other students in order to know or feel if they are successful. They seem to be focussed on their own grades.

3.2.6. Similarity relations for the students' beliefs

3.2.6.1. The hierarchical clustering of variables

The collected data were analyzed through the hierarchical clustering of variables using the computer software called C.H.I.C. These methods of analysis determine the hierarchical similarity connections between the variables.

The hierarchical clustering of variables is a classification method which aims to identify in a set V of variables, sections of V, less and less subtle, established in an ascending manner. These sections are represented in a hierarchically constructed diagram using a similarity statistical criterion among the variables. The similarity stems from the intersection of the set V of variables with a set E of subjects (or objects). This kind of analysis allows the researcher to study and interpret clusters of variables in terms of typology and decreasing resemblance. The clusters are established in particular levels of the diagram and can be compared with others. This aggregation may be attributed to the conceptual character of every group of variables. In this study the similarity diagrams allowed for the arrangement of the statements into groups according to their homogeneity.

3.2.6.2. Similarity relations for the students from Italy

The similarity relations for the Italian students' answers are presented in figure X. The diagram comprises of seven similarity clusters.

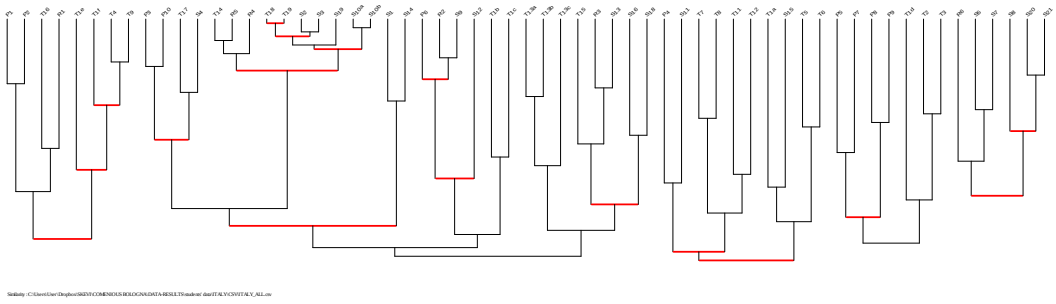


Figure X. Similarity diagram for the students from Italy

Cluster 1 consists of eight variables (P1, P2, T16, R1, T1e, T1f, T4, T9). According to the relations between those variables, it emerges that assessment helps the students find their strong points in two ways. First, when their mistakes are corrected either by

the teachers or by themselves and second, when they are assessed with open or close tasks, homework and interviews. As a result, students' positive beliefs about the purpose of assessment (for identifying their mathematical abilities – cognitive domain) are related to the formative use of errors (by themselves and by the teacher) to the use of less commonly used (less "traditional") methods of assessment.

Sixteen variables are grouped in the second cluster. In particular, those variables are P3, P10, T17, S4, T14, R5, R4, T18, T19, S2, S3, S19, S10a, S10b, S1, S14. Relations between those variables reveal a group of factors that increase the students' comprehension and motivation. The use of grades for feed-back, the use of mistakes for feed-forward actions, differentiation, self – assessment, involvement of parents and students' involvement in assessment (knowledge of criteria) are some of the main factors that contribute in students' comprehension and motivation.

The third cluster is comprises of six variables (P6, R2, S9, S12, T1b, T1c) which are associated with the affective domain. Based on the relations that are presented in this cluster, it is concluded that when students are not aware of the assessment criteria, they have negative feelings about assessment, such as anxiety, disappointment and competitiveness. These negative feelings are also related with specific methods of assessment like multiple choice and true or false tasks. Therefore, the students' unawareness of the assessment criteria is related to negative effect of assessment on their affective domain and these negative feelings are related to more common used ("traditional") methods of assessment.

Cluster 4 contains similarity relations between eight variables (T13a, T13b, T13c, T15, R3, S13, S16, S18) which are related to some factors that increase the students' motivation and their engagement in learning process. More specifically, the conditions of assessment (such as time of assessment - when) and the teachers' feed-forward actions are related to a positive belief about the purpose of assessment (for identifying the students' learning difficulties). Furthermore, the students' awareness of the assessment criteria increases their intrinsic motivation and turns them towards the conceptual learning of mathematics. Therefore, students' awareness about the conditions of assessment (when and how) and the teachers' feed-forward actions help them create positive beliefs about the purpose of assessment and the learning of mathematics.

In cluster 5 are found ten variables (P4, S11, T7, T8, T11, T12, T1a, S15, T5, T6). Relations among those variables indicate that when the students are acknowledged of the teachers' assessment criteria and their parents comments, they express a positive purpose of assessment (assessment marks their comprehension – cognitive domain). In addition, methods of assessment that are more open and in which the students are more active and creative, such as self-peer assessment, self-group tasks and projects

are grouped. Methods of assessment, which are less traditional, are related to the positive beliefs towards assessment.

Cluster 6 includes seven variables which are P5, P7, P8, P9, T1d, T2, T3. Based on the relations between those variables, it is observed that assessment and continuous feedback increase the students' motivation and self-confidence. Furthermore, a weak relation between these positive beliefs about feedback with methods of assessment such as test with matching tasks, participation in class and portfolio is appeared.

The last cluster (cluster 7) is created of six variables (R6, S5, S7, S8, S20, S21) which describe students' criteria about their success or failure in mathematics, according to the performance of the rest students in their classroom. The students' awareness of their classmates' abilities is a factor that affects them in defining their self-image. Thus, this cluster shows the negative effects of the assessment and peer assessment on the students' relations with their classmates (comparisons, competitiveness).

3.2.6.3. Similarity relations for the students from Cyprus

The Cypriot students' responses to the statements of the questionnaire are grouped in eleven similarity clusters. The relations between the statements are indicated in figure X.

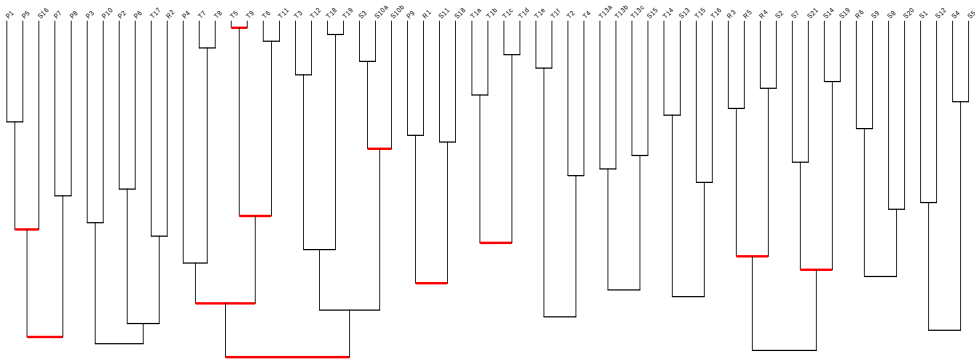


Figure X.Similarity diagram for the students from Cyprus

Cluster 1 contains similarity relations between five variables (P1, P5, S16, P7, P8) which refer to assessment's and feedback's effect on students' comprehension and motivation. More specifically, the first cluster shows that continuous feedback and the knowledge of criteria for learning increases the students' motivation, engagement and

understanding and leads to the creation of positive beliefs towards the purpose of assessment. Thus, formative assessment affects students' affective domain positively, as it increases students' self-concept and motivation.

In the second cluster, six variables are grouped (P3, P10, P2, P6, T17, R2). Relations among those variables reveal the negative effects of bad assessment practices on the students' beliefs and affective domain. In particular, bad teachers' practices (no time for feedback) leads to negative beliefs about the purpose of formative assessment and negative effects of FA on the students' affective domain, while assessment provokes anxiety and decreases students' motivation. In addition, students' focus on grading is related to these negative effects.

Cluster 3 is formed by fourteen variables (P4, T7, T8, T5, T9, T6, T11, T3, T12, T18, T19, S3, S10a, S10b) which can be considered as factors that contribute to the formation of positive beliefs towards formative assessment. Students' engagement (group activities, self-assessment, peer feedback, interviews), differentiation and teacher and parents effective cooperation are some of the main factors which create students' positive beliefs towards formative assessment. When students are assessed with the above methods that allow their active participation, they recognize the purpose of assessment and they express a positive belief.

Cluster 4 consists of four variables (P9, R1, S11, S18) which indicate the relation of the students' internal motivation with the construction of positive beliefs. Particularly, students with internal motivation face grades, mistakes and parents involvement positively (as feedback). Therefore focusing and increasing the students' self-motivation can play an important role for constructing positive beliefs about learning mathematics.

Cluster 5 includes four variables (T1a, T1b, T1c, T1d). Those variables show that the completion tasks, multiple choice tasks, true-false tasks and matching tasks are less preferable methods of assessment for students.

In contrast, four variables fall in cluster 6, which indicate the most preferable assessment methods for students. More specifically, they prefer closed/opened tasks, participation in class and homework. That guides to a discrimination among students, accordingly to the different assessment techniques and their preferences.

In cluster 7, four variables (T13a, T13b, T13c, S15) are grouped. This cluster indicates the importance of knowledge of criteria and the time of assessment.

Cluster 8 includes four variables (T14, S13, T15, T16) too. Relations among those variables highlight the role of feed-forward activities on the creation of positive beliefs for formative assessment. In particular, the teachers' "feed-forward" actions after assessment lead to the creation of positive beliefs about formative assessment.

In cluster 9 are found eight variables (R3, R5, R4, S2, S7, S21, S14, S19), which indicate the relation between the teachers' feed-forward activities and the students' development of good practices for defining self–concept. More specifically, the

teachers' effective use of assessment results for the students' improvement helps the students define their self-image as learners.

Cluster 10 is formed by four variables (R6, S9, S8, S20). Based on the relations between those variables, it is observed that assessment has negative effects in the students' affective domain. Particularly, assessment decreases students' self-image and increases the competitiveness between them.

In cluster 11 fall four variables (S1, S12, S4, S5) which are related to the students' engagement in assessment. More specifically, peer assessment and setting criteria are two important points for the students' engagement in the assessment. The *sub-cluster b* (variables S4, S5) shows the importance of peer assessment for the students in defining their learner self-image.

3.2.6.4. **Similarity relations for the students from Swiss**

Figure X includes the similarity relations as occurred form the data from the students from Swiss. This similarity diagram contains 4 similarity clusters.

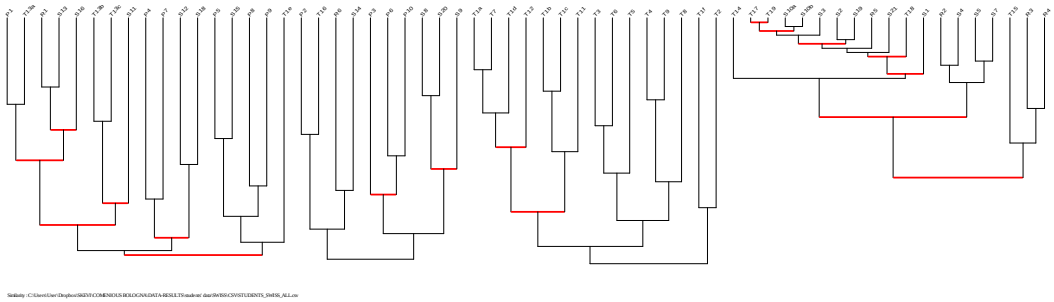


Figure X. Similarity diagram for the students from Swiss

Cluster 1 is created of seventeen variables (P1, T13a, R1, S13, S16, T13b, T13c, S11, P4, P7, S12, S18, P5, S15, P8, P9, T1e). Based on the relations among those variables, it is emerged that the time of assessment (before/during/after the instruction of each mathematic concept) and the self-correction of the errors help students to understand better a mathematical concept. Furthermore, the relations between the grouped variables in this cluster indicate that the continuous feedback and the knowledge about assessment's criteria are two elements that are associated with students' motivations, self-confidence and engagement during the lesson and they also contribute to the mathematical concept understanding.

Cluster 2 comprises of ten variables (P2, T16, R6, S14, P3, P6, P10, S8, S20, S9). Those variables show the negative effects of the assessment and peer assessment on the students' relations with their classmates. The comparisons and the competitiveness between students are two effects of assessment on students' relations. In addition, the assessment creates negative emotions to the students (anxiety) towards mathematics and it doesn't help students to face their difficulties in mathematics. This is also related with students' unawareness about their teacher's expectations/assessment criteria.

Cluster 3 contains similarity relations between fifteen variables (T1a, T7, T1d, T12, T1b, T1c, T11, T3, T6, T5, T4, T9, T8, T1f, T2). In this cluster is observed that the methods of assessment that are more closed (completion tasks, matching tasks, multiple choice tasks) and peer-feedback or group activities have a strong similarity relation. Moreover, methods of assessment that are more open and in which the students are more active and creative (self-assessment, projects, presentation of works/reports) are grouped. However, there is a very weak similarity relation between individual and group assessment methods.

In cluster 4 are found nineteen variables (T14, T17, T19, S10a, S10b, S3, S2, S19, R5, S21, T18, S1, R2, S4, S5, S7, T15, R3, R4). The relations between those variables reveal that the effort of the students to understand their mistakes after the assessment is related to the effort of their teacher to help them. Explanation, differentiation, discussion with the parents, use of the students' errors and design instruction based on the students' interests are some of the ways which teachers use in order to help their students. In addition, in this cluster is observed that the errors and the peer-assessment provoke negative emotions to the students (discouragement) and they have negative effect on the students' relations with their classmates (comparisons, competitiveness).

3.2.6.5. **The** Similarity relations for the students from France

The French students' responses to the statements of the questionnaire are grouped in eight similarity clusters. There are actually four big groups of statements, but the relations between their subgroups are not very strong, thus allowing us to consider them as distinct clusters. The relations between the statements are indicated in figure X.

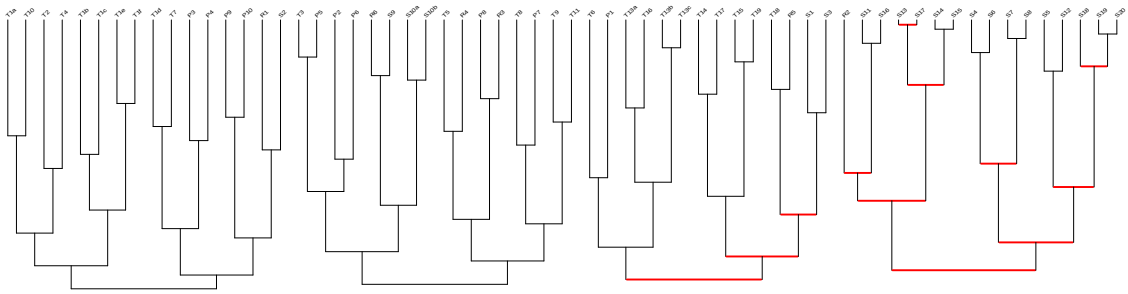


Figure X. Similarity diagram for the students from France

The first cluster includes the students' opinion regarding the importance of particular assessment methods. In this cluster most of the variables are about the use of tests, with different types of tasks (e.g. completion tasks, multiple choice tasks, true – false tasks, closed-ended tasks, open-ended tasks). This cluster includes also the use of individual activities, students' participation in class and homework. Thus in this group the more traditional or more commonly used methods of assessment are group

In cluster 2 the role of grading and the importance students give to grading is revealed. The relations formed in this cluster show that students consider assessment results as an indicator for their understanding, and do no focus on grading. Grades appear as a mean for showing students the level of their understanding, which help them adjust their effort according to the results they get. Statements about self-assessment appear also in this cluster, by having the students assess their work and then correcting their mistakes, which helps them to understand better a mathematical concept. Therefore, self-assessment appears to help the students develop their understanding.

The first relation in this third cluster shows that the use of portfolios for the students' assessment is related to a positive purpose of assessment, related to the improvement of students' mathematical understanding. In this cluster we find also some negative feelings of the students related to assessment. These negative feelings seem to be

enhanced when the students compare their results with their classmates. The teachers-parents time of discussion forms a weak relation with the rest of the variables, showing that the involvement of parents in the assessment process has an impact in the students' affective domain.

Cluster 4 includes relations between statements that reflect the purpose, the techniques and the use of results of assessment. In this cluster the students' positive beliefs about the use of assessment are related to the formative use of errors and to the use of assessment techniques that are less common and allow the students' active participation (project, self- assessment, individual interviews, group activities). Thus, these relations indicate that the formative use of errors and the use of assessment techniques which allow the students interact with their teachers or their peers and give them space to be more active contribute to the development of more positive beliefs about the purpose of assessment. As a result the use of errors and particular assessment techniques can have a positive impact on the students' affective domain, by increasing the students' motivation and self-confidence.

In cluster 5, the time of assessment and the teachers' comments about the students' strong points is related to a positive belief about the purpose of assessment, which is the identification of the students' good skills. Assessing the students through presenting their works is another factor that contributes to the creation of a positive belief about the purpose of assessment.

This sixth cluster includes statements about formative assessment techniques, mainly related to actions after an assessment. Thus in this group we can see a predominance of feed-forward actions, such as providing extra tasks and explanations, using differentiated activities according to the students' needs. These statements are related to the formative use of errors and the teachers' support to the students when correcting these mistakes, which can also be considered as a feed-forward action. A relation is formed also with the students' feed-forward actions and in particular with having students making comments on an already corrected test by the teacher. These statements relate also to a statement indicating the students' role in deciding the way they will be assessed. This indicates that the teachers' but also the students' feed-forward actions are decisive for the teaching and learning process and help the students define the way they will be assessed further on. Therefore, the importance of letting the students contribute to the way they are assessed and the necessary future actions for improving their learning is revealed.

In the seventh cluster we can see a strong relation of assessment with grading. The students' positive beliefs about the purpose of assessment are related to the knowledge of the assessment criteria. This knowledge appears to increase the students' motivation and engagement. However, the students' definition of how successful they are is based on grading. And this may be the reason that students express their anxiety towards mathematical errors. The use of their parents' comments is also found in this cluster, but it seems that some students' are mainly focused to the

grade report from their teachers. Thus, they seem to consider errors as a factor for reducing their grades and this probably causes them negative feelings, such as anxiety.

The last cluster includes the dimensions of peer-assessment and peer-feedback, but also self- assessment. These statements reveal both positive and negative points of peer-assessment and peer-feedback. On one hand, peer-assessment and peer-feedback seems to help students develop their self-assessment skills, understand their mistakes. On the other hand peer-assessment and peer-feedback is related to students' discrimination according to their abilities and competitiveness between them. Students take into account the opinion but also the grades of their classmates for defining their success. However, the students express a positive belief towards assessment and stress the importance for understanding than grading. Therefore, we could claim that engaging the students in self-assessment, peer-assessment and peer-feedback situations helps them form positive beliefs about the purpose of assessment.

3.2.6.6. Similarity relations for the students from Netherlands

The Netherlands students' responses to the statements of the questionnaire are grouped in seven similarity clusters. There are actually four big groups of statements, but the relations between their subgroups are not very strong, thus allowing us to consider them as distinct clusters. The relations between the statements are indicated in figure X.

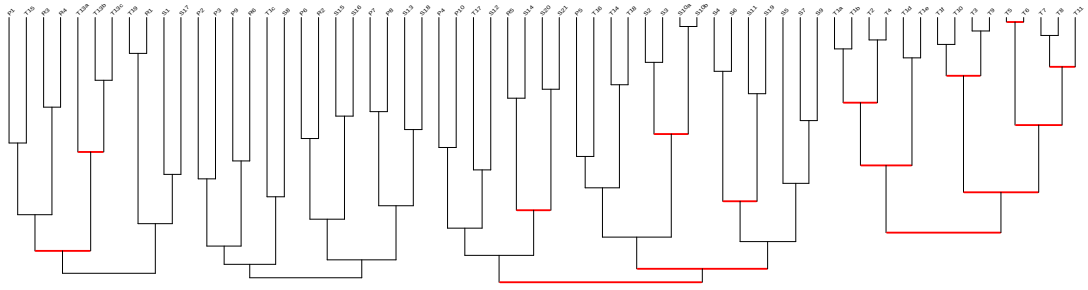


Figure X. Similarity diagram for the students from the Netherlands

Cluster 1 consists of eleven variables (P1, T15, R3, R4, T13a, T13b, T13c, T19, R1, S1, S17). At a first glance, we observe that a very strong similarity relationship between three statements of techniques (T13a, T13b, T13c) exists, which means that the teacher assesses students before, during and after the instruction of each mathematic concept. Another strong similarity relationship is noticed between

variables related with results of formative assessment (R3, R4). According to these variables seems that the teacher emphasizes on students' errors and interests in order to help them to face their misconceptions. It is important to note that a significant similarity relationship between the above variables and P1 and T15 exists. Therefore, the time the assessment is conducted is a factor that influences the students' beliefs about the purpose of assessment. The relation between P1 and T15 shows that students' beliefs about the purpose of assessment are directly related with the teachers' feed-forward actions. As regard to the rest four variables there isn't significant relationship between them.

Six variables are grouped in cluster 2 (P2, P3, P9, R6, T1c, S8). According to the relations between those variables, it emerges that the students when they make mistakes in math they deserve a low grade and then, they have to try harder. Less important similarity relationship exists between variables P2 and P3 which are related with the purpose of formative assessment. More specifically, the students believe that the grades of the assessment don't show them whether they have understood the mathematical concept, so it doesn't help them to face their difficulties in the specific mathematical concept. Finally, a very weak similarity relationship between all the variables in the second cluster is noticed.

Cluster 3 includes eight variables (P6, R2, S15, S16, P7, P8, S13, S18). A significant similarity relationship is observed between students' beliefs about the purpose of assessment and their feelings about the mistakes in math. Regarding to the rest three sub-categories of variables, the similarity relationships between them are expected. In particular, the strongest similarity relationship is noted between variables P7 and P8 which are referred to the purpose of the formative assessment. According to these variables (P7, P8), feedback contributes on students' confidence and motivation. Very strong similarity relationship exists between variables S15 and S16 which indicate that the students prefer to know their teacher's criteria of assessment, because it motivates and engages them in the learning of mathematics. The variables S13 and S18 are related due to the fact that they belong to the same category.

Cluster 4 contains similarity relations between eight variables (P4, P10, T17, S12, R5, S14, S20, S21). The strongest similarity relationship is identified between variables S20 and S21. This expected due to the fact that both variables refer to students' criteria for their success in the assessment of mathematics. In specific, other students'

grade in the test is the main criterion for the students in order to identify their success in the assessment. Similar strong similarity relationship as the above, it can be find between variables R5 and S14 which show one aspect of the teacher's role in the assessment. More specifically, the students prefer to know their teacher's expectations before an assessment in math, but at the same time the teacher wants to be with students when they are correcting their mistakes. Less significant, but unexpected similarity relationship is noticed between the variables T17 and S12, which have not any common point/element. The variables P4 and P10 related with the purpose of formative assessment and have a somewhat significant similarity relationship between them.

In cluster 5 are found eight variables (P5, T16, T14, T18, S2, S3, S10a, S10b). An almost perfect similarity relationship between the variables S10a and S10b is observed. The variables S10a and S10b show parents' engagement in the assessment and in specific, they indicate that the teachers call parents for discussion before and after the assessment. Less significant, but almost the same similarity relationship with the first is noticed between the variables S2 and S3 which are referred to self-assessment technique. Asking students to make self-assessment on their corrected work influences their motivation to make positive comments regarding their succeeded tasks. Strong similarity relationship exists between all the above variables (S2, S3, S10a, S10b). Strong similarity relationship is also found between the variables T14 and T18 which are related with formative assessment techniques. Observing these variables it emerges that if the teacher develops new task in order to help students to face their difficulties then he or she differentiates the mathematical activities helping students to promote their good skills in math. Furthermore, the variables P5 and T16 present a weak similarity relationship between them. However, this relationship is expected because they highlight that formative feedback helps students understand what they learn and what they have done well.

Cluster 6 consists of seven variables (S4, S6, S11, S19, S5, S7, S9). As we can see, all variables of this group belong to the category of stakeholders. This is expected, since these statements refer to the same object. The first two statements (S4, S6) are joined together by a very close bond and concerning peer assessment. More specifically, students respond in the same way as regards to the statements about peer assessment, the acknowledgement of their mistakes, and the development of their self-assessment

skills. The next two variables (S11, S19) are also linked together by tight bond. This time, however, are not related to the same subcategory of stakeholders. Students respond in the same way for the statements regarding the comments of their parents and self-assessment using a personal checklist. All four statements above are joined together with not particularly close bond. Nevertheless, this link seems to be important because of the red color observed in the connection. In the same cluster, distinguish three other variables (S5, S7, S9) connected by relatively narrow bond. These three variables are related to peer-assessment. All the variables of this class are linked together by weak bond.

Cluster 7 consists of fifteen variables (T1a, T1b, T2, T4, T1d, T1e, T1f, T10, T3, T9, T5, T6, T7, T8, T11). In this category, we can find the strongest and most important links between the variables. This fact is expected, since all these variables regards to the importance of some methods of assessment in mathematics. In the first subcategory we can found six variables. Variables related to participation in class (T2) and also homework (T4), are strongly linked with multiple choice and completion tasks tests (T1a, T1b). In the same subcategory, matching and closed-ended tasks tests are presented. All of the above are linked together, with a strong and important connection. Proceeding to the next subcategory, we find nine other variables. Tests with open-ended tasks (T1f), individual activities (T10), portfolio (T3) and individual interviews (T9) are some methods, which are connected together by a very strong relation. Project (T5) and presentation of their work or report (T6) are the variables with the strongest bond. This may be due to the fact that the presentations of students often concerning their projects. The last three variables of the second subcategory are associated with peer-feedback (T7), self-assessment (T8) and group activities (T11). All the variables of this cluster are connected with an important relation.

3.2.7. Factors that influence the construction of students' beliefs

The similarity relations between the students' beliefs and practices reveal some first factors that seem to be influencing the construction of the students' beliefs for F.A. These factors employ the students, the teachers or the parents. For example, regarding the students, the knowledge of assessment conditions (criteria, time etc.), the use of grading for feed-back, their engagement in the F.A process and the development of their intrinsic motivation appear to be factors that lead to the construction of positive beliefs, whereas their unawareness of the assessment criteria and their focus on grading yields the opposite results. Specific teachers' practices (feedback, feed-forward, differentiation, collaboration with parents etc) influence positively the students' beliefs.

	Positive beliefs	**Negative beliefs**
Students	Students' knowledge of assessment conditions (criteria, time etc.)	Unawareness of the assessment criteria/ teacher's expectations
	Use of grades for feed-back	Focus on grading
	Students' engagement (Assessment methods / Self/ Peer – assessment)	Errors and peer-assessment
	Students' internal motivation and self-confidence	Specific methods of assessment like multiple choice and true or false tasks
	Active participation (group activities, self-assessment, peer feedback, interviews)	
	Specific methods of assessment like closed/opened tasks and homework	
Teachers	Continuous feedback	Bad teachers' practices (no time for feedback)
	Feed-forward activities	Use of not preferable methods of assessment/ more common used ("traditional") methods of assessment
	Differentiation	

	Effective use of mistakes (for feed-forward)	
	Teacher-parents effective cooperation	
	Awareness of assessment's criteria	
	Use of less commonly used (less "traditional") methods of assessment	
Parents	Parents' involvement (parents' comments)	

3.2.8. Factors that influence the construction of students' beliefs

In this section we present a comparison between teachers' and students' beliefs about formative assessment.

In Cyprus, one of the similarities is related with assessment techniques. More specifically, teachers argue that the most appropriate assessment techniques are oral question-and-answer and matching questions, while students support that homework and participation in class are the most important assessment methods. We consider oral question-and-answer as a part of participation in class. Simultaneously, most of the teachers believe that they are skillful to apply oral questioning techniques. Furthermore, consistency is noted between teachers' and students' beliefs about formative assessment results. Particularly, most of the teachers support that one of the main purposes of formative assessment is to identify students' strong and weak abilities in mathematics and the most important result of this kind of assessment is to provide feedback for helping students correct their errors. These statements supported by the students who argue that correcting their mistakes contributes to better understanding. Another similarity referred to assessment's criteria. Most of the teachers think that sharing learning mathematical goals with students is the main characteristic of assessment techniques. In similar, students claim that when it is clear to them what and how to learn in mathematics class they become more motivated and engaged learners.

On the other hand, some differences are observed between teachers' and students' beliefs about formative assessment. Firstly, most of the teachers claim that high-quality formative assessment focuses on giving advice and guidance over giving grades, while students' opinions about this issue are inconsistent. In particular, most of the students argue that the teacher has not any time to explain them what they don't understand, but the same time most of the students support that the teacher explains

again a mathematical topic for improving students who fail. Another difference is perceived regarding self-assessment technique. Even though the majority of teachers say that when they provide feedback, they can encourage self-assessment in order to enhance students' self-monitoring and they consider that formative assessment gives students the chance to assess themselves, students claim that their teachers don't encourage them to assess themselves.

Next, the comparison about the data collected in Swiss are presented. Comparing results from two questionnaires we can do the following observation.

- **Characteristics of formative assessment**

In general, by the side of teachers, there is a good interest on student process and formative aspects. Teachers are less open to believe that an efficient formative assessment could be the student's ability to apply math in real contest and not familiar (in agree with what effectively done in the class during the assessment). Indeed students declared that in only 25,3% of the cases teachers ask elaboration of projects based on concrete situations.Teachers seem to have set up the formative assessment aspect, but despite that, for certain aspects, in the class doesn't shine the real intention of the teacher (according to students).

The results of the students questionnaire show that the teacher, rarely, after a test does comments or discussions about mistakes; however 94,2% of the teachers agree that the formative assessment should give feedback that increase motivation and lead to improve knowledge and math skills. It seems that teachers know the importance of the formative assessment but then he don't put it in practice.

- **Teachers beliefs**

It is pointed out a large agreement between teachers about the importance assessment tools as feedback, sharing criteria and self-assessment. Concerning the need to have feedback and to know criteria/objectives, students confirm the importance. However, in the matter of self -assessment, only in 56,7% of the cases, students consider it an important assessment tools.

- **The formative assessment is more efficient when**

Teachers agree both about the meaning of formative assessment and which are the most important tools to realize it. However, on the base of student declarations, only 33,8% affirm that self-assessment is a tool used by teacher in classroom; rarely there is a precise and efficient error analysis (nevertheless students consider it useful and important). Teachers agree on importance to clarify learning objectives, but seems that they never do it in the classroom in a clear way: half of students declare that, before an exam, they discuss with the teacher about what is in store for them. Also in this case, belong student opinions, we observe a discrepancy between what teacher thinks to be efficient and what really does in classroom.

- **Which evaluation criteria**

Teachers attach great importance to active participation of the student in classroom (73,9%); same thing happens for students. However only in the 57,4% of the cases it is used in class as assessment tool. Homework seems to be an important evaluation criteria. Based on students questionnaire appears that homework are one of the assessment methods used more often in the classroom, although students don't consider it so important.

- **How much capable is the teacher concerning assessment tools?**

Teachers consider themselves much capable in assessment tools as and also in discussion analysis in the classroom and performance observation. Less capable in assessment tools as au pair assessment, self-assessment, tests or oral exams. Classroom observation, in teacher opinion, is not an appropriate assessment tool. However almost every teachers consider themselves expert on use it.

- **Students feedback**

Teachers and students agree about the importance of using feedback.

- **Communication outcomes**

According to teachers, assessment formative outcomes should be discussed with students and not announced in the classroom; maybe comparing math outcomes with schoolmate produce unsuitableness and frustration (40% of students don't want a direct comparison to avoid to be ridiculed).

- **Which use of formative assessment?**

It is pointed out an agreement between teachers and students about the positive effects of the feedback on confidence and motivation. Based on questionnaire results appear that the majority of the teachers, concerning formative assessment, tend

In France, considering the results between students and teachers, it seems that we have two public living under one roof, in their own system of constraints, with different needs and expectations while being aware of the importance of formative assessment to overcome epistemological obstacles. Therefore, it seems necessary to resume the dialogue between the two communities: when the student expects more recovery, more feedback over different modalities, the teacher agrees with the principle and he knows it, but it seems that he remains blocked in the practice stage. A practical framework mastered, it is a framework in which the teacher has invested and do not it feel serene. There is a mastery of the variables that identified as being the ones from his didactic contract with the institution.

DIRECTIONS FOR THE PILOT TRAINING COURSES

1. SUMMARY OF RESULTS ABOUT TEACHERS' TRAINING

The table summarizes the results about the teachers' answers in the subjects they would like to have more training, for all the countries. First of all, we observe that low percentages of the teachers that do not want to be further trained. Furthermore, topics related to methods to assess students' achievement, the application of different assessment methods, using assessment methods to provide students with feedback and using assessment methods to develop teachers' abilities to teach effectively are among the most preferable for the teachers' training in the partner countries. We could say that there is a general agreement between the teachers from the five countries regarding the topics they fell they need more training.

Consequently, these topics will be taken into account for developing and designing our training model. The aim, the key points and the course structure of the first proposal about the training model are described below.

Table 3

Teachers' preferences for training for all the countries

Given assessment workshops in the future, please indicate which topic(s) you would like to attend,	**Cyprus (N=65)**	**Italy (N=39)**	**Swiss (N=69)**	**France (N=21)**	**Nether. (N=7)**
17. Methods to assess students' achievement,	64,6	45,2	23,2	23,8	0,1
18. Encourage students' participation in classroom activities,	53,9	74,2	23,2	0,0	0,2
19. The application of different assessment methods,	64,6	41,9	43,5	33,3	0,2
20. Analyzing assessment method results,	55,4	35,5	33,3	14,3	0,1
21. Using assessment methods to provide students with feedback,	58,5	54,8	17,4	9,5	0,3
22. Using assessment methods to improve students' abilities,	55,4	41,9	46,4	14,3	0,2
23. Using assessment methods to develop teachers' abilities to teach effectively,	52,3	67,7	46,4	23,8	0,1
24. Higher order questioning	44,6	29,0	53,6	14,3	0,1

techniques,					
25. Use of misconceptions,	47,7	35,5	26,1	14,3	0,3
26. Feedback as comments and not grades,	33,9	32,3	24,6	9,5	0,1
27. Oral feedback,	33,85	16,1	33,3	4,8	0,1
28. Sharing assessment criteria,	27,69	25,8	15,9	19,0	0,1
29. Peer assessment,	36,92	19,4	15,9	14,3	0,3
30. Students' self-assessment,	47,69	38,7	31,9	23,8	0,3
31. Other topic (please indicate):	3, 08	----	----	4,8	0,1
32. I would not like to attend any assessment workshop,	10,77	3,2	29,0	4,8	0

2. FIRST PROPOSAL ABOUT THE TRAINING MODEL

Aim of the training courses

The aim of these teacher-training paths will be to foster among teachers a proper use of formative assessment (assessment *for* learning) in mathematics education and to identify significant cases that reflect the pattern of training that will be collected and uploaded in the web repository (WP5),

Key Points

1. Tools and videos stored in the repository will be used as methodological resource for planning teacher-training paths,
2. Develop of training model patterns (or schema) in order to design training paths (at least 5 paths in response to the different learning needs of teachers), providing methodological criteria to build on other training paths,
3. Each training path shall be organised trough blended learning and face-to-face lessons, according to learning needs and resources (including those reported in the web-repository),
4. Every training path will be implemented and tested in different (but fixed) conditions with different groups of teachers, in order to identify some criteria concerning their effective exportability on other contexts,
5. In particular, we expect to test these training paths with groups of teachers that are homogeneous with respect to their formative needs, For example, we will take into account teacher, which have long lasting experience versus new in-service teachers, or teachers that have deep pedagogical-didactic previous competence versus teachers that have deep mathematic previous competence,

Course structure

•Step 1: Presentation of course - Collecting beliefs and practices

•Step 2: Presentation questionnaire's results ant theory about formative assessment

•Step 3: View some videos and preparation video's analysis

•Step 4: Planning lessons

•Step 5: Making videos

•Step 6: Analysis about the video on group work

•Step 7: Sharing video's analysis

•Step 8:Planning, making and analyzing other videos

•Step 9: Sharing video's analysis

•Step 10: Discussion about formative assessment features

Course structure Key points

Step 1: Presentation of course - Collecting beliefs and practices

•Presentation the project FAMT&L and course

•Give the platform's access and explanation the utility and use

•Discussion about administration (privacy)

•Presentation of one video (already analyzed)

•Administration teacher and student questionnaire / Interviews

Step 2: Presentation questionnaire's results ant theory about formative assessment

•Presentation results of questionnaires and interviews

•Compare results of questionnaires of FAMT&L

•Presentation about principles of theory about formative assessment

Step 3: View some videos and preparation video's analysis

•View and comment the video

•Training about video's analyses (ANVIL software)

•Identify subject of formative assessment for the video

•Explanation how to make videos (technical equipement)

•Explanation next steps: preparation a planning lessons (teacher can help with others videos in the platform)

Step 4: Planning the lessons (platform)

•Interaction between teachers and trainers (virtual meeting, forum,…)

Examples of the spaces of the platform are indicated in the pictures below.


EXAM

Step 5: Making videos

•Make video in classroom ***Step 6: Analysis about the video on group work***

•Each participant analyses the video (individual or in group, platform)

•Sharing the analyses

Step 7: Sharing video's analysis

•Presentation of the video analyzed, discussion about the grid

•Observation and comment about video and regulate the formative moment and next video

Step 8: Planning, making and analyzing other videos (Using platform)

Step 9: Sharing video's analysis

•Observation and comment about video to regulate the formative assessment,

Step 10: Discussion about formative assessment features

•Identify goods videos to put in the platform

•Update the grid

•Elaboration document with elements of formative assessment

•Administration questionnaire or interviews (same as the beginning of course)

•Administration of questionnaire about the course.