Chapter 9
Teacher Perspectives About Using Formative Assessment

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Teacher Questionnaire

Pan-European views of the project teacher's development were sampled with a questionnaire to track overall teacher change in seven countries. As described in this book's introductory chapter, teachers were participants in the ASSIST-ME project aimed at investigating the uses of formative assessment strategies along with inquiry-based teaching. Both the pre-study and final questionnaires were distributed to all participating teachers. The purpose was to gain insight into the development in teachers' perceptions of the relevance of inquiry-based education (IBE), formative assessment, competence-oriented teaching and their confident use of these aspects of assessment compared to that of control groups composed of similar collegial teachers. All of these aspects were examined in three dimensions: the teachers were asked how often they used the different methods in their teaching, how important they thought they were and how competent they felt in employing the aspects in their teaching.

The questionnaire assessed confidence by asking about respondents' self-efficacy when using formative assessment in their classroom practices. There were five questions regarding the use and perception of IBE: how teachers work with engaging their students through interesting or unusual questions and how they get them to identify investigable questions, plan investigations, have collaborative discussions and work with real-life problems.

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Questions about competences focused on six competences: investigation in science, problem-solving in mathematics, design in engineering, argumentation, modelling and innovation across all subjects.

The questionnaire was distributed to all local working group (LWG) teachers across partners as well as to a control group of teachers for each LWG during the first round of implementation. This resulted in 110 LWG sets of answers and 57 control group responses by the end of the first implementation round (see Table 9.1). Only at the end of the third implementation round 2 years later, the identical questionnaire was distributed once more to all respondents who answered the questionnaire in the first round. However, partners where the first-round response rate was too low to yield meaningful results were omitted from the final questionnaire round. We did not attempt to classify the nonrespondents, thus reducing some of the generalizability of this study. This means that by the end of the 2 years of implementations, the questionnaire was distributed to 101 LWG teachers and 52 control group members from seven partners (two from France).

Except for the 12 items relevant to self-efficacy, the questionnaire responses have not been analysed quantitatively due to the incomplete pre- and post-data sets. The self-efficacy items are an exception since it is useful to examine quantitative changes in single questions across countries.

Changes in items regarding IBE teaching suggest that developing inquiry-based teaching units was the focal point for many teachers throughout the implementations. This is supported by the work on the LWG meetings in Denmark where substantial amounts of time, especially in the first implementation round, were spent developing inquiry teaching units. The questions about assessment also hint at some change in perceptions about formative aspects of feedback and questions related to specific ways of assessing students. However, clear trends across cultures were not evident.

Table 9.1 A summary of the response rates from the pre- and post-questionnaires from both participant teachers (LWG) and those not participating (control). Cyprus and the United Kingdom were dropped from the final survey due to low response rates in the first round

	Pre-round response rates				Post-round response rates			
Country	LWG	Rate	Control	Rate	LWG	Rate	Control	Rate
Denmark	19	100%	7	58%	16	94%	4	57%
Germany	12	86%	6	100%	4	40%	2	33%
Cyprus	7	41%	3	9%	0	NA	0	NA
Switzerland	20	95%	15	83%	16	89%	13	87%
France (A)	17	68%	NA	NA	11	65%	NA	NA
United Kingdom	2	12%	2	33%	0	NA	0	NA
Finland	8	89%	2	67%	8	89%	1	50%
France (B)	7	64%	5	83%	6	67%	3	60%
Czech Republic	18	86%	17	81%	14	82%	12	75%
Totals	110		57		75		35	

First Perspective: Changes in Teacher Self-Efficacies While Using Formative Assessment

Teacher Self-Efficacy Beliefs

Introducing teachers to strategies for formative assessment and facilitating their use inevitably includes consideration of the importance of changes in teacher's personal beliefs about their capacities to adapt these approaches successfully to their classrooms. Without concomitant belief changes, teachers are less likely to successfully use less familiar methods and to continue to improve their skill at mastering them. Our efforts to introduce and facilitate the formative assessment methods—teachers' written feedback to students, classroom peer-to-peer assessment, 'on-the-fly' teacher feedback to students and structured assessment dialogue in the classroom—were grounded in strategies for enhancing teacher beliefs about their abilities to use them (see this book's introductory chapter for details about these formative assessment methods). This section of *teacher perspectives* looks at changes in the teacher capacity belief of self-efficacy while using strategies for enhancing these beliefs given the circumstances in which formative assessment methods were trialled. The findings of the teacher questionnaire which addressed capacity self-efficacy beliefs among study teachers and those not a part of the study, before and after using the formative assessment methods, are shared.

The Role of Self-Efficacy

'Self-efficacy' is the capacity belief based on Albert Bandura's work that posits that such beliefs '… contribute significantly to human motivation and attainments' (Bandura 1992). Beliefs in one's own ability to manage and implement a given challenge, such as using formative assessment with a class not accustomed to it, are instrumental in meeting the challenge (Bandura 1992). We each hold these expectations about our future ability to perform tasks based on previous life experiences. As teachers grow professionally by strategies to facilitate learning, they feel more confident about replicating those teaching methods that are successful and less confident about trials either which do not succeed or for which they receive no evidence of their success.

For example, if teachers attempt to use peer-to-peer assessment for the first time they, based on previous experiences with unfamiliar methodologies, typically will have some doubts about their chances for success. At the same time, these doubts may be balanced by positive expectations from previous successful experiences with new strategies. Considering these doubts, positive expectations and their current teaching environment, teachers will have individual levels of self-efficacy about

how successful they expect to be. Contributing to this level of self-efficacy is a teacher's general confidence as a teacher at attempting new methods of instruction. However, general self-confidence is not the same as self-efficacy beliefs, since efficacy beliefs are targeted at specific future behaviours, whereas self-confidence is non-specific. We can simultaneously have a high confidence in our teaching ability yet low self-efficacy when confronted with a specific teaching demand such as using an unfamiliar kind of formative assessment. A higher general confidence can positively influence our self-efficacies, but its effect may be diminished as attempts at a given task provide task-specific feedback about our abilities (Bandura 1997).

Therefore, as teachers implement, in this case, peer-to-peer formative assessment, the feedback they get about how the trial goes will either raise or lower their self-efficacies for peer-to-peer formative assessment. If their self-efficacies for using peer-to-peer assessment were rather low to begin with and if they cannot see evidence of successful use, they may be averse to trying the strategy again. However, if to begin with, their self-efficacies were robust and they get some credible positive feedback, their self-efficacy for using peer-to-peer assessment is slightly raised, and the chances of them tying it again are enhanced.

Essential for any change in self-efficacy is authentic feedback about the degree of success for a teaching action. Sources of such feedback include self-reflection, student activation and various indicators of student success as well as perspectives provided by colleagues and/or other observers.

The perceived validity of these sources of feedback success is important since if teachers do not have confidence in how well their use of feedback methods is working, then they are not likely to use them in the future.

Opportunities for Enhancing Self-Efficacy

Albert Bandura (1995, 1997) identified four experiential factors that determine self-efficacy expectations. He categorizes them as 'enactive mastery experience', 'vicarious experience', 'verbal persuasion' and 'affective states' (Bandura 1997). Mastery experiences are past efforts at the same or similar teaching tasks from which teachers judge for themselves how well they were able to achieve a 'novel' teaching method. Their self-reflections about the extent to which they succeed in implementing something different strongly influence their future personal expectations for using this teaching method again. In the case of facilitating peer-to-peer assessment in their classroom, how teachers judge student experiences and other indicators of performance influences how they feel about using peer-to-peer feedback.

The influence of mastery experiences on future behaviour is high. Consequently, misinterpretations of success are especially important to avoid when trying 'new' teaching methods. For example, if a teacher's self-reflections tend to be very critical, then they may avoid follow-up trials based on these harsh judgements about

their first successes. Conversely, teachers who are more objective and perhaps have a generally higher self-confidence may note where they succeeded and what to change the next time. Teachers who get feedback on the use of unfamiliar teaching methods, such as by objectively examining student outcomes, are more likely to have valid changes in self-efficacies.

Teacher self-efficacies are also influenced vicariously through seeing how their peers handle a trial of, for example, peer-to-peer student assessment. When they work in a teaching group to implement such a method and then discuss with their colleagues the degree of success, they adjust their own self-reflections to those of others with whom they compare themselves. These comparisons influence individual self-efficacies, particularly among teachers who have had little experience of their own and look to peers with more experience for indicators of success (Bandura 1997).

Similarly, 'verbal persuasion' that teachers receive from those who they respect such as other teachers, administrators or university faculty has an effect on their individual perceptions of self-efficacy. These sources of verbal coaching, when valid and not just kindly supportive, influence self-efficacies. The veracity of the feedback from significant others can also serve to align self-reflections with the reality of a teacher's success and hence influence self-efficacy. Even when this feedback is negative and therefore likely to depress self-efficacy, if it is combined with suggestions for ameliorating the difficulties, the negative effects may be limited (Bandura 1997).

The affective perceptions of teachers attempting unfamiliar teaching methods, perhaps like peer-to-peer assessment, can have a negative influence on their self-efficacy in that their performance may be hindered by negative affective messages that reduce the otherwise positive feedback of their efforts. The disequilibrium of attempting untried teaching methods when compared to usual procedures can increase negative affective effects for some teachers and hence depress their self-efficacies. This is particularly true for inexperienced teachers and for teachers who depend only on their own self-reflections. Vicarious feedback from observing peers and valid encouragement from respected colleagues can help reduce attributions to inability.

The Environment in Which Formative Assessment Is Used

With a goal of testing the usefulness of formative assessment methods, we included with our implementations opportunities for all of Bandura's methods for self-efficacy change (Bandura 1995, 1997) to be used. For each of the trials in eight country sites, local working groups (LWGs) of experienced teachers were formed. Over the course of 2 years, before, during and after feedback implementations, the teachers met with one another and project leaders to plan activations and discuss the

results. During implementations, LWG teachers tried the assessment methods multiple times and reflected both individually and as local groups on the results of their trials. After concluding their trials, the LWGs along with the project leaders in each country met to discuss the outcomes. Before and after concluding their project work, all of the teachers in the LWGs, as well as teacher colleagues in each country who did not participate in the trials, answered questions about their experiences on a standard teacher questionnaire that was translated into each country's language.

These teacher trials with formative assessment methods were designed to provide opportunities for 'mastery' of the less familiar methods since they were tried multiple times with intervals between for reflection and feedback. Since the project engaged experienced teachers, their self-reflections after repeated lesson trials were likely to have influenced their self-efficacies for each of the methods they used. In addition, since they met with peers in their LWGs before, during and after trials, the opportunities for vicarious influences from the group were frequent. Concomitantly, there were opportunities for influential members of the LWGs as well as project leaders to affect teacher self-efficacies through social persuasion at meetings where the processes and results of the trials were discussed. It was hoped that the engagement of experienced teachers who volunteered for the project, along with frequent opportunities for LWG reflection and feedback from project leaders, helped control any possible negative affective consequence effects of trying new classroom teaching methods.

How Self-Efficacy Was Assessed with the Teacher Questionnaire

The teacher questionnaire was administered to all participating teachers as well as to a sample of similar teachers from the same countries who were not involved with the study, both before and after trials with the formative assessment methods. It contained 12 items whose aim was to assess the self-efficacy of teachers unfamiliar with various formative assessment methods. These items (see Fig. 9.1) were derived from a commonly used international instrument for science teaching self-efficacy (Enochs and Riggs 1990; Bleicher 2004). The two constructs of self-efficacy and outcome expectations, both of which are theoretically part of capacity beliefs (Bandura 1997), were both represented among the questionnaire items. Nine questions required teacher efficacious projections of their future capability at performing a given teaching action; three questions (*s in Fig. 9.1) queried the likely outcome of teaching efforts given the circumstances in which the teaching occurred. Both perspectives are indicative of the likelihood that a teacher who has experienced using these formative assessment methods is to use them again since it is not only their judgement of their own ability to use a method (self-efficacy) but also whether, given the circumstances of their classroom and students, they would actually be able to implement it (outcome expectations).

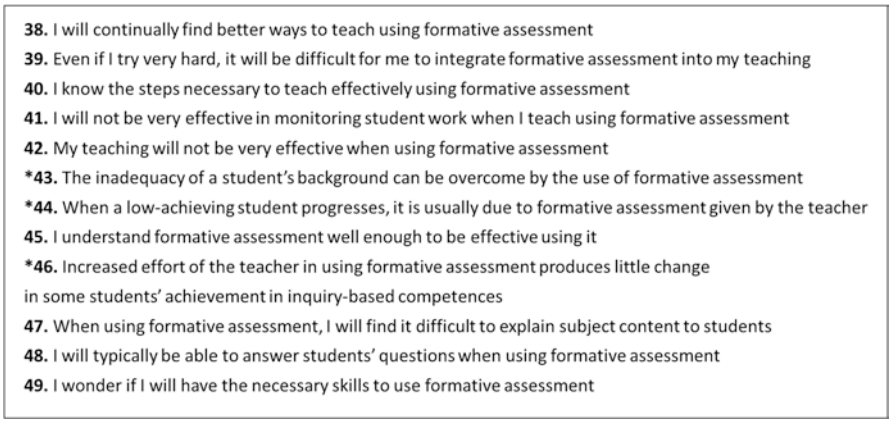

Fig. 9.1 Teacher questionnaire items aimed at assessing self-efficacy (*outcome expectations)

Teachers in each of six countries responded to five-point Likert scales for each of the 12 items. The polarities of some items were reversed to reduce response sets. Eighty-three teachers out of a possible 95 (64 participating teachers and 31 control teachers) in six countries responded to both the pre- (administered in 2014) and post-teacher (2016) questionnaire administered in their own languages by local researchers. The full response rate of 87% of teachers completing both pre- and post-questionnaires was high. This high response rate can be attributed to the fact that the teachers were all known to researchers who had worked with them for several years and the surveys were not anonymous. There may have been some bias since the desire of these participating teachers to 'please' the researchers may have affected scores. On the other hand, the 2 years between pre- and post-administrations would have made it unlikely that teachers recalled their pre-responses when completing the post-questions. The 33% respondents who were control teachers were subject to as much bias since they had no participation or relationship to the researchers and probably did not recall their pre-responses when completing the post-survey.

Since the 12 items in the questionnaire do not represent a standardized instrument for collectively measuring self-efficacy, the individual item results are more useful in assessing change than aggregated scores. Because self-efficacy is an individual's capacity belief, summative data for all six reporting countries is more useful than individual or country data in judging the potential of these experienced teachers to raise their self-efficacies while using the formative assessment methods. Individual and country changes in self-efficacy have the potential to inform individual and country success with these methods. Consequently, we chose an overall cross-country perspective to gain general feedback on the trials of formative assessment.

Changes in Self-Efficacy Beliefs While Using Formative Assessment Methods

A hypothesized outcome of the trials of assessment methods was for positive changes in teacher's self-efficacies to occur when using the given formative assessment methods. The results of the 12 questionnaire items about self-efficacy provide relevant indicators. Table 9.2 contains the changes in mean scores on the 12 pre- and post-items for the project teachers (LWGs) and other teachers (control groups). Overall (means), there were no changes in self-efficacy for the project teachers (+0.06 out of 5 points), while the collegial teachers (control groups) who had no exposure to the formative assessment methods of the project reduced their self-reported efficacies (−0.49 out of 5 points) over the course of the study. Since these 12 questions did not comprise a comprehensive and validated instrument, it is more useful to look at changes in individual items since each assesses a different aspect of capacity belief. Seven items 38, 39, 40, 41, 42, 45 and 49 (see Table 9.2) directly address teacher projections about their future use of formative assessment.

The projections in these seven questions are not confounded by the outcome expectations of items 43, 44 and 46, since these three questions ask teachers about characteristics of their teaching situation which may influence their self-efficacy, but they do not assess the self-efficacies directly associated with the use of the four formative assessment strategies of the project. Nor are they tangential to using formative assessment, as are items 47 and 48, which address teacher content knowledge along with formative assessment.

For the seven items (38, 39, 40, 41, 42, 45 and 49) directly addressing self-efficacy, questions 39, 40, 41, 42 and 49 all showed significant differences in the pre- to post-changes for the two groups of teachers. In each of these five questions which allowed teachers to indicate their future confidence in using formative assessment methods, the LWG teachers were more confident and the control teachers less so. Even for question 49 where teachers made a general assessment of whether they '… will have the necessary skills to use formative assessment', the unchanged pre- to post-responses of the LWG teachers (−0.02) compared favourably with the drop in self-efficacy (−0.8) for non-participating teachers. The non-significant differences in pre- to post-changes for the two groups for questions 38 and 45 may indicate an overall positive outlook for using formative assessment as compared to responses to the five questions (39, 40, 41, 42 and 49) which were more specific and less based on a general future projection.

Table 9.2. Changes in the mean pre- to post-scores for 12 items (Fig. 9.1), for local working groups and for controls for six countries (outcome expectation questions shaded). Five-point scale LWG n = 54; control n = 29

	#38	#39	#40	#41	#42	#43	#44	#45	#46	#47	#48	#49
LWGs	0.04	0.27	0.50	0.58	0.60	-0.21	0.25	0.46	0.35	0.63	0.01	-0.02
Control Groups	-0.1	-0.19	-0.31	0.296	0.019	0.09	-0.31	0.3	-0.8	0.438	-0.65	-0.8

Self-Efficacy Beliefs as Indicators of Teacher Change

Higher teacher self-efficacies have been associated with the use of inquiry methods and student-centred teaching approaches such as provided by formative assessment (Czerniak 1990). Therefore, some evidence of our expectation that project teachers would increase their self-efficacies for using formative assessment methods along with inquiry would be a positive indicator of the potential of introducing these formative assessment methods into classrooms. If teachers' experiences with innovative formative assessment had significantly decreased their self-efficacies, then we would need to re-examine our procedures for their introduction into classrooms. The influence of teacher self-efficacy beliefs on teacher's roles, planning, lessons and student achievement is strong (Tobin et al. 1994). Therefore, positive changes in self-efficacies for experienced teachers trying unfamiliar methods such as innovative formative assessment provide alignment between these methods and those associated with other student-centred approaches in that they all are associated with higher self-efficacies. The observation that experienced teachers in this study had increases in self-efficacy when using innovative formative assessment methods provided encouragement for further efforts to introduce them to classrooms.

Second Perspective: Changes in Teachers Subjective Theories of Assessment—A Czech Perspective

This section on teacher's perspectives uses teacher interviews and case studies to look in depth at the challenges which implementation of formative assessment into everyday teaching faces. One frequently mentioned obstacle is a lack of appropriate support for teachers (e.g. Bernholt et al. 2013; Brown 2004). To arrange the support properly, especially for teachers who introduce new forms of assessment, it is important to understand the teacher's perspectives and their expectations related to assessment and its functions and values in teaching.

The research on practice of formative assessment is rather broad in scope (c.f. Bernholt et al. 2013); it covers various forms of assessment and various educational settings. For example, Hogson and Pyle (2010) summarized research on assessment for learning in primary science. Their report reviewed several different contexts of research, including the development of self-assessment skills, the use of different techniques for eliciting peer assessment, the links between feedback from peers and from teachers and the relationship of a formative classroom climate to peer- and self-assessment activities.

However, the current literature does not cover the issue of changes in teachers' conceptual understanding of formative assessment. With this incomplete understanding of teacher perspectives about formative assessment in inquiry teaching, especially at the primary school level, researchers in Czech Republic focused on further understanding of the teachers' points of view.

When implementing or upscaling new practice, teacher understanding of their own practice is challenged (Whitehead 1989). It has been argued that formal theories of educational processes are very often useless for eliciting the change in the practice of teaching unless they are constructed from authentic teacher experience. This view is reflected in Korthagen et al. (2001) concept of personal practical knowledge. It is knowledge that builds on gestalts of experience but can be reflected and is accessible to conscious description and communication, which helps in further refinement of it in interpersonal settings. Another term, which has become popular in the German-speaking countries from around the 1980s of the twentieth century, is subjective theory. The term 'subjective theories' (ST) has been used to describe the fact that humans construct their own theories while constantly reflecting on the reality they perceive (e.g. Groeben et al. 1988). Subjective theories which often arise spontaneously, under pressure and without conscious control, have an argumentative structure which is implicit, comprise more liberal assessment criteria, etc. (Janík 2005, p. 478). Subjective theories of teaching help to understand teaching as a series of deliberate, reflected actions. Most teachers develop subjective theories that allow them to justify their actions during class (c.f. Edmondson 1998). It can be assumed that teachers develop particular parts of their subjective theories when introducing new practice. The confrontation of their new teaching experience with former theoretical knowledge that has influenced their initial expectations leads to a gradual refinement of their subjective theories and thus further influences implementation of the new techniques.

Objectives of the Study of 'Teacher Perspectives' in Czech Republic

In Czech Republic, formative assessment is seen as more or less embedded in common Czech teaching culture, but typically only in the forms where the feedback is provided by the teacher (see also Chap. 4: On-the-fly assessment). Peer assessment is perceived mostly as a supplementary option (e.g. Košťálová and Straková 2008) probably also due to the fact that peer interactions as a form of learning communication are not frequently used (Šeďová et al. 2012).

However, as peer assessment is a promising but also rather challenging method of assessment in inquiry-based lessons in elementary mathematics (Hodgen and Marshall 2005), Czech researchers investigated teachers' subjective theories of formative assessment and their development over time during a trial implementation of formative peer assessment in inquiry-based elementary mathematics.

How Perspectives of Teachers Were Assessed

A working group of six elementary teachers participated in this study. Together with researchers, teachers developed inquiry-based teaching units of primary mathematics, where formative assessment instances were implemented and reviewed. The teachers in pairs of two taught the teaching units in second-, fourth- and fifth-grade classes. The units consisted of a sequence of 4–6 inquiry-based tasks, implemented mostly in 2-h blocks.

Teachers reflected upon their subjective theory of formative assessment before and after the experimental teaching units. The reflection was elicited and organized by the Struktur Lege Technik (SLT, Scheele 1992). SLT is a structured interview that enables externalization of teachers' subjective theories of formative assessment in inquiry-based learning and consequently allows their description and clarification.

The first step whose purpose was to determine the content of the relevant cognitions was done by conducting a semi-standardized interview. As formative assessment is a relatively new concept for teachers, the researchers also offered several metaphors to facilitate broad conceptualizations. The second step, which involved reconstructing the structure of the subjective theory, was facilitated by providing paper cards bearing the main concepts and ideas expressed by the teacher in the previous interviews. The teachers were asked to organize the cards and describe the connections between them. The final step was an overall description of teacher understanding of formative assessment as depicted by explicated subjective theory. This process of explication of subjective theory of formative assessment was done twice, before and after the experimental teaching period that lasted for 8–10 weeks. Besides reconstruction of subjective theory of formative assessment, the researchers collected teachers' commentaries after each enacted lesson.

How the Interviews Were Analysed

Data were analysed in a qualitative manner. The subjective theories were first analysed by thematic coding. The initial subjective theory and the one created after the period of experimental teaching were compared. An inductive approach (Boyatzis 1998) where thematic codes were organized within a template (Crabtree and Miller 1999) was used to search for changes in teachers' subjective theories. The changes were analysed first as individual case studies, and then the whole group of teachers was studied in search for similarities.

What Was Learned from the Czech Teachers' Perspectives

The reflective interviews with teachers after the completion of particular lessons showed that implementation of peer assessment during inquiry-based tasks in mathematics was rather difficult and challenging for both teachers and students. The

main problems that were identified by the teachers were time and resource demands (worksheets, assessment tools, teacher assistant time, etc.) and novelty of the assessment method. The experimental teaching thus provided an important new experience, which could stimulate the development of teachers' subjective theories of assessment.

Thematic coding was led by expectations driven by the inquiry and formative assessment literature (Black and Wiliam 2009; Eastwell 2009). The main thematic codes were benefits of formative assessment, obstacles of implementation, relationships between formative assessment and inquiry-based learning, relationships of formative and summative assessment within inquiry, advantages and disadvantages of formative assessment for students, learning tasks relevance for formative assessment and teachers' roles in formative assessment.

The development of the six teachers' subjective theories was summarized as case descriptions. Following are two examples, showing the difference in depth of conceptual understanding of formative assessment and subsequent views on prospective actions which should be taken for further implementation of formative assessment in a teacher's practice. These two teachers worked as a pair in the first round of experimental teaching; they taught in parallel classes, in the same school, and they discussed their teaching units together. Though they worked in similar conditions and have similar lengths of teaching practice and similar limited experience with inquiry-based teaching and no previous experience with formative peer assessment, their subjective theories of formative assessment developed differently.

Case Studies

Teacher A

This fifth-grade teacher had no previous experience with formative assessment, less than 5 years of practice and taught the topic 'big numbers'.

Before she started to use formative methods of teaching, Teacher A expected that the use of formative assessment in inquiry-based math lessons would provide effective continuous feedback for students—contrary to summative marks ('…when the students see the marks, they never see the mistakes. The mark means end of the work.'). She felt uncertain whether she would master inquiry and formative assessment together. As a main means of support, she considered worksheets/forms/rubrics for students. The main obstacle for the implementation of formative assessment which she saw was in parents' views on learning ('…only working with the student book is seen as sound learning, anything else is seen as entertainment or relaxation').

During the teaching trials, she realized that students frequently were not able to provide effective feedback for their peers, and she did not know how to help them. She also reflected that she had difficulties in summing up the lessons in a final whole

class discussion, which could institutionalize the new piece of knowledge (Brousseau & Novotná 2012). After the experimental teaching, she reconstructed her subjective theory of formative assessment and revealed that she perceived inquiry-based learning as more important for her attitude towards teaching than formative assessment. The salient problem of formative assessment in inquiry-based lessons for her was that students were not able to assess the work of their peers. She did not find the prepared worksheets to be a valuable support for her formative assessment trials. Instead, she would like to observe a more experienced colleague's teaching. Further, she saw the importance of development of the students' assessment skills. She believed that students value more peer assessment than the assessment provided by the teacher. The parents' opinion was still seen as an obstacle ('… I do not know how I could defend the time we have spent on it and explain to parents that we did not get enough practice of the tasks in the student book').

Overall, Teacher A expected in correspondence with theory that formative peer assessment would provide continuous feedback to her students, but she found it very difficult to facilitate peer assessment in a way that will lead to an effective and formative feedback. She expressed a need for support. She did not perceive formative assessment as a natural ingredient of inquiry-based learning, but rather as something that is additive to inquiry and that she could therefore concentrate on later when she masters teaching inquiry and the anticipated reluctance of parents. As a whole, she especially considered the benefit that formative assessment can bring to her teaching, paid less attention to the perspective of student learning and dealt in greater extent with classroom external factors (support for teacher, attitude of parents).

Teacher F

This fifth-grade teacher also had no previous experience with formative assessment, practised teaching for 15 years and, as Teacher A, taught the topic 'big numbers'.

Teacher F saw formative assessment as a tool which should help students not only in learning to assess (self and the peers) but also in mastering the curriculum. The goals of formative assessment in inquiry education which she foresaw before the trials were that the students would learn about peer assessment and how it should meaningfully be provided for the recipient and what components of peer assessment are necessary for the recipient to get enough hints to see how to proceed. She thought that the teachers' role is the most important in the implementation of formative assessment, and thus it is important that the teacher has enough knowledge about formative assessment and is willing to use it. The teacher has to communicate to students what is necessary for good formative assessment, to make clear to students the principles of solution or criteria for assessment. Some teacher training therefore should precede the implementation of formative assessment in IBE, and also assistence in classes would be helpful, as the implementation is time demanding and not all teachers have a proper readiness. She did not see any problem in persuading the parents that this way of work would be productive; neither did the

large number of students in the classroom seem to be a problem for her. On the other hand, she believed that formative assessment is more fruitful than summative assessment and understood that formative assessment cannot replace summative assessment.

During the trials, she appreciated cooperation with the researchers, possibilities to consult about the tasks and the process of teaching and peer assessment. She reflected on her role, which she found even more important and difficult than she foresaw, and on the difficulties students had with providing peer assessment. She appreciated that the trials helped her students find out how to work during inquiry and to recognize that assessing others' work is not an easy task and that they need to 'know' (criteria of assessment and solution of the task) before being able to assess. She thought that some children prefer the feedback from peers to her feedback, especially because they can express their thoughts in similar language. Written peer assessment still seems too difficult; the students were able to be more precise and detailed when using oral assessment. It would be good to start with simpler tasks and with some task for training, e.g. working on a series of similar tasks and only at the end ask the students for peer assessment. She also mentioned that the students would prefer to have an opportunity to see and discuss more solutions before assessing. She experienced that time was a large issue as she realized that students may need more time to think over assessment; she maybe gave too much feedback herself and that some of it the students probably would communicate on their own when having enough time.

Overall, Teacher F dealt much more with the process of formative assessment, its relation to learning and summative assessment. She was concerned with her own role in teaching students to formatively assess their peers. She acknowledged the role of students' language and problems that the students may have in writing formative assessment with enough precision. She also considered the time issue, not only from the organization of peer-assessment perspective but also from the cognitive one (time to think). As a whole, she was concerned about classroom internal factors that affect the implementation of formative peer feedback.

Czech Teachers' Concerns

To analyse the results of the entire group of teachers, Czech researchers searched for thematic code with higher occurrence. Attention was paid especially to those codes which mostly diminished after the teachers accomplished the teaching units with formative assessment in their classes, to codes that newly emerged and to codes that were more frequently mentioned (including during the post-lesson interviews).

The concerns that emerged in interviews before the implementation of formative assessment but were much less mentioned in the interviews after the experimental teaching were:

- The relation of formative assessment to summative assessment (mostly feelings that formative assessment is needed and necessary, but summative assessment is seen as preferred, inevitable and expected by administration and parents). It seemed that teachers got this point during their experimental teaching.
- The role of parents and the relationship of parents (feelings that parents expect marks and see peer assessment rather as an entertaining or distractive activity than an essential part of learning). This stayed important for Teacher A; other teachers turned their attention to other issues after the experimental teaching.

The newly emerged concerns or issues which were more intense after gaining the experience of formative assessment implementation were:

- Time demands (the combination of inquiry task and peer assessment seemed to be highly demanding with respect to time and allocation of students' attention; teachers recognized the importance of appropriate complexity of the task)
- Importance of peer assessment for students' learning (both in terms of deepened understanding of assessors and peer-language explanation for assesses)
- The difficulties that students had and possibilities to overcome them

How Czech Teachers' Perspectives on Formative Assessment Developed Over Time

The Struktur Lege Technik helped to delineate the key issues that the teachers considered about formative assessment before and after the trials. It revealed their worries about their own capability to facilitate student peer assessment and expectations of prospective positive outcomes and showed how they perceive formative assessment in the structure of their teaching goals. Teachers gained experience with the method of peer assessment, and they evaluated its benefits and limits. They would recommend developing simpler tasks of shorter duration and simpler and more structured tools for providing peer feedback. The research also revealed that it is very important to develop more deeply an understanding of teaching goals, and especially the role of formative assessment within them. The results indicate that teachers need time to develop a deeper understanding of the role of formative peer assessment in inquiry-based instructions and that there are big differences in the ways in which they conceptualize formative assessment. The subjective theory of formative assessment exploration is a good tool both for investigations of teachers' perspectives on the implementation of formative assessment and for teachers' preparation for facilitating student practices.

Third Perspective: Teacher's Experiences About Using an Internet-Based Application to Facilitate Formative Assessment

Another perspective of teacher's experiences with formative assessment in the context of IBE was made possible through an inquiry platform which was developed to support four assessment methods (peer-to-peer, teachers' written, on-the-fly and structured assessment dialogue). The platform was designed to scaffold a version of inquiry-based education (IBE) with support for formative assessment. It was more appropriately purposed to support formative assessment through grading/feedback and peer assessment rather than on-the-fly and structured dialogue. Key features were aligned with Marshall et al. (2009) 4E x 2 model of inquiry-based instruction (see Figs. 9.2 and 9.3):

- Idea creation and sharing between peers and between student, teacher, and experts
- Formation of inquiry approaches—either structured or open ended
- Mechanisms (e.g. messages, chat boxes, mind maps) to capture ideas and/or metacognitive processes of individual students or groups
- Mechanisms (e.g. audio, video, photographs, spreadsheets, graphs) to allow students/groups to collect a wide range of evidence (data) types
- Mechanisms to allow the organization, manipulation and analysis of different forms of evidence (data)
- Mechanisms to reflect on the reliability and validity of evidence (data)
- An environment to capture the developmental stages of student metacognition
- Mechanisms for students to track their confidence ratings on their inquiry skills over time
- Messaging, chat, discussion, help and feedback forums that could be used in peer or teacher/learner interactions or cached and explored for research purposes
- The facility to engage in discussion and participation of any inquiry or formative approach in- or outside of a formal classroom situation
- The potential for formative and or summative assessment
- A light web-based design, avoiding downloading and capacity issues for laptops or mobile devices

How the Platform Could Support the 4E × 2 Model of Inquiry-Based Instruction

Rather than offering many of the closed inquiry affordances, such as Operation Aries (Koenig et al. 2010) or SimScientists, (Pellegrino and Quellmalz 2010), the platform was developed to be as adaptable as possible depending on the experience, expertise and interests of the end users (teachers and students). It allowed teachers

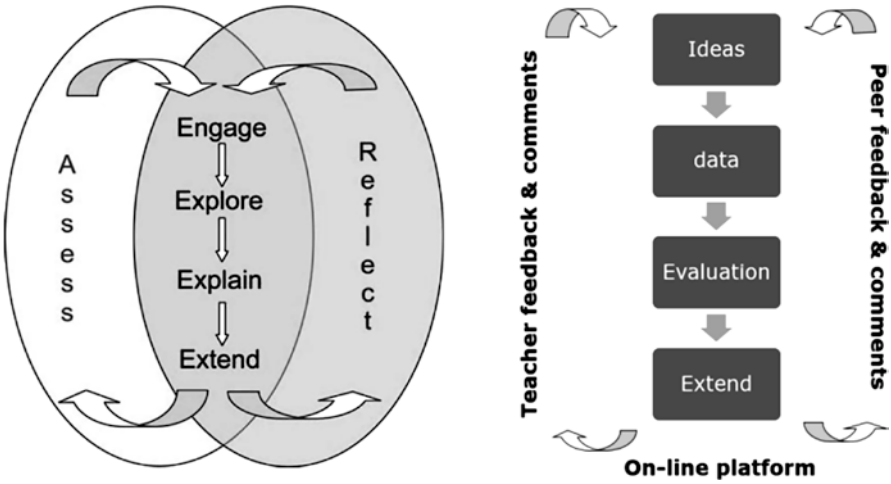

Fig. 9.2 A comparison of elements of IBE (Marshall et al. 2009) with the online platform

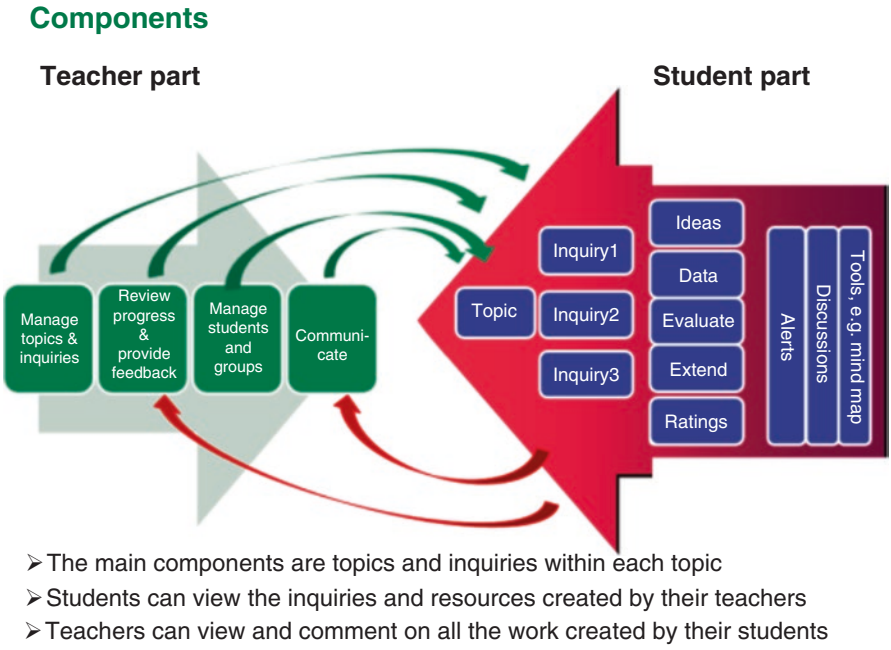

Fig. 9.3 Screenshot of the features of the online platform

to select very open-ended screens (and inquiry topics) for particular classes, more structured screens (and topics) for others and the facility to customize the language and approach of any given area of inquiry. The platform could be used to build up particular inquiry skills or metacognitive approaches and then build up to more holistic end-to-end inquiries. It is important to note that although the platform could allow students' freedom and creativity for inquiry, the teacher remained in control of the learning environment and the areas of inquiry they wanted students to explore. Students could work on individual projects or be assigned to groups. They could also be working on a few separate inquiries at the same time—everything being collected in a named inquiry area.

From the teachers' points of view, Fig. 9.4 summarizes the pedagogical and operational features of the platform.

From the students' points of view, Fig. 9.5 summarizes the features that are built into the platform for students' use and illustrates formative benefits of the platform.

It was possible for the platform to be used only for the development of ideas and the collection and collation of various forms of evidence (data) in order to establish an initial area for inquiry. Therefore, inquiry work did not have to work in a structured linear path; the teacher could choose to direct the path. It was also offered in an adapted primary and secondary school design and language. These adaptations also included appropriately simple or complex user mechanisms.

Everything that the student or groups did on the platform could be evidenced and shared with other students, teachers and researchers. All available evidence could be downloaded, explored or presented to others. The intention was for the platform to be as flexible as possible to support the creative ways in which inquiry-based and formative assessment methods could be utilized by teachers and students. This also included the possibility that the platform could be used alongside any non-technological approach and therefore could be considered an enabling or blended learning tool to support varied ways of implementing the assessment methods.

Affordances and Challenges of Using the Platform

The affordances that the platform provided were designed to be as adaptable and flexible as possible in terms of providing an array of conversational, planning, data, video capturing and analytical mechanisms and tools to explore IBE and provide for formative assessment. The online environment provided students and teachers with an integrated environment to facilitate the creation of ideas, plan, execute and evaluate investigations but also collaborate and share their work through peer and teacher assessment.

The development of the platform was not primarily focused on the collection of inquiry-based evidence for the purposes of summative assessment. Rather, it was designed to support the progression of formative e-assessment in broader assess-

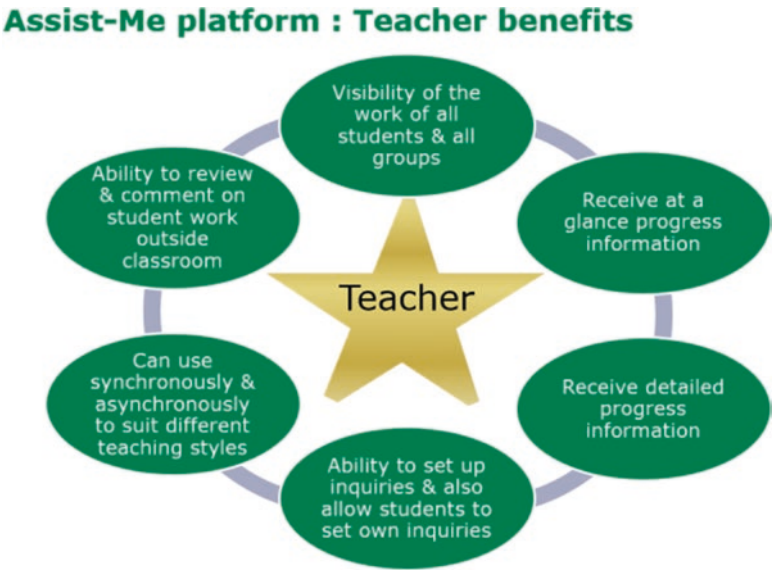

Fig. 9.4 Teacher features of the platform

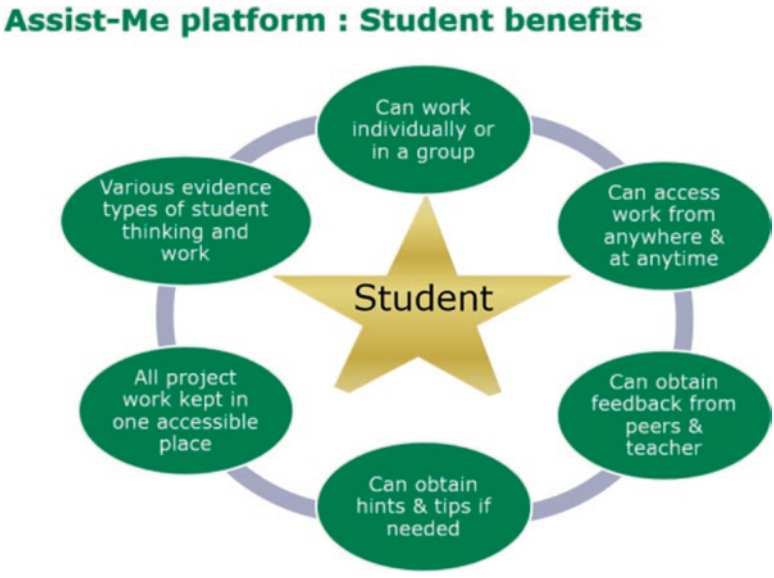

Fig. 9.5 Student features of the platform

ment contexts and in particular personalizing the use of such technology to drive opportunities for assessment for learning (Ripley 2006). Integrating technology of this type into teaching and learning and making use of the mechanisms available in the platform enabled, for example, the creation of online e-portfolios that can support both formative and self-regulated learning activities (Crisp 2007; Coombs 2010). In addition, the inclusion of dialogue and conversations provides rich evidence of reflective thinking and can capture qualitative evidence as part of self-assessment learning tasks, an agenda promoted by Futurelab (2007).

The platform was trialled over a number of phases, with small amendments made between phases based on requests and feedback by the participating countries. Teacher groups were provided with face-to-face and online training sessions in order to familiarize themselves with the platform and the ways in which it could be used alongside traditional methods to support inquiry and formative assessment methods. Some partner groups were happy to explore and experiment using the platform, some groups lacked either technological or assessment knowledge to effectively engage with the platform and there were some groups who were philosophically opposed to using technology for formative purposes. One clear outcome from the research was that as much as teachers requested sophisticated tools and mechanisms built into the platform from the start, it became clear as the research phases progressed that they much preferred simpler interfaces to gain confidence and platform usage by teachers and students.

In general terms, the platform had mixed levels of interest and usage. These results reflected the difficulties and challenges that teachers had in implementing formative approaches in IBE. Many of the teachers reported low levels of efficacy in terms of implementing traditional forms of formative assessment. This was clearly compounded when an online environment was also made available to them and their students. Many of the features of the online platform, particularly the inclusion of messaging, chat and uploading of differing file types (photo, video, aural), have similarities to those found in social media and ‘apps’. While most students are now familiar and confident working with these forms of technology, it might be assumed that some of their teachers are less comfortable with them. The challenge of familiarizing themselves with sophisticated new technologies, setting up and managing groups while also facilitating formative assessment strategies, proved to be a step too far for most of the countries and teacher groups. There was evidence of trialling the platform, however little of concerted classroom use.

The findings for the use of traditional forms of IBE indicated that there is a concerted need for support and professional development to implement formative assessment into classroom practice. The same issue applies when countries work towards integrating technology into the curriculum and pedagogies. Provision of equipment, software and guidance, however, easy to use, will itself not be enough for most teachers to make use of the affordances that technology can offer. Whether technology takes the form of an integrated platform such as the one developed or just makes use of available mobile technology found in devices such as mobile phones, tablets and their applications, the gap between the resources that could be

used and what are currently being used needs to be closed in order to enhance formative assessment opportunities and encourage deep learning.

Summary Perspective

Together, these teacher perspectives reveal participant teacher experiences that result in some increase in beliefs in their abilities to use formative assessment in their teaching as well as clear concerns about the challenges to be expected. Although the lack of clear generalizable trends across cultures may be due to the multiple relevant variables within education in diverse settings, the growth in useful knowledge and confidence in using formative assessment methods among teachers points to realistic perspectives for further work at national levels. The promise of an Internet-based platform to facilitate inquiry teaching and learning as well as formative assessment remains an attractive potential that was not fully tested in this project's classrooms. Possibilities for the introduction and even institutionalization of formative assessment methods into science inquiry classrooms are informed by these teacher perspectives.

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