

FORMATIVE ASSESSMENT IN INQUIRY BASED ELEMENTARY MATHEMATICS

Alena Hošpesová

Faculty of Education

University of South Bohemia in České Budějovice



Pedagogická
fakulta
Faculty
of Education

Jihočeská univerzita
v Českých Budějovicích
University of South Bohemia
in České Budějovice



ASSISTME



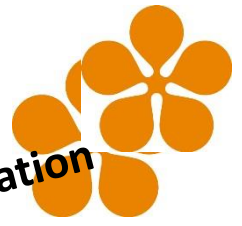
SEVENTH FRAMEWORK
PROGRAMME



Project ASSIST-ME



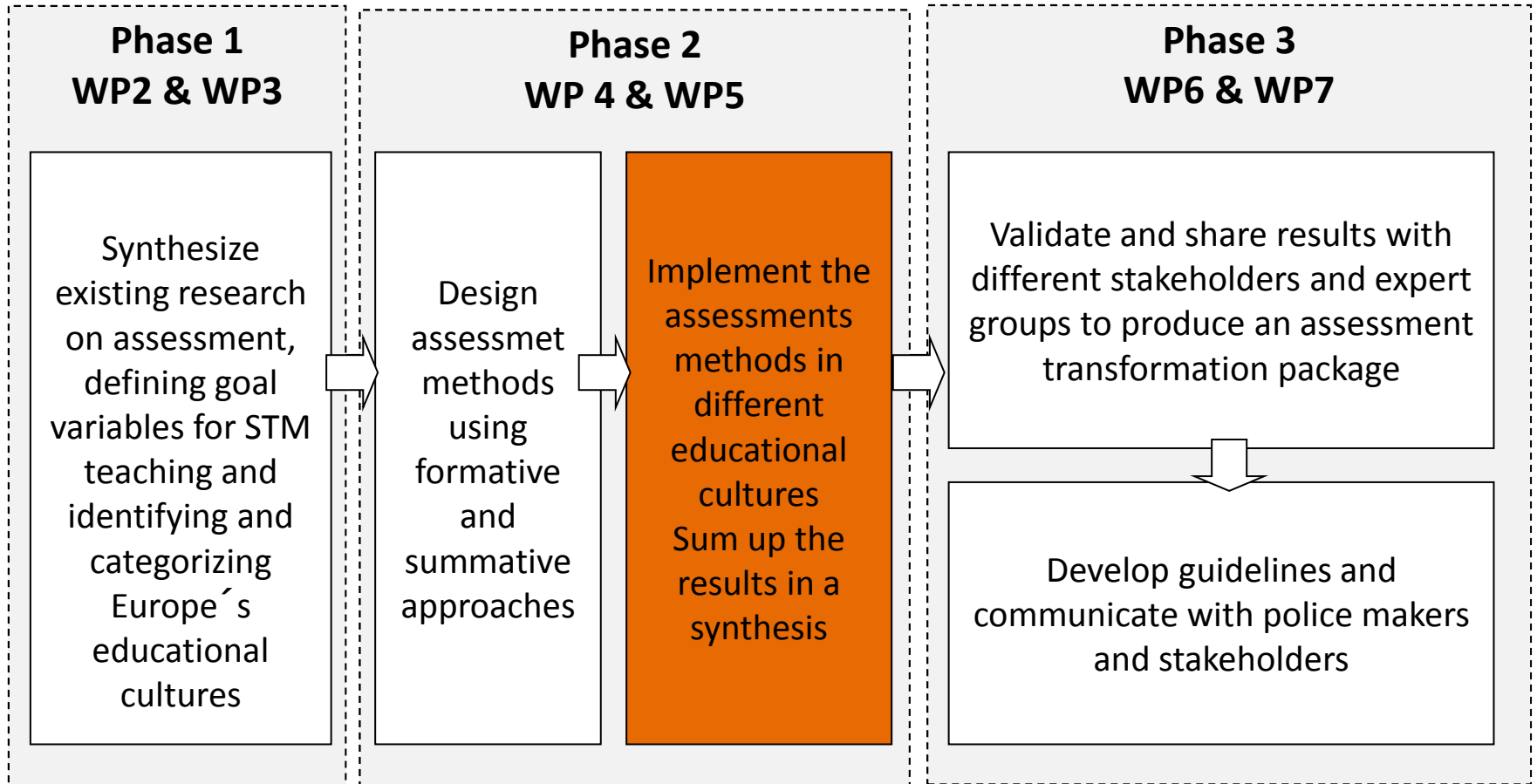
- The international project ASSIST-ME (Assess Inquiry in Science, Technology and Mathematics Education)
- Participants: eight European countries (the Czech Republic, Denmark, Finland, France, Cyprus, Germany, Switzerland and the United Kingdom)
- Objective of research is to develop formative assessment methods that
 1. fit into everyday classroom practice,
 2. provide qualitatively oriented descriptions and monitoring of competence-oriented, inquiry-based learning processes,
 3. can be combined with existing summative assessment requirements and methods used in different educational systems.



Establishing of foundation

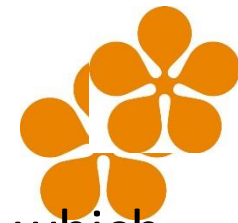
Finding results

Influencing and dissemination





Specific focus of our research team



Inquiry based mathematics education (IBME) “... education which does not present mathematics to pupils and students as a ready-built structure to appropriate. Rather it offers them the opportunity to experience how mathematical knowledge is developed through personal and collective attempts at answering questions emerging in a diversity of fields, from observation of nature as well as the mathematics field itself, ...” (Artique, Baptist, Dillon, Harlen and Léna 2011, p. 10)

Problem solving competence

„A task, or goal-directed activity, becomes a **problem** (or problematic) when the “problem solver” ... needs to develop a more productive way of thinking about the given situation.” (Lesh and Zawojewski 2007, p. 782)

Formative assessment

- Self-assessment
- Peer-assessment

Aim of the study



- Questions:

What information teachers and pupils get from formative self- and peer-assessment?

How pupils on primary school level are able to formulate their assessment suggestions for their classmates, understand and accept them?

The case study - organization



- From October to December 2014
- Two teachers teaching in the 5th grade (children aged 10 – 11)
 - 8 experimental teaching/learning units
 - the teachers were including IBME where possible
 - To provide space for using methods of formative assessment.
- Topic
 - traditionally taught in this grade of primary school → “great numbers”
- Lesson planning - done in cooperation of all members of the local working group in České Budějovice (the authors of this paper and 3 teachers)



- video recordings of the lessons
- audio recordings of group work if it took place
- all pupils' written production was collected
- Worksheets
 - Description of the solving procedure
 - The pupils swapped the worksheets and provided each other with a written feedback on the solving strategies.
 - Having got comments from peers, each pupil (or a group of pupils) had the chance to revise the original solution with respect to the feedback s/he received. In addition, each student also briefly responded in writing to the feedback s/he received.
- Written solutions and comments
 - transcribed
 - open coding

Preliminary findings



What did the pupils focus on in peer assessment?

- influenced by questions formulated in the worksheet
 - 2nd and 3rd stages of the solution (quality of the problem solving plan, comprehensibility, clarity of the calculation)
- „in the light“ of their own solving procedure
- In the initial stages – general comments: “We liked/I did not like”
- Later – the comment grew more accurate
- Pupils rarely assessed correctness of the result.



Preliminary findings



Problem: How many lentil grains are there are in a 500 g packaging?

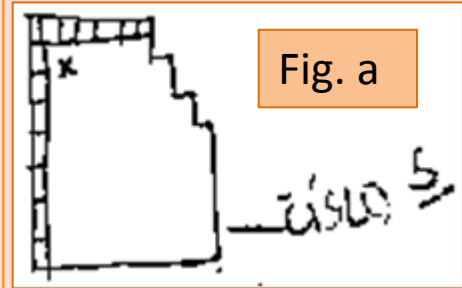

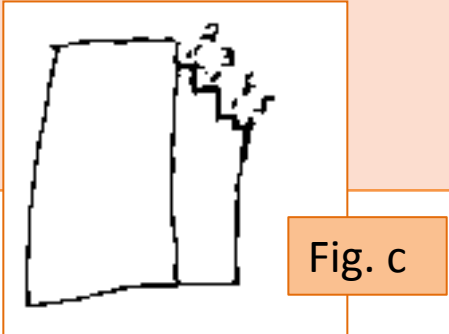
- Initial difficulties in description of the solving procedure
- As the children gradually got more experienced in recording the problems (in the course of sequence of lessons), their comments grew more accurate.

Solvers	Evaluators
First we found out that 5 g contain 80 grains. $500 : 5 = 100$, $100 \cdot 80 = 8\ 000$ There should be 8 000 lentil grains in the packaging.	☺ We like that they have the same principle as we had. ☹ But weighing should be accurate.
We poured the grains into a large vessel and weighed it. We subtracted the mass of the vessel from the mass of the grains. We found out that the only grains weighed 501 g. Then we found out that 20 grains weigh 1 g. Calculation: $501 \cdot 20 = 10\ 020$	☺ The procedure was correct. ☹ But our result was different.

Preliminary findings

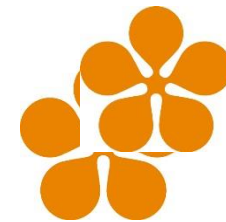


Problem: Record for your friends the manual how to determine the number of small squares on a square grid.

Solvers	Evaluators
<p>Multiple the top row by the vertical row (from the top to the bottom) and write the result next to the drawing (Fig. a)</p> <p>You determined this part (Fig. b)</p> <p>Now determine the staircase using the same procedure (Fig. c)</p> <p>Calculate 2 – 5 stairs</p> <p>$2s = 224$, $3s = 371$, $4s = 336$, $5s = 258$</p> <p>Now let us add the gained numbers of stairs.</p> <p>Add this result to number s. That is the final result. The result is 1573.</p>	<p>Their solution is correct. We are not quite sure what “number s” stands for. We think that the calculated number is correct. The description is good. May be everybody would understand.</p> <div data-bbox="969 778 1433 1063">  <p>Fig. a</p> </div> <div data-bbox="1464 842 1835 1356">  <p>Fig. b</p> </div> <div data-bbox="1008 1078 1458 1409">  <p>Fig. c</p> </div>



Preliminary findings



- ^{ASSISTME} Reactions on assessment – “Did your friends’ advice help you?”
 - “☹️ It did not because if they write that the measuring should be accurate, I don’t know how exactly”.
 - “No. Those who were checking our work must have lost their lentils.”
 - “☹️ Saying the result was different is of no help.”
- As the children grew more experience with peer assessment, they grew more self-critical:
 - “We think it should be briefer and we did not finish the manual because we had forgotten.” “We think it’s all quite muddled.” “We could do it better to make it comprehensible. But otherwise we think it’s OK.”

Positive influence on the pupils’ reasoning.



Concluding remarks



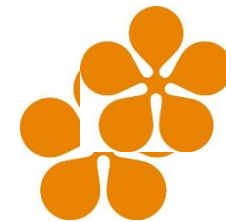
Implementation of IBME - impact on the culture of education
Using formative assessment contributes to a change of the culture into culture dialogical, sharing, accepting all (even erroneous) ideas.

Peer-assessment

- possible method of assessment, more typical and rooted on Czech primary school level is “on the fly” assessment
- dependent on social climate in the classroom
- Influence of pupils’ experience in it
- the criteria for assessment
 - first formulated by the teacher according to educational objectives
 - if the criteria are formulated on a very general level, the pupils will discover some criteria on their own



Concluding remarks



Our research of formative assessment in IBME will continue – two rounds of testing are planned for 2015 (geometry, pre-algebraic thinking).

- deeper a priori analysis and more accurate formulation of the goal of the teaching/learning experiments and of the problems solved by the pupils
- development of more detailed criteria of assessment.

"On-the-fly formative assessment arises when a "teachable moment" unexpectedly occurs, for example, when a teacher circulating and listening to the conversation among students in small groups overhears a students say ... (Shavelson et al., 2008, p.300).



ASSISTME



Thank you for your attention.



Alena Hošpesová, Iva Žlábková

Faculty of Education

University of South Bohemia in České Budějovice