



## Collective reflection – a way of improving teachers' competence

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### *Introduction*

The demands of the society on the results of education have been growing lately. In connection with it also grow the demands on the professional preparation of teachers. The teacher's role is changing. The teacher should be able to support the development of all potentialities of his/her students; he/she should become a creator of an inspiring climate and a bearer of challenges for students to discover new knowledge, to understand the importance, meaning and sense of mathematics and to develop a positive attitude towards mathematics. He/she should be able to react to his/her students' statements in concrete situations (to their questions, unexpected solutions, etc.) and use them for the improvement of education. In this context, demands arise to improve and cultivate (a) teachers' beliefs about the basis, meaning and goals of the teaching of mathematics and (b) the quality and level of teachers' professional competence (Climent & Carillo, 2001; Scherer & Steinbring, 2003; Hospesova & Ticha, 2003).

### *Teacher's competence - specification of the notion*

We understand teachers' professional competence as a complex qualification, skills and dispositions for a successful performance of the profession, which (a) includes knowledge, skills, attitudes, experience, values and personal characteristics and (b) is based on a theoretical reflection of practical experience.

In similar sense, many authors speak about "knowledge" (Bromme, 1994; Harel & Kien, 2004; etc.).<sup>1</sup> An often-cited reference is L. S. Shulman (1986) and his considerations about "*knowledge base for teaching profession*" and "*teachers' content knowledge*". According to Shulman, a teacher's knowledge of the content includes "*subject matter content knowledge*", "*pedagogical content knowledge*", and "*curriculum knowledge*". He emphasises that "*pedagogical content knowledge*" is characteristic for the teaching profession because it covers subject-specific content and the didactical approaches to it. Moreover, J. Ainley and M. Luntley stress the need of "attention-based knowledge" of teachers, which means "knowledge that enables ...[teachers] ... to respond effectively to what happens during lessons" (Ainley & Luntley, 2005). In our opinion, it means capability of teacher when his/her subject and pedagogical knowledge on the one hand and attention-based knowledge on the other condition each other. We consider attention-based knowledge a part of "pedagogical competence" (according to Helus' classification of teachers' competence used in Hospesova & Ticha.,, 2003).

### *Competence and reflection*

We believe that one of the attributes of the professionalism of teachers is a competence for a qualified pedagogical reflection (Bruner, 1996; Krainer, 1996; Climent & Carrillo, 2001;

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<sup>1</sup> We use the word „competence“ because in our opinion it is broader than the term „knowledge“. Among others, it stresses the ability to act, dynamic perspective, conative dimension.



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Jaworski, 2003; Helus in Hospesova & Ticha, 2003). Some authors stress a necessity to systematically carry out and develop not only self-reflection but collective reflection (P. Cobb (1997): “To emphasize this indirect link between the individual and collective aspects of mathematical development, we distinguish between the psychological process of reflective abstraction and the communal activity of collective reflection that occurs as children participate in reflective discourse.”), too. For instance, P. Scherer and H. Steinbring (2003) emphasise that a mathematics teacher’s work is so demanding that it is necessary to come to “a qualified conception of collective reflection of everyday teaching activities“. We share this opinion, too.

A systematic reflection of one’s own actions, decision processes and pedagogical situations is a key element in the professional development of both student teachers and practising teachers. Such a reflection creates a space for the transition from the intuitive to conscious and well-grounded behaviour. Thus, various techniques should be available which enable teachers to lead a deep inner dialogue (Scherer & Steinbring, 2003). Reflection is an important aspect of action research whose main actors are practising teachers (Jaworski, 2003).

### ***Project Socrates - Comenius***

We started to deal with reflections within an international project Socrates – Comenius “Understanding of mathematics classroom culture in different countries“ (Hospesova & Ticha, 2003). Its goal was finding how to improve a life-long education of elementary teachers and to develop their competence. Gradually we concentrated on following areas: (a) the cultivation of the teachers’ teaching via reflection, (b) the formation of teachers’ more sensitive approaches towards students’ ways of thinking and (c) becoming aware of moments valuable from the point of view of students’ cognition, develop a sense of such moments and capability to use them.

### ***Research question***

In our research, we focused mainly on how a systematic qualified pedagogical self-reflection, individual reflection and collective reflection can influence the improvement of subject-didactic and pedagogical competence of teachers and how they contribute to the improvement of teaching.

### ***The method of work within the frame of the project***

Within the Comenius project, several teaching experiments for 6-11 year old pupils were prepared and realised in co-operation with elementary teachers who were members of the team. The teachers thus became teacher-researchers carrying out action research. The choice of the topic was always made in cooperation with the teacher who carried out the experiment, based on her practical work in the classroom.

The teaching experiments were video recorded and the recordings were available for all members of the team as subject of individual reflection. The focus of the individual reflection was the teacher’s decision. The individual reflection was followed by the collective one. During the whole team meeting, the video recording (or its didactically interesting parts chosen by the teachers) was analysed part by part. This procedure enabled us to follow the development of both the competence of the teachers (pedagogical and/or subject-didactic), and the level of their reflections, too.

### ***Results of work within the frame of the project***

In the contribution will be presented in more detail concrete samples of:

#### ***Changes and professional growth of the teachers***



The reflection was used as a means of the development of teachers' competence. We have identified change in the attitude of the participating teachers to the work within the project and to the assessment of their own competence. It can be described by several stages:

- Feeling of self-confidence as for the content and methods of the teaching of mathematics at the beginning of work.
- Uncertainty of and doubt about one's professional competence after several discussions in the team often given by one's inability to react appropriately to the unexpected (a) reactions of students when solving problems in the experiment, (b) reactions of other members of the team during the collective reflection.
- Effort and willingness to change ones' work and deepen knowledge both of mathematical content and its didactic elaboration and to better understand students' concept development processes.

The level of reflections developed in several mutually connected levels of growing quality:

- A simple dialogue aimed at intuitively understood observations such as "I (do not) like it." in which teachers speak about their feelings.
- An effort to apply a deeper view and look for effective methodological procedures for a certain teaching content which aims at the improvement of teaching.
- A deep appraisal of teaching from the point of view of goals, content and methods, which leads to the construction and realisation of own teaching experiments and formulation of open questions. (Hospesova & Ticha, 2003).

When suggesting experiments, posing problems and mainly when watching the video recordings, the teachers realised that it was important to know both the mathematical content and possibilities of its didactic elaboration.

During the discussions, the teachers' view of the meaning of collective reflections changed, their understanding and appreciation of the meaning of video recordings developed, the role of reflection started to be understood as a means of becoming aware of and evaluating one's own professional (mainly subject-didactic) competence and of the professional growth.

#### ***Teaching experiment suggested by the teacher***

One of the indicators showing the growth of teacher's competence is, in our opinion, their ability to suggest experiments.

At the beginning of our work on the project we chose the part-whole relationship as a pivot topic, which penetrates all grades of the elementary school. The preparation of the experiments on the area of the development of the pre-concept of fraction, the realisation of the teaching and collective reflection enabled the researchers to influence the teachers in an unobtrusive way. It was possible to lead them towards a deeper understanding of fractions, to being aware of different approaches and representations and their important role in the development of the concept of fraction. The development of the students' images of fractions and their diagnosis was discussed during several whole team and group meetings. We believe that in this way, we managed to markedly develop subject-didactic competence of teachers in this area. Its evidence are, among others, experiments concerning the topic "fraction" which were suggested and carried out by the teachers themselves. In the presentation we plan to present concrete samples of these experiments.

#### ***Open questions for further work formulated by the teacher***

Another of the indicators showing the growth of teacher's competence is, in our opinion, ability to pose open questions which emerged in frame of the work on the project. Samples of such questions:



- Under what circumstances a teacher is open to the incentives from discussions. What competence and personal characteristics does he/she have to possess?
- How to motivate teachers to feel the need to work on themselves? Is it possible to convince at least some of them to try what we have done within the project?
- Do there exist good conditions for collective reflections? How to create such conditions? Or was it only an interesting experiment, which will end together with the end of the project?
- How to enable all teachers who are interested to cooperate among themselves or with a teacher-educator from the university? Are there enough teacher-educators and researchers who are able and willing to lead teachers and have conditions for doing so?

### **Closing remarks**

Some teachers regardless of age find it difficult to take part in the discussion and express their opinion. They might need more time to think the situation over. Their low self-confidence (self-evaluation of their competence) has a negative effect, too. They often try to support their opinion by an authority. They ask: “So what is the correct way?” This question reflects their view that there is the “correct” way. They expect a manual of “how to teach correctly”.

One of the reasons of video-recording of teaching episodes was to enable the teachers who realised the experiment to see the teaching from “the outside”, to get “critical distance” (Scherer & Steinbring, 2003). Nevertheless, the teachers usually remained closely connected to their students, it is very difficult for them to change into the role of an observer and some of them failed to do so.

One teacher wrote “When watching the video, it is not easy to separate the outer and inner view of my activity during the lesson. I think that it is impossible to see oneself as another person.” But on the other hand she added: “Thanks to the opportunity to video record my lessons and thanks to the follow-up reflections, I learned to predict possible problems in a much better way and to readily react to unexpected problems in my everyday practice, to leave children enough time to think and order their thoughts. I think that if ways were found for more teachers to acquire this experience, it could be one of the ways to improve the quality of teaching.”

Our experience shows that the co-operation with colleagues leads to the improvement of subject didactic and pedagogical competences of the teacher. Teachers have an opportunity to become aware of deficiencies in their mathematical knowledge and in their teaching and to remove them on the basis of incentives from the collective reflection.

### **References**

- Ainley, J. & Luntley, M. (2005). What teachers know: the knowledge bases of classroom practice. In *Proceedings of CERME 4*, Sant Feliu de Guíxols, Spain. <http://cerme4.crm.es/>.
- Bromme, R. (1994). Beyond subject matter: a psychological topology of teachers' professional knowledge. In R. Biehler et al. (eds.), *Didactics of Mathematics as a Scientific Discipline*, Kluwer Academic Publishers, Dordrecht, Boston, London, 73-88.
- Bruner, J. (1996). *The culture of education*. Cambridge: Harvard University Press.
- Climent, N. & Carrillo, J. (2001). Developing and Researching Professional Knowledge with Primary Teachers. In: J. Novotná (ed.) *Proceedings of CERME 2*, Praha: UK PedF, 269-280.
- Cobb, P., Boufi, A., McClain, K. & Whitenack, J. (1997). Reflective discourse and collective reflection. *Journal for Research in Mathematics Education*, v. 28, 3, 258-277.
- Harel, G. & Kien, L.H. (2004). Mathematics teachers' knowledge base: preliminary results. In: *Proceedings of the 28<sup>th</sup> Conference of the International Group for the Psychology of Mathematics Education*, v.3, 25-32.



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- Hospesova, A. & Ticha, M. (2003). Self reflection and improvement of mathematics classroom culture. In Mariotti, M.A. (ed.) *Proceedings of CERME 3* [CD-ROM]. Universita di Pisa, 2004.
- Jaworski, B. (2003). Research practice into/influencing mathematics teaching and learning development: Towards a theoretical framework based on co-learning partnerships. *Educational studies in mathematics*, v. 54, 2-3, 249-282.
- Krainer, K. (1996). Some considerations on problems and perspectives of in service mathematics teacher education. In: C. Alsina et al. (eds.) *8<sup>th</sup> International congress on Mathematics Education: Selected Lectures*. Sevilla: SAEM Thales, 303 – 321.
- Scherer, P. & Steinbring, H. (2003). The professionalisation of mathematics teachers' knowledge – teachers commonly reflect feedbacks to their own instruction activity. In Mariotti, M.A. (ed.) *Proceedings of CERME 3* [CD-ROM]. Universita di Pisa, 2004.
- Shulman, L.S. (1986). Those who understand: knowledge growth in teaching, *Educational Researcher*, v. 15, 4-14.

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