

Mathematical trails supporting the collaboration among teachers and didacticians

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Mathematical trail

While solving mathematical tasks in outdoor conditions, students can see a direct connection between mathematics and the real world in natural environment (Barlovits and Ludwig, 2020). Mathematical trail is an outdoor activity when students collaboratively solve mathematical problems directly related to real objects with the support of technology, mobile devices with the MathCityMap (MCM) application (Haringová and Medová, 2022). However, the preparation of the MCM trail is time-consuming and it is not possible to transfer designed tasks out of the place they were developed. When preparing the MCM trails teachers need the support in posing suitable tasks, formulating scaffolding in form of hints and using the application. Including several teachers from the same school in design of the MCM trail broadens the future exploitation of developed MCM trails.

Adapted lesson study

Through indirect changes in teachers' knowledge and beliefs, routines and professional standards as well as in teaching materials, lesson study can affect the teaching and learning of participating teachers (Wake et al., 2016). Collaborative design of lessons focused of mathematical problem-solving is considered as a promising approach of professional development of in-service mathematics. We adapted the lesson study approach (Lewis et al., 2019) and adjusted it to the needs of the collaborative design of MCM trail instead of focusing of special mathematical content. We kept the four phases: (1) study, (2) planning, (3) teaching, and (4) reflection repeating cyclically and cyclical nature of lesson study.

In the study phase of the adapted lesson study teachers do not study by themselves but experience the mathematical trail prepared by the didacticians from the position of the student. Later, the didacticians introduce the MathCityMap for designing the mathematical trails. The second phase, planning, is divided into two steps. First, teachers create the problems for the trail individually. This allows and force all the participating teachers to contribute to the common goal, the MCM trail. After that, teachers obtain feedback from their colleagues and from the didacticians and the mathematical trail is composed. In the implementation phase the teachers supervise the students during the MCM trail. They observe students' approaches for solving the problems, mistakes and misconceptions as well as the collaboration within the students' groups. In contrast to traditional lesson study, all the participating teachers teach and observe the lesson in the same time. The last phase comprises reflection where the teachers and the didacticians share their experience with implementation of the designed mathematical trail. Didacticians try to support teachers in formulation of their findings.

Methodology

In order to find the answer to the research question “Where and how does the collaboration occur during the implementation of the adapted lesson study focused on MCM trails?”, fifteen mathematics teachers from schools in three different cities in Slovakia and two didacticians (authors) are involved in the research. More than 200 students from 12 classes (grades 3 to 9) were solving designed MCM trails. At the beginning, the participating teachers completed an introductory interview. In collaboration with mathematics teachers, two cycles of adapted lesson study were carried out. Each phase of the cycle was audiorecorded, partially transcribed and analysed. Deductive coding was used for the transcriptions. Situations where the collaboration occurred were identified and the level when it had occurred was determined.

Results

Based on the observation of individual phases we identified three levels of collaboration: collaboration among students, among teachers and between didacticians. Students work together to solve problems during mathematical trail, teachers when designing the problems to be included in the mathematical trail, and didacticians collaborate in the preparation of professional development meetings focused on mathematical trails. We observed the shared work also cross the levels, didacticians cooperate and collaborate with teachers during the entire adapted lesson study cycle. Teachers supervise their students and offer scaffolding during the implementation of the mathematical trail.

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