High school teacher training challenges in the Italian interdisciplinary project *Liceo Matematico*

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The project *Liceo Matematico* and the issue of teacher training

In this work, we deal with a challenging research question: what teacher training activities are effective to train mathematics high school teachers to teach properly interdisciplinary modules involving Mathematics? The context of the research is an Italian national project for high schools, named *Liceo Matematico* (Capone *et al.*, 2016), that aims at turning Mathematics, hard subject to learn, into a tool to connect disciplines and deal with current social challenges. To make this possible, it is necessary first to deepen into the epistemology of disciplines and to look for fruitful connections between them, then to design suitable modules for high school students. Operationally, the project consists in additional activities for high school students (40 hours per year), carried out by voluntary mathematics high school teachers, trained by university teachers. University teachers identify topics, epistemological issues and interdisciplinary connections (Frodeman, Thompson Klein and Mitcham, 2010) relevant in order to pursue the general goal of the project, and then propose possible classroom activities. Each module is proposed in 2 steps: in the first the contents are presented with a frontal lesson, while in the second step the didactical activities are before proposed to the teachers and then discussed with them in terms of potential students' difficulties and connections with the curriculum. After the course, the high school teachers have to choose some modules and adapt them for their students, consistently with the school institutional constraints and goals. We focus our attention on the teachers' choices and adaptations of the modules proposed in the training course.

Research framework: Mathematics Teachers Specialized Knowledge

To describe the aspects of teachers' knowledge considered in the training course, we chose to use the Mathematics Teacher's Specialized Knowledge (MTSK) model elaborated by Carrillo-Yañez, Climent, Montes, Contreras, Flores-Medrano, Escudero-Ávila, Vasco, Rojas, Flores, Aguilar-González, Ribeiro and Muñoz-Catalán (2018). Such model is focused on "the specialized components of mathematics teachers' knowledge, that is, their knowledge of mathematics as the object of teaching and learning" (ibid. 2018, p. 14). It includes three sub-domains of Mathematical Knowledge: mathematics content itself (*Knowledge of Topics, KoT*); the interlinking systems which bind the subject (*Knowledge of the Structure of Mathematics, KSM*); how one proceeds in mathematics (*Knowledge of Practices in Mathematics, KPM*). For what concern the pedagogical content knowledge (PCK), two sub-domains concerned teaching and learning (Ball et al., 2008), *Knowledge of Mathematics Teaching* (*KMT*) and *Knowledge of Features of Learning Mathematics* (*KFLM)*, while the last sub-domain of PCK is *Knowledge of Mathematics Learning Standards* (KMLS).

Methodology of the research

We carried out a preliminary study after the first year of teacher training to investigate whether and how the course had provided teachers with the suitable knowledge that could allow them to adapt the trainers' proposals without transforming them so much to lose their most important aspects. We analyzed the modules proposed by university teachers using the model MTSK and then we used the same model to analyze the teachers' choices and adapted modules. Finally, we analyzed the teachers' adaptations in terms of differences and similarities with the original proposals, identifying the sub-domains of MSKT that were more considered by the teachers to adapt the modules.

Data analyses

For the first year the modules proposed by university teachers were: theorems with Origami; programming languages; congruence and divisibility; the language of Physics; From frescoes to videogames. The modules addressed merely the following domains: KoT (5/5), KSM and KPM (3/5); the only modules including interdisciplinary aspects explicitly were Languages of Physics and Art & Science. Looking at patterns in teachers' choices and adaptations, it emerged that the interdisciplinary modules were the less considered and, in these cases, the teachers felt the necessity to modify them a lot, separating and juxtaposing Mathematics and the other disciplines, using merey the epistemological perspective of Mathematics and using the other disciplines just to engage students and act on motivation, without really integrating the two as it was proposed in the modules.

Discussion and conclusions

One of the main aspects of the *Liceo Matematico* project is interdisciplinarity. This preliminary analysis showed that the interdisciplinary activities were the most problematic to adapt for the teachers and the less chosen, so we realized that another kind of specialized knowledge is necessary for the teachers to carry out meaningful interdisciplinary activities, that we name *Mathematics Interdisciplinary Knowledge (MIK)*, i.e. the awareness of the different epistemological status of the disciplines, fruitful connections and critical issues emerging when mathematics is integrated with other disciplines, both sciences and humanities. Without a specific meta-reflection on these aspects the teachers fail in identifying the crucial points of interdisciplinary activities. In the second year we are interacting with the teachers addressing explicitly this point and looking for activities in the course that potentiate the MIK domain. As a general aim, we will try to characterize explicitly this domain providing examples and clarifying its specificity, according to our a priori analysis and results.

References

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