

# Concepts for teaching units in mathematics for migrant or minority students – Final report

## Project context and objectives

As stressed in the project application, the multicultural nature of modern society constitutes one of the most significant changes to have influenced education in many European countries, especially at primary and middle school level. It has a major impact on schools where more and more attention must be paid to new teaching methodologies “allowing pupils with different backgrounds (and carrying different values!) and the entire class to take real advantage from the new educational context” (Favilli, 2013). Not enough attention has been paid so far to teaching mathematics in culturally heterogeneous classrooms. Researchers focusing on this area usually analyze linguistic issues (e.g., McDermott and Varenne, 1995). When asking how mathematics is specific and what the dangers of teaching it in culturally and linguistically heterogeneous classrooms are, literature focuses mainly on in-service teacher training that would provide mathematics teachers with the tools needed for work in linguistically and culturally heterogeneous classrooms (e.g., Barton et al. 2007; Bishop 1988; César and Favilli 2005). For more detailed information see also (Moraová, Novotná and Favilli, 2018)

Work in heterogeneous classes requires materials that do not block understanding of mathematics for any pupil in the classroom. Arslan and Altun (2007) are aware of the importance of learning environments. They point out that the usually recommended learning environments may be alien to certain groups of pupils, and teachers must take steps to decrease this alienation. The teacher’s task is to work with such learning environments that are comprehensible for and accessible to all pupils in the particular group. This is the only way to achieve equity in education and to prevent exclusion of some groups of pupils from education. The developed teaching units should be based on the concept of substantial learning environments (SLE) defined and developed by Wittmann (1995, p. 366) for teaching in any classes: “a good teaching material for teachers and pupils should be the one which has a simple starting point and a lot of possible investigations or extensions”.

The aim of the project was therefore to develop concepts for creating teaching units designed specifically for classes with migrant and minority pupils and illustrate them on specific examples, with the goal of giving mathematics teachers a tool allowing them to create their own teaching units matching the needs of pupils in their own classrooms.

The concrete objectives of this project were:

- Research the literature for studies in multicultural and multi-ethnic issues in mathematics teaching, and possible educational approaches in multicultural classroom settings
- develop concepts for teaching units in mathematics, specifically designed for migrant and minority students,
- create examples of concrete teaching units based on these concepts,
- develop "good practice" guidelines for mathematics teachers on how to use the concepts to create their own teaching units suitable for their own classrooms.
- Use the results in teacher training activities, and disseminate them in the national and international mathematics education community

## Execution of project

1. The partners had a kick-off and planning meeting in Prague, February 26-28, 2019. In this meeting, partners planned the literature research and discussed ideas on how to describe the teaching unit concepts. During this meeting partners also decided that it would be more productive to start producing concrete teaching units first (after literature research), then derive general teaching unit concepts by a comparison and abstraction process.

2. In the time period from February to April 2019, partners did research the literature with respect to multicultural mathematics teaching and summarized those aspects that are important for creating the teaching units and the concepts. A summary can be found in (Novotná, Ulovec and Moraová, 2020).
3. In email exchanges in May 2019, partners discussed the results of the literature analysis and decided to develop two concrete teaching units per partner, based on the analysis results.
4. In the time period end of May to middle of July, both partners developed the concrete teaching units. The CZ partner developed the units “Folk song” (fractions) and “Plastic bottle village” (measurements), the AT partner developed the units “Energy from sun and wind” (percentage) and “Parabolas to cook with” (conic sections) and piloted the units in a teacher training course. Also, partners decided to submit a poster to the SEMT conference ([www.semt.cz](http://www.semt.cz)) as a first dissemination activity. The poster was accepted, and final version was finished on August 9.
5. Partners had a development meeting in Vienna, August 26-29, 2019. In this meeting, partners cross-checked and discussed all developed units and had an extensive feedback process. Also, partners discussed various dissemination channels and decided to submit presentations for the APLIMAT and ICME conferences.
6. In the time period September to October 2019, partners produced final versions of the teaching units (see attachment).
7. In November 2019, partners made a comparative analysis of the four produced teaching units and decided to create three teaching unit concepts: “Topics of interest for both minority and majority pupils”, “Using cultural differences as funds of knowledge”, and “How (seemingly) simple things can be very different (and difficult) in other places and cultures” (see attachment).
8. In a final meeting in Prague, December 8-11, 2019, partners discussed and finalized the three teaching unit concepts. Partners also discussed the two conference submissions to APLIMAT and ICME, as well as further dissemination channels (workshop at “Dva dny s didaktikou matematiky” in Prague, poster at “ÖMG Fortbildungstagung für Lehrkräfte” in Vienna) and usage of the concepts and units in the pre-service teacher education in Prague and Vienna. Partners also discussed about the plan for a European collaboration in the Erasmus+ framework based on the project results and experiences, and decided to submit an application in that framework. Partners also decided, together with researchers from UKF Nitra, Slovakia, to submit an application for a joint project in the Multilateral Scientific and Technological Cooperation in the Danube Region framework.

### Project results

1. Three concepts for teaching units in mathematics, designed for students with a migrant or minority background
2. Four examples of fully developed teaching units for specific topics, based on the concepts
3. “Good practice” guidelines for mathematics pre- and in-service teachers, supporting them in how to use the concepts to create concrete teaching units for their own classroom settings
4. The teaching units were used in several teacher training courses at both partner institutions, at a pre-service course “Teaching experiment” in Prague, and will be used at a workshop at “Va dny s didaktikou matematiky” in Prague and a seminar “Fachdidaktik Vertiefung” in Vienna.

### Future collaboration aspects

The two project partners will be the core group for an Erasmus+ Strategic Partnership application in the area of School Education, where – in collaboration with other European universities and particularly also in collaboration with secondary schools (currently foreseen are partners from Austria, Czech Republic, France, Greece, and Italy) – they plan to create a larger variety of teaching unit concepts and full teaching unit examples, have these concepts and units field-tested in schools as well as evaluated by international education experts, use case studies with questionnaires and interviews

to research the effectiveness of the concepts and units, and make those concepts and units available in a variety of European languages.

The two project partners have, together with two researchers from UKF Nitra in Slovakia, recently submitted an application for a joint project in the Multilateral Scientific and Technological Cooperation in the Danube Region framework, where they plan to find out needs of mathematics teachers with respect to migrant students, conduct a textbook analysis with respect to multicultural aspects, and develop context-rich, problem-based teaching materials for teaching mathematics in multicultural classrooms.

#### Dissemination and scientific project output

ULOVEC, A., NOVOTNÁ, J., Concepts for teaching units in mathematics for migrant and majority pupils. In Proceedings of SEMT '19, Praha, 2019, pp. 489–491.

NOVOTNÁ, J., ULOVEC, A., MORAOVÁ, H., Teaching mathematics to migrant or minority students: Concepts for creating materials. APLIMAT 2020, Bratislava [article accepted].

NOVOTNÁ, J., ULOVEC, A., Developing concepts for mathematics teaching units with a focus on migrant and minority students. ICME 2020, Shanghai [article accepted].

NOVOTNÁ, J., MORAOVÁ, H., ULOVEC, A., Příprava podnětných výukových prostředí vhodných pro multikulturní třídu. Dva dny s didaktikou matematiky, Praha [workshop accepted].

#### References

ARSLAN, Ç., ALTUN, M., Learning To Solve Non-routine Mathematical Problems. *Elementary Education Online*, 6(1), 2007: pp. 50–61.

BARTON, B., BARWELL, R., SETATI, M. (Eds.), Multilingualism in mathematics education. *Special Issue of Educational Studies in Mathematics*, 64, (2), 2007.

BISHOP, A. J., Mathematics Education in its cultural context. *Educational Studies in Mathematics*, 19, 1988: pp. 179–191.

CÉSAR, M., FAVILLI, F., Diversity seen through teachers' eyes: discourses about multicultural classes. In *Proceedings of the 4th Conf. of the European Society for Research in Mathematics Education*, 2005, pp. 1153–1164.

FAVILLI, F., Globalization in mathematics education: integrating indigenous and academic knowledge. In *Proceedings of CIEAEM 65*, 2013, pp. 49–67. Retrieved from [http://m3eal.dm.unipi.it/images/doc/08.dissemination/IT-PI\\_2013\\_EN\\_CIEAEM65.pdf](http://m3eal.dm.unipi.it/images/doc/08.dissemination/IT-PI_2013_EN_CIEAEM65.pdf)

MCDERMOTT R., VARENNE H., Culture as disability. *Anthropology & Education quarterly*, 26(3), 1995: pp. 324–348.



MORAOVÁ, H., NOVOTNÁ, J., FAVILLI, F., Ornaments and tessellations: Encouraging creativity in the mathematics classroom. In *Mathematical Creativity and Mathematical Giftedness: Enhancing Creative Capacities in Mathematically Promising Students*, Springer International Publishing, 2018, pp. 253–284.

WITTMANN, E. Ch., Mathematics education as a “Design Science”, *Educational Studies in Mathematics*, 29, 1995: pp. 355–374.

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## Participants

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