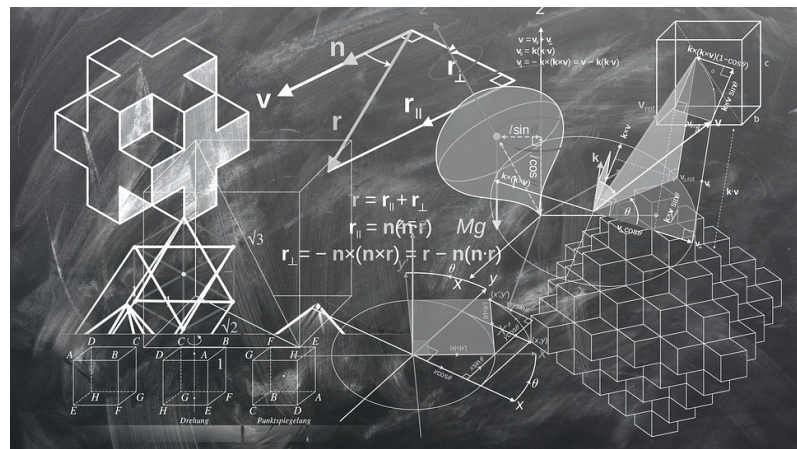




The results of project MERIA

The focus of project MERIA is to promote inquiry based mathematics teaching (IBMT) across four partnering countries (Croatia, Denmark, The Netherlands and Slovenia), to produce innovative teaching and learning materials and support teachers in the process of implementing new teaching approaches, all with a goal to investigate what can make mathematics teaching more relevant, interesting and applicable to our students.

During the project's lifetime the project team has produced a set of didactical handbooks to facilitate its goals. First is the [MERIA Practical Guide to Inquiry Based Mathematics Teaching](#) in which the basic tenets of theoretical frameworks are described and illustrated with many examples. One of the main



results of the project is a compilation of five [MERIA scenarios and modules](#) that have been tested and developed in cooperation with teachers in associated schools in all four countries. The scenarios are showcases of didactical situations that provide a very important insight and support for teachers trying to implement inquiry-based mathematics teachers in their own classrooms. Finally, as the change of teaching methods may be quite challenging, we have designed and delivered a cycle of professional development course for around 100 teachers in partnering countries, with all activities described in detail in the [MERIA Workshop Guide](#). All of these outputs have been evaluated and improved to support the MERIA team and the final users (mathematics teachers) in achieving the desired goal. Along with online versions available with free access at the project's official webpage, MERIA Practical Guide was published in Croatian financed by the Croatian Mathematical Society. Publishing of MERIA scenarios and modules in Danish has been financed by the Ministry of children and education in Denmark.

Evaluation of MERIA teaching materials and training activities

Quantitatively, all targets set out in the application form have been achieved. In total, working with associated schools and through workshops in all four countries, we have introduced MERIA and retrained around 150 teachers. Among these, 31 teachers from 13 associated schools have participated in semi-structural interviews. During the design phase in 2017 and 2018, teachers in associated schools have tested eleven MERIA scenarios in 64 lessons and 1290 students have provided feedback on the relevancy of the lesson and their satisfaction.





Mathematics Education - Relevant, Interesting and Applicable

Here are some of the most interesting data from students evaluation.

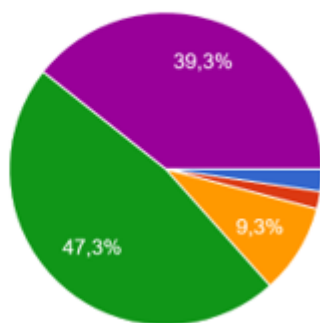
Compare the lesson to a traditional one.

(Sample: Croatia 389 students, Slovenia 306 students, the Netherlands 189 students, Denmark 34 students)

- 1 - Much less interesting
- 2 - Less interesting
- 3 - The same
- 4 - More interesting
- 5 - Much more interesting

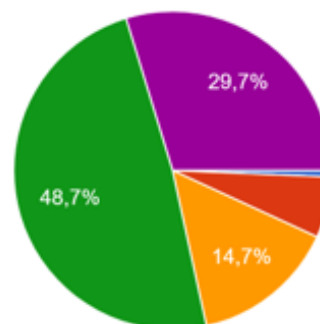
CROATIA

389 odgovora



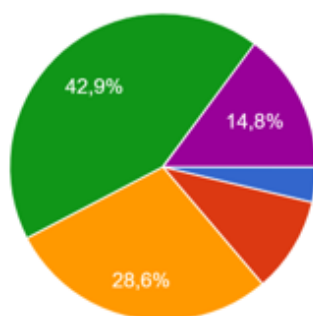
SLOVENIA

306 odgovora



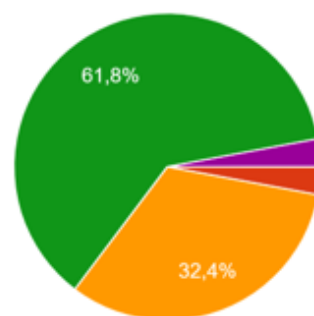
THE NETHERLANDS

189 odgovora



DENMARK

34 odgovora

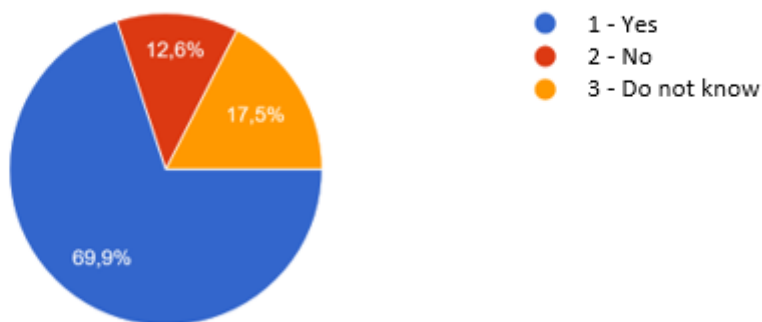




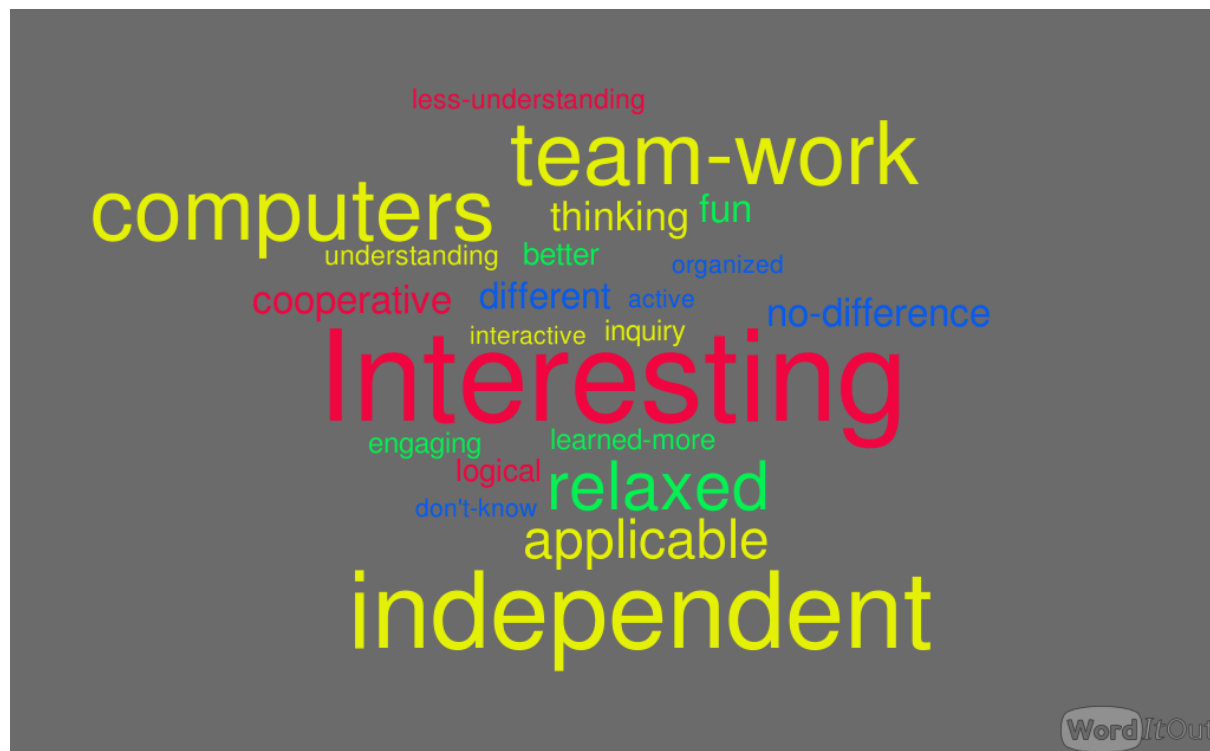
Mathematics Education - Relevant, Interesting and Applicable

*Do you find mathematics more meaningful (related to your life) because of this lesson?
(Croatia, 389 students)*

389 odgovora



*What are the biggest differences in today's lesson and the traditional lessons in your opinion?
(Slovenia, 306 students)*





Mathematics Education - Relevant, Interesting and Applicable

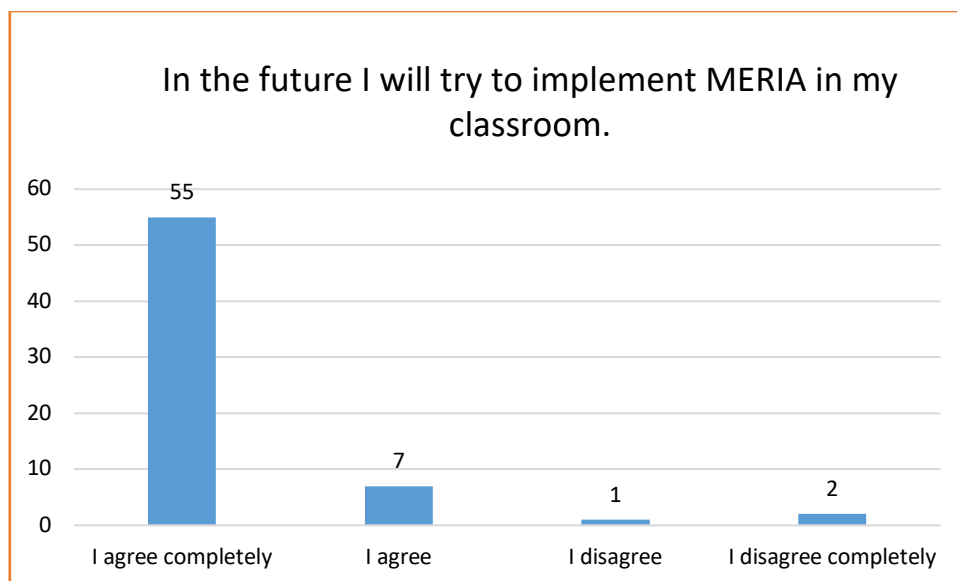
Furthermore, almost all teachers participating in the MERIA professional development cycle were asked to implement at least one scenario and report about the outcome, so we estimate that about 80 more lessons have been performed based on MERIA materials with around 2500 students participating. Here are some of the comments from teachers in Slovenia:

"The content and the material are useful for my everyday teaching practice because they are well prepared, and they contain different ways of students solving the problem. The inquiry method is efficient since it pushes students to start thinking and learn better. The method is very time consuming and we do not always have time. Some examples are too difficult for our students."

"I will plan at least 2-3 MERIA scenarios for the next school year. I will also do shorter inquiry activities because they do not take so much time."

"Carry on what you have started. Spread the idea. Do as many scenarios as you can. The workshop has confirmed my beliefs that we need different instruction and different knowledge. Students can do more than I thought and I will include inquiry activities in my lessons, along with solving open problems. All I need is to make the first step."

And some reactions to MERIA Final Conference organized in May 2019, with around 80 teachers from all four countries.





Mathematics Education -
Relevant, Interesting and Applicable

I liked the most... the way of thinking, usefulness and importance of the project. Today we have the opportunity to participate in a lot of the lessons and workshops but ~~for~~ for the teacher is important to recognize the tree ~~in~~ in the forest of this workshops and online lessons ~~quantity~~
Suggestions for improvement...
Quality before quantity!
Thanks!

Reflection on the project's impact

At the end of the project we have repeated the semi-structural interviews with teachers in associated schools. Here are some of the findings, taken from the *MERIA project impact analysis*. Teachers appreciate that they have received detailed materials and an opportunity to discuss the implementation with other colleagues. From the materials they value the structure as it provides them the way how to implement inquiry based teaching, while feedback from other colleagues helps them to gauge their expectations and improve their actions. Teachers' understanding of inquiry based teaching is mostly experiential and they define it as "students working on their own". This understanding has certainly evolved through workshops as they report that their perspective has changed, and they provide examples on it. Concerning their own skills, teachers have improved in their role to "withdraw in a meaningful way" and value the time given to students to work without their interference.





Mathematics Education - Relevant, Interesting and Applicable



Teachers clearly illustrate their values and support their reasoning with positive examples. They have not adopted the vocabulary of the theoretical frameworks, but it is clear from the interviews that they use the concepts that are central to these frameworks. For example, teachers emphasize students' autonomous actions ("didactical situations"), they often mention students' expectations and

time needed to adapt to a novel way of learning ("didactical contract"), they are aware of the structure of a lesson ("phases in TDS") and of their role to support students ("scaffolding") and to connect students work to the topic of the lesson ("target knowledge" and "institutionalization"), also they value realistic and open problems ("rich contexts in RME" and "didactical potential"). As a form of professional development, they rate MERIA workshops (and the project in general) very positively and emphasize that they highly appreciate being active participants and discussions about their experiences. They point out that there are a few such opportunities as mostly professional development is provided in a form of lecture with no materials.

We have teachers from different types of schools. Some teachers identify their students as "not so good as in other schools" and they find students' lack of prerequisite knowledge as an obstacle to advance to further topics and experimenting with different types of teaching. Some students show negative attitudes towards mathematics and persisting resistance to engage in a discussion or to think about the problems autonomously. Teachers report that students "learn for grade" and describe students' expectations as "show me the procedure, give me another similar task and grade me". Also, all





Mathematics Education - Relevant, Interesting and Applicable

teachers reported that during the first implementation of a MERIA scenario students were confused by the change of the teaching method and asked for help what to do. Those teachers that tried more scenarios in the same class report that students adapt successively with time and that there was a high level of satisfaction of both students and the teacher. Teachers claim that their teaching is heavily constrained by the final national external assessment and the amount of the mathematical curriculum it covers, but they clearly point out that logical thinking is also required at these exams and that MERIA scenarios support its development. So, it is useful to incorporate inquiry based teaching since it supports mathematical reasoning required in the final assessment, but this argument is not always clear to students and their parents. This all points that the negotiation of the didactical contract is crucial for successful implementation of inquiry based teaching.



Teachers feel that inquiry situations bring more dynamics to their classrooms and that MERIA scenarios are interesting to their students. They suggest that parents would think that students were only playing and had not learned anything, while they think students work more during inquiry based lessons than while passively copying solutions of tasks. Students get more engaged because of an element of mystery and it was very positive for the teacher that the students realized that behind a guessing game there is no magic, but a mathematical (scientific, logical) explanation. In particular, students like new ways to present their results (e.g. in the form of a letter to a mayor, or when multiple students write on the board at the same time) and working in a relevant context (discuss payrolls, provide advice, construct a slide). Overall, all teachers report that students were engaged and that they were positively surprised by the students with

more modest achievements. In general, teachers feel that they have enough time and freedom to incorporate inquiry based lessons during the year and add that this statement is related to the fact they have tried the scenarios ("now that I know what it is about") and received positive feedback ("my students managed and were satisfied"). So, we conclude that it is personal experience that leads teachers' decisions. It is also important to note that teachers express positive attitudes towards the materials because they trust the authors (the authority of the project team). Hence, we further hypothesize that the use of materials and the success of the professional development also depends highly on the persons providing it.





Mathematics Education -
Relevant, Interesting and Applicable

Follow up – Teachers' Inquiry in Mathematics Education (TIME)

The story does not stop here! The same project team will continue to provide further professional development cycles and we hope that more scenarios will be produced in the near future. As we learned much from MERIA and all of the teachers that were involved, a need for a follow-up project emerged.

The main idea of the project Teachers' inquiry on mathematics education (TIME) is to explore how a community of math teachers working together in one school can improve their practice through joint exploration, planning and interaction between themselves and with university professors. We will explore how such a community can reach a high level of independence and sustainability in creating innovative teaching and learning materials and upgrade their professional knowledge.



More concretely, the idea is to adapt the well-established format of Lesson study (LS) to conditions in the participating countries. LS is a Japanese model of shared inquiry, performed by small groups of teachers with a specific goal to improve their teaching, and thereby students' learning. In this project we propose to form LS teams of teachers in all partner countries. The teams will work on implementation of inquiry based mathematics teaching (IBMT). While there is an abundance of research showing effectiveness of LS at the primary and lower secondary level, especially in Japan and other East Asian countries, the model is new in Europe and especially at the upper secondary level.

The project TIME will draw on results and networks established by MERIA. MERIA results show that teachers are eager to learn about IBMT, and that innovative scenarios based on Theory of Didactic Situations and Realistic Mathematics Education produce inspiring lessons which motivate students and allow them to engage in higher level mathematical activity. MERIA also showed that design of such materials is an iterative process that requires expertise and time. Dissemination activities showed that teachers need such innovative materials and moreover that they often do not believe they can produce them on their own.

The first part of the project (TIMELESS) is dedicated to establishing LS among all partners. The second part (TIME²) will shift the focus to teachers taking the role of designers, as it is the usual practice of independent Lesson study. In particular, teachers will learn how to use didactical phenomenology to develop new scenarios with rich and motivating mathematical contexts. During dissemination activities at the end of the project, experiences and materials will be shared to a wider public of teachers. Stay tuned!

