IEEPS
Improving educational effectiveness of primary schools

POLICY BRIEF
IMPROVING EDUCATIONAL EFFECTIVENESS OF PRIMARY SCHOOLS

Results of the IEEPS project and recommendations for improvement of teaching

INTRODUCTION

The main goal of the project "Improving educational effectiveness of primary schools" (IEEPS) was to help schools improve education outcomes of their pupils. For pupils to attain greater learning, schools need to know: (1) what their contribution to pupil achievement is, (2) what teaching and school practices most effectively impact pupils, and (3) how these practices can be applied in everyday teaching. To achieve all three, the researchers first undertook a large study of pupil achievement in which pupils' results from the fourth grade on the TIMSS 2011 international test were connected to their eighth grade results on the tests distributed in 2015, and a wealth of data on teaching and pupil and family characteristics was collected based on prior theory and empirical research, namely dynamic model of educational effectiveness (Creemers & Kyriakides, 2008). Then, using rigorous sophisticated statistical analyses and improving and utilizing an existing School performance feedback system for reporting results to schools, created by KU Leuven, schools were given individual feedback on value-added (their contribution to pupil learning beyond influences of individual and family characteristics) and a report on most effective teaching practices alongside the handbook with practical advice on their application in classrooms. Finally, several similar programs of professional development were created, which helped hundreds of teachers improve their everyday teaching.

Schematically, the project was conducted to reach the following four goals:

GOALS OF THE PROJECT

Determining how school and teaching influence pupil achievements in mathematics and sciences, considering the diversity of pupil population regarding individual pupil characteristics.

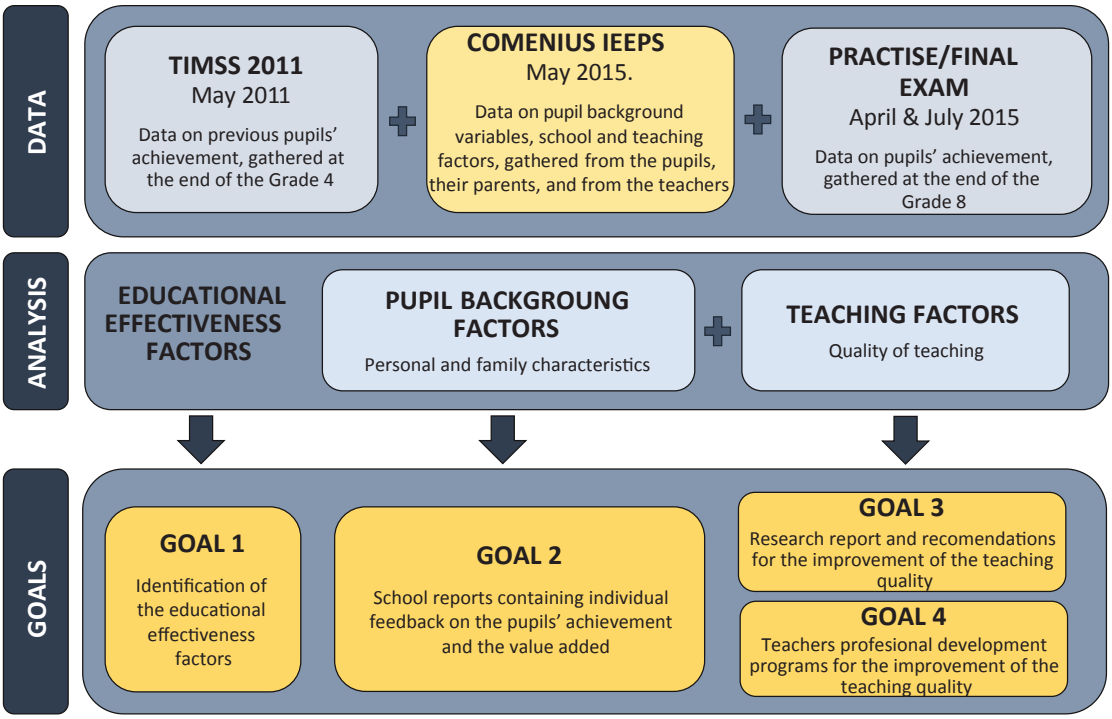
Delivering individual feedbacks to schools about pupil achievement and schools` value added.

Creating a report about factors of quality teaching – designed to help teachers improve their teaching – based on the findings of this study.

Designing and implementing of professional development training programs for teachers based on the results of this research and the recommendations for the development of quality teaching.

The basic concept and main steps of the IEEPS study can be graphically presented as follows (Figure 1):

Figure 1. *Data sources, conducted analyses and aims of the Comenius IEEPS Study*



The realized educational effectiveness research was based on the theoretical model proposed by Leonidas Kyriakides and Bert Creemers (Kyriakides & Creemers, 2008) – the dynamic model of educational effectiveness – which identifies eight teaching factors that influence learning and pupil achievement the most.

EIGHT FACTORS OF QUALITY TEACHING

Management of time

refers to activities that maximize the cognitive engagement of pupils in the activities and assignments in class. Effective teachers organize time well and use efficient procedures for class management, making the classroom climate learning-oriented.

Classroom as a learning environment

is an environment with positive pupil-teacher and pupil-pupil interactions, where the teacher develops a sense of wellbeing and belonging to the class or school in pupils, encourages their involvement and supports their learning and development.

Orientation

refers to significance and purposes of specific teaching contents within a wider context of pupil knowledge, everyday application and scientific knowledge. This factor focuses on questions that refer to importance of learning the subject contents and how these contents can be useful in everyday situations.

Structuring

refers to organizing the teaching that successfully contributes to pupils' ''inner'' structuring of the taught content. It includes structuring the lesson well, so that the parts correspond to specific tasks (repetition, emphasizing the important parts, summarizing...).

Application

means applying the learnt material through the task solving and problem situations related to the lesson and a particular topic of the class. This form of practical pupil work is based on creating opportunities for a direct and immediate application of acquired knowledge.

Teaching-modelling

implies that teachers help pupils develop and apply different strategies for understanding and learning, that is, engaging higher cognitive processes. Teaching-modelling also includes using numerous teaching techniques to explain the teaching content.

Questioning

implies that teachers should, often and in every lesson, ask pupils questions that encourage use of more complex cognitive processes in learning, give them enough time to think before and after answering and provide an adequate feedback.

Assessment

refers to all activities that aim at determining the levels and characteristics of pupil knowledge, giving constructive feedback to pupils and taking corrective steps in teaching so that the pupil can meet the expected educational outcomes.

Although IEEPS project included various research findings (e. g. about teacher professional programs, about individual school performances etc.), most of the policy brief will be devoted to the effective teaching practices, as they are most amenable to succinct description for policymakers.

RESULTS

Pupil characteristics and teaching practices in relation to pupil achievement in mathematics

The results show that the following pupils` and their families` characteristics explain 46% of differences in pupil achievement in mathematics: *gender, socioeconomic status of the family, conscientiousness, impulsivity, reading habits* and *previous achievement* (the achievement in mathematics in the TIMSS 2011 study). Girls, pupils with higher socioeconomic status, pupils who are more conscientiousness, less impulsive, and those with more developed reading habits all have higher achievement in mathematics. Also, the pupils who obtained better results in the fourth grade also have higher achievement in mathematics in the eighth grade. After the control of the listed pupil characteristics, there remain 44% of differences at the pupil level that can be explained by factors this study did not include.

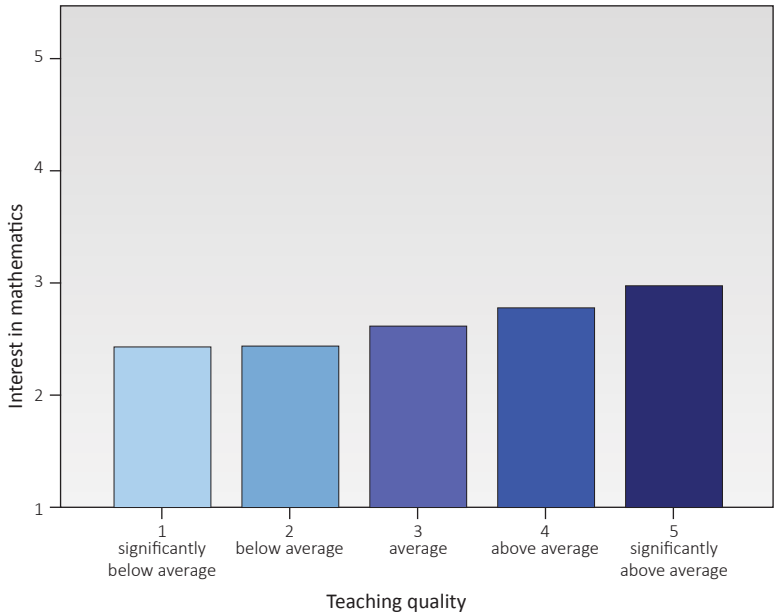
These analyses indicate that, after the pupils and classes were equated according to the listed pupil characteristics, only 10% of differences in pupil achievement could potentially be attributed to teaching factors. However, it was determined that none of the measured teaching factors had a significant impact on achievement in mathematics.

Pupil characteristics and teaching practices in relation to pupil interest in mathematics

The results show that, among various pupil characteristics, the statistically significant impact on pupil interest in mathematics is evident in the following: *reading habits, impulsivity, conscientiousness* and *pupil achievement* in said subject, with these individual pupil characteristics explaining around 12% of differences in pupil interest. The pupils with more developed reading habits, those who are more conscientious and those who are less impulsive, as well as pupils who have higher scores in mathematics exam also have higher interest in this subject`s content. When these individual differences between pupils are controlled, there are 72% of differences between pupils left unexplained by this study.

When it comes to the contribution of teaching to pupil interest in mathematics, about 16% of differences between pupils can potentially be attributed to different characteristics of teaching. The analyses of the contribution of individual factors of quality teaching to pupil interest in mathematics showed that all measured teaching factors – Management of time, Classroom as a learning environment, Structuring, Orientation, Application, Teaching-modelling, Questioning, and Assessment – have a statistically significant impact. These factors individually explain from 1% to 10% of differences in interest in mathematics. In order to determine the overall contribution of teaching to pupil interest in mathematics, the impact of a general factor *teaching quality* (consisting of all of the individual factors) was examined and it was found that it explains 9% of differences in pupil interest in mathematics from the total of 16% that can be attributed to the influence of teaching.

Figure 2. *Differences in pupil interest in mathematics depending on the teaching quality*



Note. The chart shows the pupil interest in mathematics after the pupils have been equated up by their reading habits, impulsivity, conscientiousness, and mathematics achievement.

Pupil characteristic and teaching practices in relation to pupil achievement in biology

The research confirmed that the following factors have a significant contribution to achievement in biology: *gender, socioeconomic status, previous achievement* (the achievement in biology[1] in the TIMSS 2011 study), *reading habits* and *conscientiousness*. Girls, pupils from families with higher socioeconomic status, pupils with more developed reading habits and those who are more conscientious have higher achievements. Also, higher achievement in biology on the TIMSS testing in the fourth grade is related to higher achievement in this area in the eighth grade. The listed characteristics of pupils and their family environments explain a total of 10% of variances in pupil achievement. After the equating of individual differences between pupils, a total of 70% of differences was left unexplained, so they can be assigned to pupil characteristics that weren't measured in this study.

At the teaching level, 20% of differences were left unexplained for pupil achievement in biology. Out of ten examined aspects of teaching, statistically significant impact on the achievement in biology was determined for seven factors: Management of time, Structuring, Orientation, Assessment, Teaching-modelling, Application and Questioning. These factors, taken separately, explain from 1% to 1.5% of differences in pupil achievement. The general factor *teaching quality* explains a total of 1.4% of differences in pupil achievement in biology.

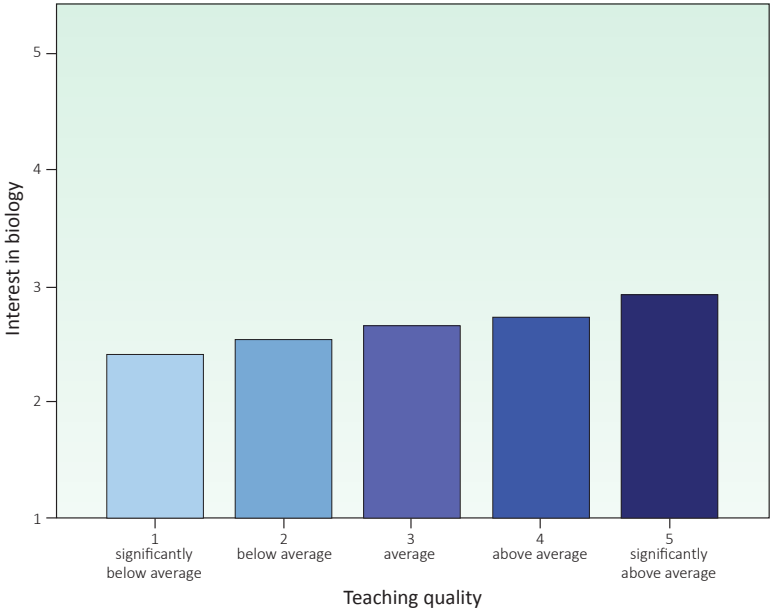
1 The TIMSS study examines, among others, the domain of the living world, the content which is closely related to the content of biology in higher grades.

Pupil characteristics and teaching practices in relation to pupil interest in biology

The examination of pupil interest in biology shows that among the examined pupil characteristics, statistically significant are *achievement in biology, reading habits, impulsivity* and *conscientiousness*, as well as *parental involvement.* As expected, the pupils who are more successful in biology show higher interest in this school subject. Additionally, pupils with more developed reading habits, less impulsivity, higher conscientiousness and those whose parents are more involved and interested in their school activities and duties show higher interest in biology. These characteristics of pupils and their family environments explain a total of 14% of differences between pupils in their interest in biology. Unobserved individual pupil characteristics influence about 75% of variances between the pupils.

After the pupils were equated by their relevant individual characteristics, there was 11% of variability left in their achievement that potentially comes from the factors related to teaching. The analyses of examined factors of quality teaching show that, out of ten aspects of teaching measured in this study, nine of them have a statistically significant contribution to pupil interest in biology. All aspects, except pupil-pupil interaction (aspect of the Classroom as a learning environment factor), are significantly related to pupil interest in biology. The general factor *teaching quality*, which encompasses all examined teaching factors except pupil-pupil interaction, is responsible for 8% of differences in pupil interest in biology, while only slightly less than 3% of teaching related differences are left unexplained.

Figure 3. *Differences in pupil interest in biology depending on the general teaching quality*

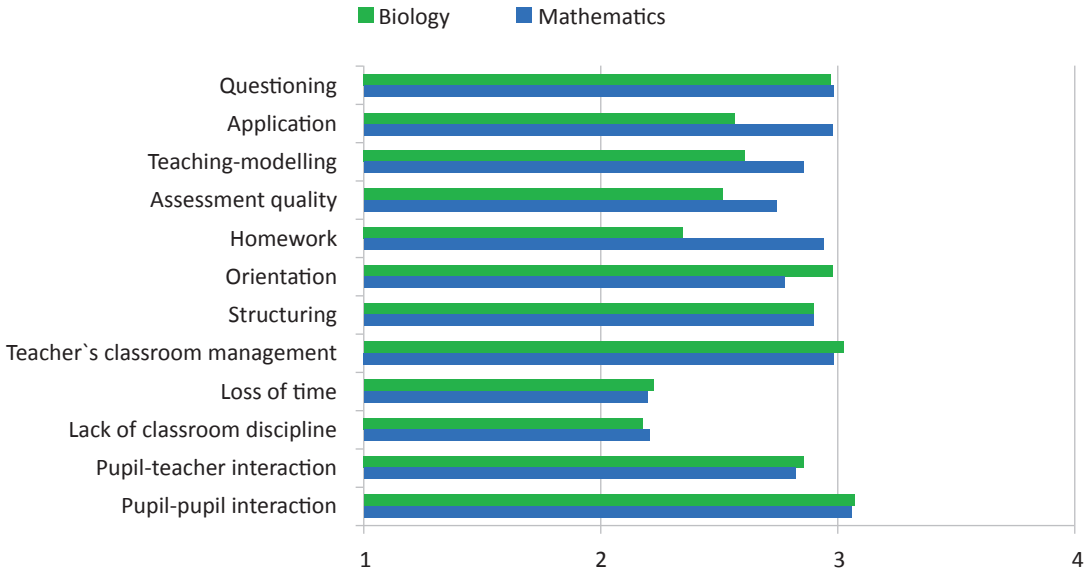


Note. The chart shows the pupil interest in mathematics after the pupils have been equated up by their achievement in biology, reading habits, impulsivity, conscientiousness and parental involvement.

Frequency of effective teaching practices

Considering the representativeness of the school sample and a wide coverage of measured teaching variables that were based on previous theory and empirical research, this study has offered an abundance of data about the importance of examined teaching practices in primary schools. Figure below shows the frequency of different manifestations of eight aspects of quality teaching (some of the factors are additionally classified[2]). Score 1 represents the answer *never or almost never*, score 2 stands for *rarely*, score 3 for *often* and score 4 for *always or almost always*.

Figure 4. *Frequency of certain teaching practices and classroom situations*

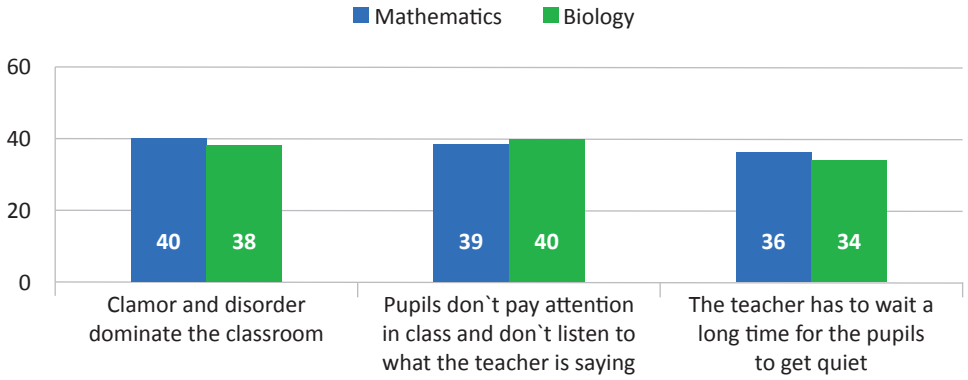


The most frequent positive aspects of biology and mathematics classes in primary schools in Serbia are good pupil-pupil interaction, teacher`s management of activities in class, questioning and structuring. When it comes to homework, application, teaching-modelling and assessment quality, the pupils say those positive practices are more common in mathematics, while orientation is more common in biology classes. In the following text we will briefly present the results for particular items that are noteworthy – these are the aspects of teaching that are rarely present in class, but are deemed effective in relevant literature.

First, we should point at alarming results regarding disorder and lack of discipline in classroom. The study, according to pupils` answers, revealed some troublesome aspects of teaching in primary schools in Serbia, as shown in the following chart.

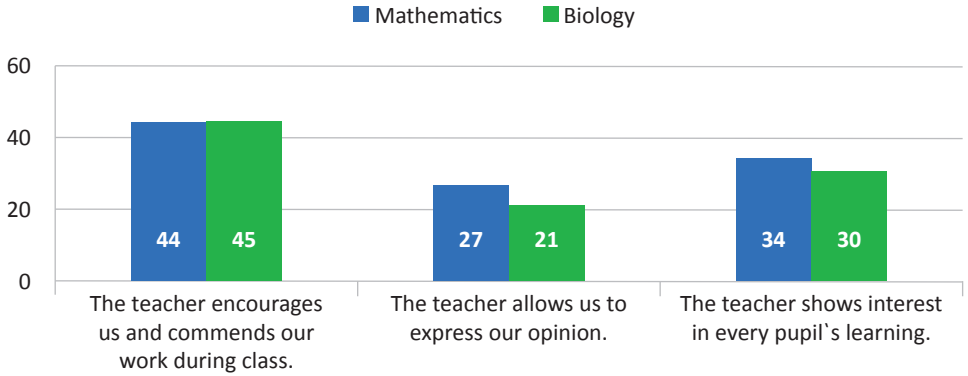
2 The factor Classroom as a learning environment consists of two scales: Pupil-teacher interaction and Pupil-pupil interaction. The factor Assessment consists of two scales: Assessment quality and Homework. The factor Management of time consists of three scales: Lack of classroom discipline, Loss of time, and Teacher`s classroom management.

Figure 5. *Lack of classroom discipline – the percentage of pupils who think it is often or (almost) always present in class*



The study confirmed that positive interaction between pupils and teachers is often present, but the frequency of some aspects deviates from this general picture.

Figure 6. *Pupil-teacher interaction – the percentage of pupils who think that the listed aspects are rarely or (almost) never present in class*



The structuring practices which seldom appear in primary schools in Serbia are shown in Figure 7. The problem is more common in mathematics classes.

Figure 7. *Structuring – the percentage of pupils who think that the listed aspects are rarely or (almost) never present in class*

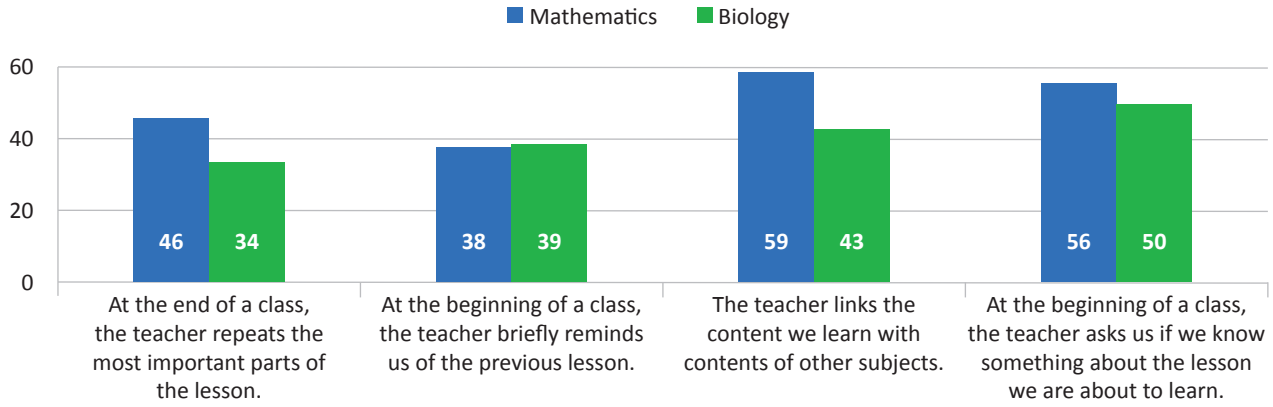
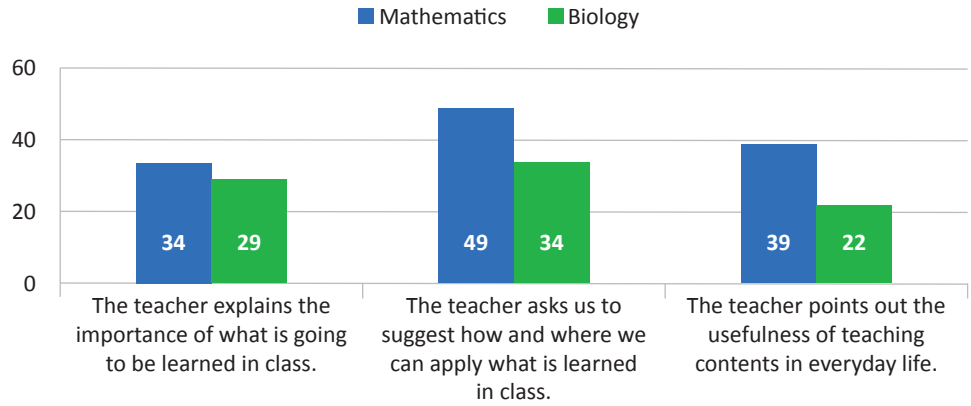


Figure 8 shows that in certain aspects of the teaching factor Orientation, pupils specifically recognize deficiencies in mathematics classes.

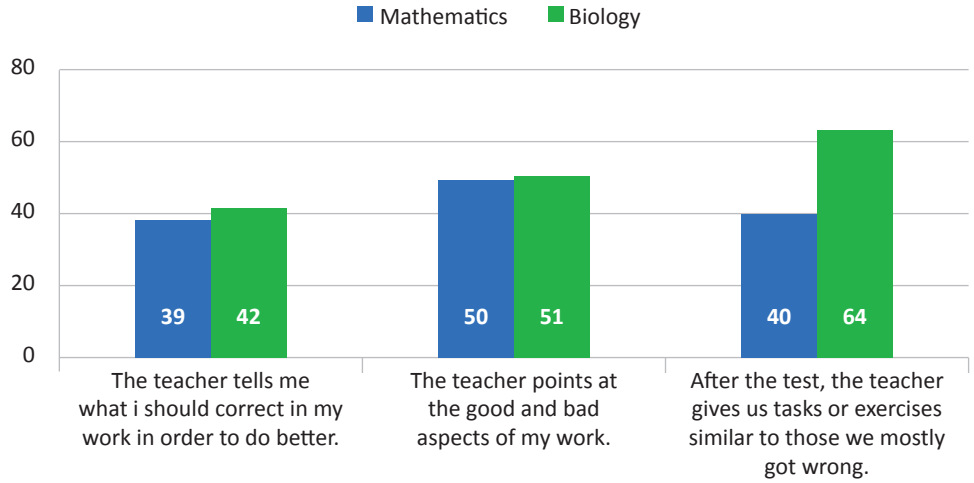
Figure 8. *Orientation – the percentage of pupils who think that the listed aspects are rarely or (almost) never present in class*



Results show that mathematics teachers give homework more often than biology teachers. However, according to pupils` answers, teachers of both subjects rarely or (almost) never review or check homework accuracy (49% in mathematics and 61% in biology).

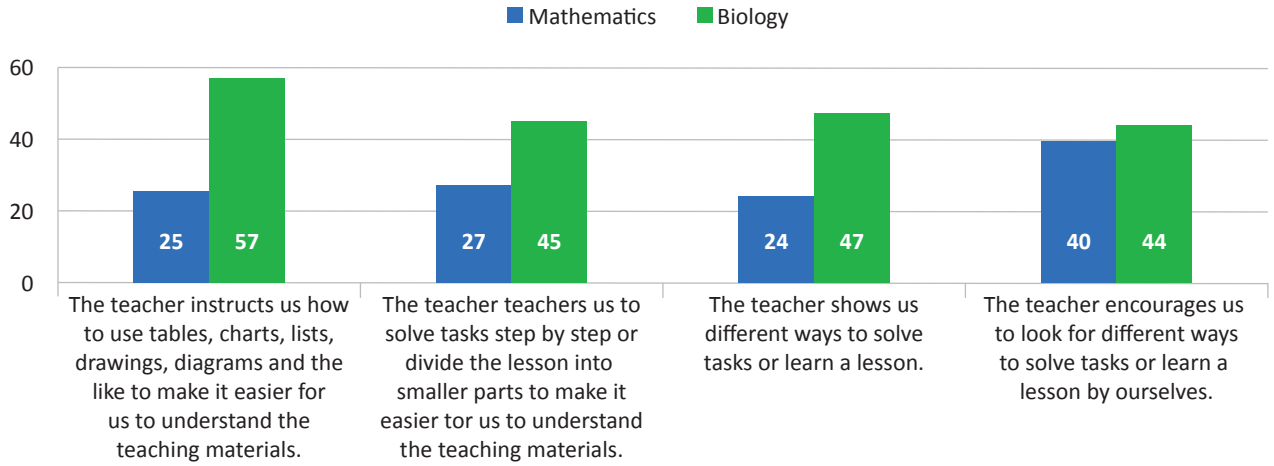
In this research, Assessment quality refered to correcting pupils` answers and giving feedback on how certain tasks should have been done, as well as feedback about pupils' work. Data show that particular aspects of assessment are unacceptably rare in teaching, as shown in Figure 9.

Figure 9. *Assessment quality – the percentage of pupils who think that the listed aspects are rarely or (almost) never present in class*



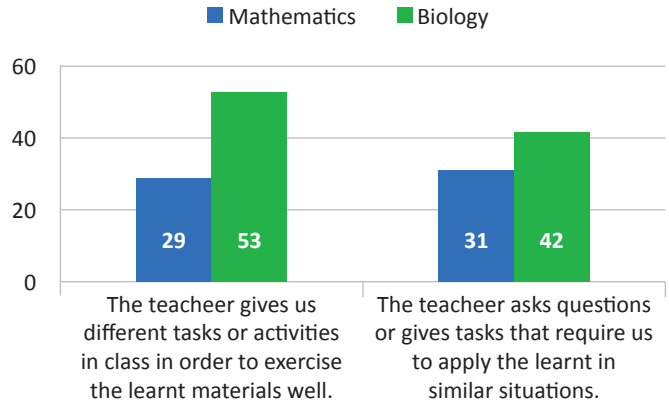
When it comes to the Teaching-modelling factor, Figure 10 shows that some practices of teaching-modelling are specifically rare in biology classes.

Figure 10. *Teaching-modelling – the percentage of pupils who think that the listed aspects are rarely or (almost) never present in class*



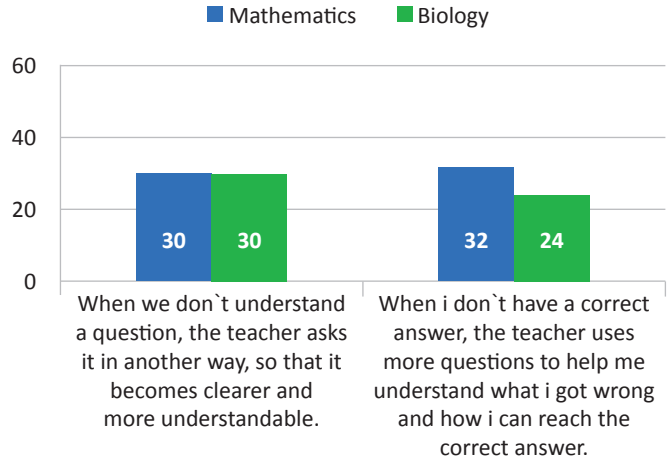
Study results show that Application is less present in biology classes. Figure 11 shows practices where those differences are particularly visible.

Figure 11. *Application – the percentage of pupils who think the listed aspects are rarely or (almost) never present in class*



Regarding questioning, pupils estimate that it is relatively often present in classes. However, some worrisome tendencies are evident here as well, as presented in the following figure.

Figure 12. *Questioning – the percentage of pupils who think that the listed aspects are rarely or (almost) never present in class*



CONCLUSIONS AND POLICY RECOMMENDATIONS

Based on our study results, it can be concluded that in Serbia, similar to many other countries, the pupil factors crucially affect pupil achievement and interests. That is why the school`s mission is, among other things, to provide equal educational opportunities to pupils with different socioeconomic status, so that the pupil's personal and family factors play a less decisive role in their achievement and interest. This way, the educational system becomes more equitable and, consequently, contributes to social cohesion, economic benefits for both the society and individuals, and exercise of rights to equal education for all.

Numerous authors indicate the importance of creation of educational policies that simultaneously promote quality and equity in education, and suggest series of possible measures: effective identification of pupils from vulnerable groups; better connection of education, health and social sectors; provision of quality preschool education and wide coverage of education; creation of early, preventive and intensive educational and social interventions for children from vulnerable groups (i.e. intensive individual teaching; provision of free meals in schools, transportation and textbooks; active inclusion of pupils in remedial teaching and quality extracurricular activities; organization of summer education camps; etc.); promotion of reading at an early age; using strategies to control impulsive behaviour; providing better horizontal and vertical mobility between different educational levels and educational programs; postponing the age when pupils are selected into schools with different academic pathways (i.e gymnasiums, four-year and three-year long vocational high schools); quality cooperation with parents, etc.

Regarding the teaching factors of pupil achievement and interest, our study results are ambiguous at the first glance. It has been determined that teaching factors didn't show a significant connection with pupil achievement. The most likely explanation is that the measure of achievement used in this study (combined results of the practice exam and the final exam) depends heavily on factors outside regular teaching – for example, preparation of pupils for the test by means of private tutoring, preparatory classes at school/municipality or independent preparation at home – so the effects of the examined teaching practices can hardly be felt in that situation. Besides, it is debatable whether the practice exam and final exam adequately depict the format and content of what is learnt in higher grades of primary school and whether they are for that reason not under the influence of the examined factors of effective teaching.

On the other hand, it has been determined that factors of effective teaching are connected significantly with pupil interest in mathematics and biology. Furthermore, these factors explain most of the differences in pupil interest that can be attributed to teachers, and not to individual pupil characteristics. Generating interest in a subject is a very important goal of education and, having in mind continuation of schooling and lifelong learning, not any less important than achievement in education. For this reason, but also because of the impact of the presented teaching practices on pupil achievement, as confirmed in literature, it is necessary to invest in initial education, teacher induction, and professional development of teachers within and outside of the institution, in order to improve quality teaching practices, particularly the ones that this research confirmed to be rarely present in class.

It is for this reason that creation of professional development courses was an important goal of the project. Research results become much more meaningful if it is possible to translate and apply them in practice. Several similar strands of professional development courses were developed in Serbia, Cyprus and Belgium based on educational effectiveness findings. They all rely on the research results to equip teachers with knowledge and practical skills regarding eight factors of quality teaching in an extensive and interactive way or work with schools to explain the findings and reports and promote their use for improvement of teaching. Teacher trainings and school visits took part over the school year, so as to provide continuous professional support and feedback to staff, and, importantly, to allow time to school staff to reflect upon what they learnt and adapt their routines and practices. The findings of the evaluation of these programs for professional development show that the participants think the seminars are well thought-out, inovative, meaninful and interesting and, what is most important, recognize that they will be useful in improvement of education in their schools.

Finally, one of the goals of the Comenius project "Improving educational effectiveness in primary schools" was to improve and expand the use of school performance feedback mechanisms (systems). The existing School performance feedback system in Belgium was fine tuned, another similar system in Slovenia was improved, and such system was introduced anew in Serbia. This project tried to examine which individual variables could explain a part of differences in pupil achievement (i.e., socioeconomic status of the family or pupil gender), which variables should be used to statistically equate the differences, how much variance in pupil achievement they explained and, finally, if every school could have its own profile created on the basis of these parameters. The cooperation of partners resulted in improvements of the existing systems, their readiness for application to other projects (other research studies, national tests, international tests), and piloting of the system in Serbia where each of 125 schools obtained its unique profile which informed the school whether their contribution to pupil learning was expected or below/above expected based on pupil individual and family variables.

Recommendation deriving from this segment of the project is that the applied feedback system should spread to other education systems, as it can be very useful for individual schools, because it allows them to consider and improve their influence on pupils. Also, sucg feedback system could be used for the educational system as a whole, because it enables education authorities to direct support to schools who need help the most (the schools with lower pupil achievement levels and contributions to pupil learning that are below the expected levels based on pupil individual and family characteristics). Establishing such systems can, in theory, be very useful for school quality assessment and the latter improvement of schools. We should, however, tread cautiously: systems for giving feedback to schools have limitations of their own and should not be used for teacher and school assessment in order to penalize them. If a country decides to establish a feedback system, it should recognize its complexity, potential benefits and effects, and carefully select the kinds of data that would be collected, the methods for their analysis, and the ways to report them.

THE RESEARCH METHOD

The main segment of the research within the project "Improving educational effectiveness in primary schools" was realized in April and May 2015, on a sample of pupils (N=5476), their parents (N=5021) and teachers (N=2500) from 125 primary schools that participated in the 2011 TIMSS study cycle. Starting from the content of eight factors of the dynamic model of educational effectiveness[3], the questionnaires were created to provide pupil assessment of different aspects of teaching practice they encounter in their mathematics and biology classes[4]. Data on individual pupil characteristics were provided by pupils and their parents, while different school aspects were examined through teacher questionnaires. As a measure of actual pupil achievement, the results from the practice exam and the final exam were used (in mathematics and biology), which were taken by pupils in 2015. The results of the TIMSS study, in which the same pupils participated in 2011 as fourth graders, were used as a measure of previous achievement.

Utilizing data from different education levels (ISCED 1 and ISCED 2) and different sources (teachers, parents, and pupils) was enabled by a coding system. All research participants were guaranteed anonymity, with questionnaires sent to the research team without personal information, only with a code, within closed envelopes and through school coordinators.

In this study, a sophisticated analytical tool was used – the hierarchical linear modelling – which allows for a simultaneous analysis of the pupil achievement factors at different levels (the pupil level, the teacher/classroom level, the school level). Since the data did not fit a three-level model, this research used a two-level model, which included pupil and teacher levels. After we considered the individual pupil characteristics, we analyzed the effect of particular teaching practices on mathematics and biology achievements. We also examined the effect these teaching practices have on pupil interest in mathematics and biology.

3 Management of time, Classroom as a learning environment, Structuring, Orientation, Application, Teaching-modelling, Questioning and Assessment.
4 Choosing these two subjects was conditioned by content of the TIMSS tests.

INFORMATION ABOUT THE PROJECT

Title of the project:
IMPROVING EDUCATIONAL EFFECTIVENESS OF PRIMARY SCHOOLS (IEEPS)
http://ieeps.edu.rs/

Registration number:
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Partners:
Faculty of Education (Univeristy of Kragujevac, Jagodina, Serbia)
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Institute for Educational Research (Belgrade, Serbia)
http://www.ipi.ac.rs/
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