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TEACHING MATHEMATICS – COMPARATIVE METHODS AND LEARNING TECHNOLOGIES¹

Summary: In this paper we have investigated the possibilities of application of a form of innovative teaching method drawing on the holistic and comparative approaches, and the need for its further expansion through new learning technologies.

The proposed solution gives some answers to the questions of preservation, transposition and improvement of traditional and modern methodology of teaching mathematics.

The method was tested during three school years. The subjects in this research were students in the age group from the first to the fourth year of the Secondary Technical PTT School in Belgrade, belonging to all the educational profiles, i.e. classes with different annual mathematics classloads; 11 classes took part, with 308 surveyed students in total. The experimental method was combined with systematic non-experimental research. As regards the research techniques, the questionnaire was applied as a system of closed-ended questions with a view to measuring the presence of defined indicators in the realized classes. The questions in the questionnaire had to be answered in writing. Assessment scales were created for the students' evaluation sheets.

In this paper we intended to show how the student is guided and instructed to overcome all the obstacles in mathematics, gradually, and not how to understand everything easily with no effort.

In line with our intentions and expectations, we can conclude that only an individualized and yet comprehensive approach to each student as subject at the centre of the teaching process, and their learning through participation – can enable the student to acquire knowledge at their own

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pace, to become more interested in this science, think more creatively, develop their own (critical) opinion, apply their mathematics knowledge, cooperate, demonstrate what they know, develop the competitive, team spirit and more lasting knowledge.

By analysing the relevant literature dealing with improving teaching methodology, we can conclude that: the cyclical nature of theory, practice and experiment, as well as the fact that different mathematical questions bring about yet new ones, leave space for further research into the comparative methods of teaching mathematics, and not only mathematics. The power of mathematics is in its idea. As a result mathematics, as a concept, takes us wherever we want to go.

Key words: *teaching mathematics, holistic methods, learning technologies, learning through participation.*

INTRODUCTION

The holistic approach in the process of teaching mathematics and holistic methods, which are not only humane, but fine and noble as well, are a guarantee that in the part of educational work involved in teaching mathematics where there is no alternative to the responsibility of a teacher, what is implied here has enduring meaning.

The teaching of mathematics in primary and secondary schools needs to be reformed – both in terms of importance of the presence of mathematics in schools, and in terms of importance of the contents offered through teaching mathematics. Unfortunately, there are not a sufficient number of studies dealing exclusively with investigating the applied innovative or comparative teaching methods in the mathematics teaching process, their effects and evaluation, first and foremost by the students themselves. Larger by far is the number of studies dealing with educational consequences, the syllabi and curricula designed for teaching mathematics.

To the best of our knowledge, we have not been able to find any similar or identical related studies which would in a similar way evaluate the application of a selected modern teaching method along with its further development and improvement in technological terms.

It is our intention in this work to present the explored possibilities of application of a modern teaching method, emphasising the need for its further expansion by new learning technologies, as well as to analyse all the implied results according to the predefined principles

and defined evaluation indicators. In addition, we intend to answer, or at least raise the question of how to form, or just apply the existing learning technologies as further improvements to innovative teaching methods, suited to the age characteristics of students in the mathematics teaching process, as well as what the students' *age characteristics* are in reality, as opposed to absolutely imaginary assessments and overestimations.

In line with the tendencies and needs of the teachers of mathematics at this digitalised age, as solving any mathematical problem has an inventive and creative side to it, new learning technologies are a creative process filled with challenges, which are additional motivating factors to overcome them. The application of digital online learning at schools in Serbia is lower than the OECD average. The statistics indicate that 46% of students in Serbia do not use computers at school, notwithstanding the improvement since 2009. And the results of the Case Study on the application of digital and online learning in occupational education in Serbia demonstrate a similar improvement (Ministry of Education, Science and Technological Development Serbia, 2017 from <http://www.mpn.gov.rs/wp-content/uploads/2015/08/Okvir-digitalnih-kompetencija.pdf>).

Innovative methods and digital technologies are important and, this study shows, necessary in modern mathematics teaching, as the teaching materials used in classes are more specific, and the teaching subject matter more acceptable to all students, the classes are more interesting and meaningful, and the students more highly motivated, with deeper concentration and attention, thus adding value and quality to the classes. While teaching creatively, a teacher of mathematics has high chances of developing in their students creative qualities, love and desire for mathematics and learning in general.

Finally, we do not always have to learn from experience, as the modern age offers few reasons for learning mathematics. And its applicability in terms of creativeness in mathematics requires awareness of its applications.

The treasure trove of methods which lead to acquiring mathematical knowledge required for understanding the quantitative and spatial relations and laws pertaining to different phenomena in nature, society and everyday life, which also successfully cultivate love for mathematics, is very rich.

THEORETICAL APPROACH TO THE PROBLEM

The importance of innovative methods and forms of teaching mathematics. Every day mathematics comes to be increasingly applied in nature and society alike. As a result of the application of mathematics in everyday life, a large number of interesting atypical tasks have been devised. By their content, some interesting way of solving them, and indicating some attractive characteristics of mathematical features, these tasks facilitate the acquisition of knowledge and even intensify interest in independent education in mathematics. In addition, these tasks encourage the students' creativity and freedom of spirit, and contribute to popularising and expanding interest in mathematics, as well as in the world around us.

Whether relying on the traditional, or the modern methodology of teaching mathematics, the teaching of mathematics should combine usefulness with pleasure, answer the questions of not (only) how something works, but why it is required and interesting to know that, because mathematics is so serious that not a single chance should be missed of making it more fun.

Freedom and discipline as two sides of the coin of teaching mathematics require the authority of teacher only in terms of help in developing the personality of students (Montessori, 2013). Helping a child in the modern age also consists in preparing a well-devised environment including all the elements the child requires to develop. As a result, well chosen didactic materials, such as digital technology materials, in itself lure the child's curiosity, motivating them for work and investigation, for learning (Ovcara, 1990). The required early recognition of specific differences in individual children's development, i.e. the inevitability of teaching heterogeneous classes, is only possible through cooperation and joint work on the tasks at hand.

In view of the aforesaid, when we know that the recognition of mathematical symbols and their adequate manipulation in thought processes have a long and particularised development, it is clear in more ways than one that in the process of acquiring mathematical knowledge every child is a personality with their particular qualities and that traditional forms and methods of work should be improved and refined by applying the holistic approach, holistic methods and forms of pedagogical work with elements of multifrontal teaching, along with modern innovative teaching methods in a digital environment (Bojanin, 2002).

It is precisely in the ability to recognise and apply various strategies in overcoming problems in teaching primary and secondary school mathematics, in innovating and refining

teaching methods, work forms and content, that the competence of a teacher is reflected. At the same time, the teacher of mathematics for the digital age does not have to be a scientist to correctly and appropriately apply its scientific methods in teaching the principles of mathematics as a science and its scientific methods (Kurnik, 2005). In the teaching of mathematics it goes without saying. The question of veracity is not just important – it is crucial for mathematics. Thus the truths of mathematics in pedagogical work also need nice historical stories to accompany them for both the declared and those other potential lovers of meaning to be attracted to them.

The development and application of comparative methods and forms of teaching mathematics . The reform of the mathematics curriculum in the second half of the 20th century, through the OECD Dubrovnik Programme of 1960, implied the realisation of a new dominant idea of the set approach to teaching mathematics, and in teaching methodology the presence of the following triad: theory – experiment – practice. The passed reform decisions represented a significant turning point on the way to modernising the teaching of mathematics with a view to reducing the existing disparity between the development of mathematics as science and its development as a school subject. It should be noted that even before this programme was passed, prof. Stanko Prvanovic, a reformer and teaching methodologist, had laid the foundations to the methodology of contemporary mathematics teaching in Serbia, and made a remarkable contribution to establishing the Methodology of Mathematics of a multi-scientific discipline: mathematics, pedagogy and psychology, drawing on the development of mathematics as science, the development of pedagogy and results of psychological research. The reform of teaching mathematics at the time required transcending the seeming disparities between the modern and the traditional (Prvanovic, 1981).

As early as that, certain elements, and even multifrontal teaching in full swing, could be perceived in the methodology of teaching mathematics. The focus is on the student, the student in the position of subject, the position in which they are guided to shape and form their mathematical education by their own endeavour. The central place was assumed by the so-called programmed teaching, individual or individualised teaching and some forms of group work and teaching (Prvanovic, 1972).

Nowadays, the so much essential methods of comprehensive, individualised holistic approach and the multifrontal modern approach to teaching mathematics are only just emerging,

unrecognisable and all but non-existent in the educational process of acquiring, and further application, of mathematical subject matter. It is therefore advisable for the teacher to conduct an assessment of their own skills in relation to contemporary teaching methods and technological literacy, and then, through specific activities, to develop their students' curiosity, inclination towards independent mental activity, and point out to them the paths of new discoveries.

Everything indicates that modern methodology of teaching mathematics should also shape the teaching of mathematics as a system founded in the development of both mathematics, as well as, no less considerably: pedagogy, psychology, computer science, information theory, operational research, then the development of technology, primarily information technology, computer engineering and learning technologies. In this environment the teacher of mathematics would be more like a consultant, mentor, facilitator, and one who points to the sources and content of knowledge, and the student a subject independently acquiring knowledge, skills and habits and developing their creative abilities. Through this approach to teaching, the teacher of mathematics would be even more driven towards innovations and investigation into new knowledge together with students, not instructing, but helping them in their development and *self-regulated learning*, motivating them to develop a personality that will think creatively, constructively, critically, while the teacher would become aware of the significance of their own responsibility in the role of a *reflective practitioner*. Thus they would improve their pedagogical and educational work, resolve many dilemmas, improve the teaching planning method, expand the range of methods they can employ in teaching in more innovative ways. The interest and resourcefulness of students in such a working environment would further encourage the improvement of both the teaching and the teacher, while the teaching would become more dynamic and interesting to all the students. In a proper and imaginative way, the focus in teaching mathematics would shift towards the interactive and interdisciplinary approach.

These new and further findings and their application have been motivated by the attitude of the most outstanding didacticians, that if we are searching for a good example of the educational process, that example of testing and evaluation must be from the teaching of mathematics.

A METHODOLOGICAL FRAMEWORK OF RESEARCH

Solution through the realisation of the innovative teaching method Two Stars and a Wish. The holistic, i.e. comprehensive approach to the application of modern innovative methods in teaching mathematics significantly contributes to the development of the abilities, skills, attitudes and competence of young people for living in modern society in general, at a time when the school and the teacher of mathematics are expected to know and apply a highly diverse range of appropriate teaching methods and forms of work, by means of which the students would be given a chance of proper development required by the modern age.

One form of innovative teaching method of the holistic and multifrontal approach in mathematics classes, entitled *Two Stars and a Wish*, which develops the creative, inventive and critical opinion of students, can be applied in the process of self-regulated learning or group problem solving – both in covering new subject matter and revising the previously learned ones. It is useful for the development of students' healthy interrelations, for strengthening their team spirit and improving their communicative skills. As opposed to the usual monotonous classes of mathematics where the teacher takes the stage as the communicator of knowledge and information, while the student receives the knowledge passively, in classes where the innovative holistic methods and approaches are applied, the teacher enables the students to take an active part in teaching and learning, namely to learn through participation (Table 1).

The *Two Stars and a Wish* method is relatively simple and can be used with different variations. It depends on the creativity and inventiveness of the teacher of mathematics, and on its adaptability to a heterogeneous class. It can be specifically used for practising the students' self-evaluation and peer evaluation. In addition, it teaches the students how to praise others, to point out their mistakes to them, but also to accept criticism.

The realisation of this method requires that the students are given specific tasks to be later assessed and evaluated, for the solving of which they have previously acquired the required knowledge, or have been solving them while revising, practising and expanding the acquired knowledge. It is therefore important for the teacher to carefully select the teaching content and materials adapted to absolutely all the aspects (the holistic approach) that the application of this method involves.

The method is realised in several stages. First, each student realises the task assigned to them in the best possible way and according to their capacities and acquired knowledge, on one's

own. After the time assigned for this part of the class, every student forwards their work to another student for checking, in a group or pair, depending on the way the teacher has initially conceived and planned the class realisation. The students then assess others' work as follows: they assign two stars –the stars serve to highlight any mistakes and detected omissions, write down two criticisms next to each star, and a wish inside a heart sign – as a proposal, suggestion, guideline for improving a specific element of knowledge or rather as a praise, delight and compliments for expertly solved problem tasks. Depending on the number of students per class, each student will check one work if the activity is planned to be performed in pairs, or several works passed around if the activity has been planned to be done in groups. The work of each student would be passed around and be evaluated as many times as there are students in the group. All students within a group would sometimes not perceive the same good or bad elements in the same work. After a period of time (which can be limited and predefined), the teacher stops the process. Each student then takes his work and checks how it has been evaluated. They are expected to make a list of the stars and wishes from the heart, namely all the given suggestions and advice, so that they can improve and correct their work, but also become aware of possible praises and support for even greater improvement. The students self-evaluate the results of their own learning, achievement and other activities for the area in question in the personally created self-evaluation table *My Learning and Improvement*, which is on the front cover of the school notebook, in the self-regulated learning process. Homework assignments can also be used as teaching material for evaluation, and while quite applicable to pair work, this method is even more interesting and productive in students' group work.

Table 1: *The description of activities during one representative class*

	The teacher's activities	Students' activities
The introductory part of the class (preparation for active learning)	duration: 5-10 minutes	Along with asking revision questions and getting the expected (correct) answers of students... we check homework assignments – discussing exceptional points in individual assignments;
	Introducing the students to the topic; presenting the contents; developing motivation and interest, and activity of students.	- identifying more difficult examples (or parts), giving suggestions, instructions, helping students;
	The teacher devises, creates and organises the situation and the manner of learning.	- guiding the students to cooperate and display solidarity in class;
	If required, as in any part of class, the teacher (in the role of mentor, not instructing, but helping) will give suggestions and lead the students to achieve the aim set to them more easily.	- (possible) task solving with the teacher's help.
The middle part of the class (learning and the results of learning)	duration: 30-35 minutes	When the teacher prepares and distributes the tasks, the students are first motivated to arrive at the solutions on their own, and then by application of the TWO STARS AND A WISH method, to give their work for evaluation to a friend who is their pair at the desk (or in the group), following which they finally realise the self-evaluation of their work and achievement.
	Pointing out the class objective	The students are given tasks, they understand their current activities and actively approach problem solving.
	*The content of the central part of class (revision, practice, even systematisation) mainly consists of special – additional materials! Due to the scope of the content, examples, solved tasks, selected in line with the methodology; various notes, drawings which are sometimes required.	T A S K S : * In the teacher's special, additional materials; in electronic form or prepared work sheets with tasks from the students' compulsory reading list.
	The teacher will distribute the prepared worksheet or electronic form tasks to all the formed pairs – groups, or individually to each student.	All the students from the other groups – pairs follow and take part in the discussion about solutions. They cooperate when required and learn in cooperation – we make comments, (self-)evaluate the total and individual contributions to arriving at the solution of the mathematical problem set before each group (and individuals). (individually counting our “stars” and “wishes from the heart”, i.e. criticisms and advice for previous and future progress in learning and work in general).
	In this central part of the class, as in any other, the teacher (in the role of mentor, not instructing, but helping), will give suggestions and lead the students to achieve the aim set to them more easily.	

The final part of the class (reflection and self-reflection—one look back on the class)	duration: 5-10 minutes	Students actively follow and summarise important elements of today's class; they note down the following activities with the aim of making progress and in the form of homework.
	A summary of essential and important content; questions – answers; homework!	
	The teacher notes down and evaluates – formatively and summatively – together with students – all the forms of activities and endeavour in learning and overall progress; In a committed and objective way they evaluate the content of the devised plan and achievement (reflection).	They self-evaluate their own progress. They self-evaluate the results of their own learning, achievement and other activities relating to the previous area of learning in a personally created self-evaluation table "My learning and progress", in the self-regulated learning process.

The process of researching a given problem . Research into a given problem was based on the method which included the following phases: formulating the problem to be examined, drawing up the research plan, identifying the procedures to be used in collecting the data and their processing, carrying out the research, processing the obtained results, their analysis and interpretation. It combined the method of experimental and the method of systematic non-experimental research.

Experimental research was chosen as the most suitable scientific method for identifying the causal relationship between certain phenomena. It is *systematic* – because it follows everything of importance to the phenomenon being examined, and *controlled* – taking into account the conditions in which the phenomenon is being observed.

With regard to the *techniques* of this (mathematical – pedagogical – psychological) research, the *questionnaire* was used which represents – in line with specific principles – a system of closed-ended questions of different types, with students selecting one of the provided answers in terms of evaluating the presence of defined indicators of the applied method and realised classes. The questions from the questionnaire had to be answered in writing.

Evaluation scales were created, which determine significant points, or phenomena, in the students' evaluation sheets, according to the assessors' estimation.

Further parameters that were considered in the qualitative evaluation of the results relate to the following elements: the effort the students make in solving the questionnaire, their current emotional state such as fear of being surveyed, as well as individual characteristics – a slower or quicker pace of mental activity. However, the aforesaid factors are of negligible importance and

effect to the psychological process of realisation of evaluation of mathematics classes within this research.

The survey was devised, prepared and carried out according to predefined principles, as only in that case can it have any value and contribute to this research, which will be further discussed in some future studies.

Classes of mathematics based on this idea and methodology of self-regulated learning, the holistic and multifrontal approach through the application of one of the innovative teaching methods and its variations, with the teacher playing the reflective practitioner's role – have been conceived, planned, realised and evaluated in the course of three school years.

During the school years: 2013/2014, 2014/2015 and 2015/2016 all the classes were chosen in which the teacher of mathematics was teaching in the current years, without later repeating the evaluation sheets, i.e. questionnaires on the opinions and attitudes of the students who had already had an opportunity to evaluate the realised classes, but waiting for the realisation of some new teaching contents, as well as the completion of the educational work period in new classes in the following school years. Thus the participants in this research were students of all ages from the first to the fourth class of the Secondary Technical PTT School of Belgrade and all the educational profiles of this school: PTT Traffic Technician, Telecommunications Technician, and Telecommunications Network Lineman, i.e. classes with different annual mathematics class load, namely with two to five classes a week. The average number of students in those classes is 28, and 11 classes were surveyed in total, while sometimes not all the students took part due to absence, so that the total number of the subjects surveyed was 308 students.

The students could, but did not have to sign themselves in the class evaluation process, i.e. survey. As a result, the value of their openness and honesty in their answers is all the more significant. Some of them were not anonymous, and the answers were: uninformed, unlikable, critical and derogatory assessments, charming, funny, but also clumsy, inspirational, motivating for the teacher and edifying; as well as those anonymous, and at the same time: rational, accurate, complete, surprisingly precise, appealing, imaginative and above all – confirming the teacher's work and endeavour. Taken all together and in every possible sense, they were the answers that additionally motivate the teacher (Table 2).

Table 2: *The results of surveying the students – the evaluation of the realised classes*

Questions	The presence of evaluation indicators				
	5- completely	4- to a great extent	3 –mostly	2 –to a lesser extent	1- not at all
1. The presence of innovations (in the work method and content) in mathematics classes is:	11.11%	45.37%	35.19%	6.48%	1.85%
2. The presence of scientific, but also creative thinking in our mathematics classes is:	29.63%	32.41%	29.63%	6.48%	1.85%
3. The presence of development of critical opinion and thinking in relation to the class topic is:	16.67%	46.30%	19.44%	13.89%	3.70%
4. I like different forms of work in class (individual, pair, group work etc.) and work methods present in our mathematics classes:	46.30%	23.14%	21.30%	8.33%	0.93%
5. I am aware and understand that this work method contributes to my self-education and motivates me for lifelong learning:	43.51%	24.07%	21.29%	8.30%	3.70%
6. I am convinced that it is useful and in conformity with contemporary social needs and trends for active learning:	33.33%	33.33%	26.85%	5.56%	0.93%
7. Would you repeat taking part in similar mathematics class activities and would you recommend them to others:	YES: 88.90%	MAYBE: 1.85%	NO: 9.26%		

RESEARCH RESULTS

The analysis, evaluation and implications of the research results. The results of the research together with perception theory – all the prominent elements and factors throughout the learning process, the process of learning for the sake of learning, then insight, understanding, comprehension, acceptance and application of the acquired knowledge - confirm all the individuality, and personalized individuation process of each child.

We could say that every child is talented for mathematics in his/her own way. And that understanding the importance and essence of mathematics in general and its application, i.e. understanding the world around us, is of extreme importance.

If we want to understand that solving any big problem is one new discovery, we should also understand the big role teachers play in the process of motivating children for learning – through activities, developing their curiosity, affirmation, pointing out respectable examples and generally developing and maintaining the children's interest in learning mathematics – through mathematics contests, mathematics quizzes, exhibitions and video presentations, publications and constant professional advancement and learning by the teachers themselves, by laying more emphasis both on the learning process and the contents, but also by a more efficient strategy and active teaching – because many ideas come from children. It is also advisable to critically observe the content of teaching with a view to refreshing it and introducing something new and inspirational.

This example was intended to demonstrate how a student is guided and trained to overcome all obstacles in mathematics, gradually, and not how to understand it easily and without effort.

After all, the educational value of teaching mathematics is precisely that success is achieved at the price of great effort, great but not futile, great, but not like an effort which bothers and exhausts the student, rather like an effort which gives the most wholesome pleasure, and as such strengthens and empowers the student's whole being. Memorising is tiring. Real mental and creative work is not tiring, but refreshing, activating all the student's functions, while the results are the purest pleasures, real joy, a joy which elevates, refines, keeps us from all deviations, strengthening our mental and general well-being.

In other words, a well-founded teaching methodology as a multi-scientific discipline based on mathematics, pedagogy and psychology, the holistic comprehensive approach and holistic methods in teaching provide all the necessary and sufficient opportunities for further perpetual improvement and promotion of teaching mathematics, the teachers of mathematics and teaching of the digital age, in particular nowadays in the era of electronic culture, communications and new learning technologies.

In view of that, new ways of assessing and evaluating many achievements, causes, effects, but also solutions, are either found in these research processes, or in the mutual evaluation of

students and teachers, as well as in the comparative evaluations of exemplary educational systems, in this case in the Republic of Ireland.

Comparative example with teaching mathematics in the education system of the republic of ireland. In the Republic of Ireland, the school system is organised into four levels, according to the age of students. The school starts between the ages of three and five, at the junior level, which is the first of eight years of primary school. The junior level consists of two years: the lower (junior) and the higher (senior) levels. The classes are less strictly organised at this educational age, with students learning mathematics through interaction (in pairs, groups), as well as cooperation with the teacher, so that the learning of mathematics is conducted through the use of workbooks and toys. Following this educational level, the students enrol in the primary level of education which lasts six years. At this level, classes are more strictly organised so that learning primarily takes place through the use of workbooks, with teachers carrying out small demonstrative mathematics tasks, with the application of modern teaching methods, with less interaction or in groups. The primary education level is taught at the same level of difficulty for all students, and is modelled in such a way that the students learn the basics and fundamentals as preparation for the following years of education. The students are tested five times at the primary level for achieved mathematics outcomes, obtaining a percentual result of their own achievement. The junior level curriculum includes numbers, planes, space, data, algebra and measurements.

The students enrol in the second (secondary) level of education around the age of 12. This educational level is divided into two cycles. The first is the cycle of younger children (junior), which consists of three years of education with the final exam and acquisition of the junior certificate. At the junior level students, together with their parents and teachers – mentors define, i.e. choose at which level of difficulty to learn mathematics. There are three different levels of difficulty, as follows: the foundation, ordinary, and higher levels. The students are split into groups based on similar abilities according to the purpose of teaching the syllabus, which involves solving moderate problems. The higher level is the most advanced level of learning mathematics at the second education level, which includes general syllabi with complicated exercises and tasks to be solved. Generally speaking, the junior cycle syllabi cover algebra, statistics and probability, functions, geometry and trigonometry. This is followed by the junior certificate exam, after which the students enrol in the senior cycle of the second education level, which lasts two to three years

and which is also divided into three levels of difficulty, like the junior cycle. This cycle concludes with the leaving certificate exam, while the evaluated achieved outcomes as the result of the exam are used as points for enrolment in tertiary education. The teaching syllabus for the senior cycle covers the same areas as the junior cycle, with the topics further expanded by advanced mathematical concepts such as derivatives and integrals, but also prescribed mathematical proofs of theorems.

The teaching of mathematics at all the levels of education in the Republic of Ireland tends to be formal, little focusing on the practical applications of what is being learned, on the contents from the history of mathematics, or on application in projects of any kind. The shortage of practical applications of mathematics can be explained by the fact that this part is, through particular topics, contained in specifically applied mathematics. Applied mathematics includes the use of mathematics in physics, engineering, biology, etc., so that it is avoided in the core subject of mathematics.

In the Irish school system, like in Serbia, in the period until 2009 mathematics was taught primarily and exclusively by using the blackboard and books (printouts). This was followed by technological changes in teaching methods. New methods of teaching mathematics through various practical applications and by means of digital technologies were introduced in Ireland in 2011. Observed through the comparative analyses of the educational systems of Serbia and Ireland focusing on teaching mathematics, the presence of the digital environment and its application, as well as tendencies towards additional learning technologies, are almost the same at the moment; but still with a noticeable advantage in the possibilities and range of applications in the teaching process in Republic of Ireland's mathematics education.

The system of teaching mathematics in the educational process of the Republic of Ireland allows and enables the students to acquire such knowledge that through practical examples in the course of realisation of the syllabus they learn how to apply it in real modern life.

CONCLUSION

These contents in the teaching process, stimulating the student's curiosity, encourage the student to ask questions to acquire new knowledge. The wish for such innovation and investigation

in teaching mathematics was prompted by frequent comments on the sluggishness of our educational system, on school not being difficult to children, but boring and archaic.

It is demonstrated that only through the individualised, yet comprehensive approach to each student as subject at the centre of the teaching process, by learning through participation – does the student acquire new knowledge at their own pace, become more interested in science, think creatively, develop their own (critical) opinion, apply the knowledge from mathematics in everyday life, cooperate, show everything they know, develop the competitive, team spirit and more lasting knowledge.

Wishing to give answers and shed light on some other upsides and downsides of teaching mathematics in Serbia, and in the world for comparison, we settled on this subject. Even though we knew from the beginning that different mathematical questions bring forth other new questions and solutions, we know for certain that the idea of mathematics remains its power. For that reason we recommend the application of what we have presented here or some variation of it in other school subjects.

The cyclical nature of theory, practice and experiment, and further research into the subject of comparative methods and forms of teaching mathematics – and not only mathematics, should turn into ever active statistics the aim of which is progress. In the belief that progress in well organised societies is centred on education systems the ethics of which aims at strong selection and even stronger vision. Because of that, mathematics as a concept is a key driver of change.

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