CORRELATION EDUCATIONAL MODEL IN PRIMARY EDUCATION CURRICULUM OF MATHEMATICS AND COMPUTER SCIENCE

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Abstract - This article gives insight into methodical correlation model of teaching mathematics and computer science. The model shows the way in which the related areas of computer science and mathematics can be supplemented, if it transforms the way of teaching and creates a "joint" lessons. Various didactic materials are designed, in which all instructional content is available to students on the internet in Moodle system, using multimedia and didactic games.

I.INTRODUCTION

Methodological proposal of a creative mathematics teaching that we elaborate on in this paper will apply to methodological solutions to certain mathematics classes, with a strong correlation between the subject of mathematics and the subject of computer science. As the National Curriculum Framework of the Republic of Croatia [1] within the educational objectives and areas specifies, it is necessary to encourage students in their work, instruct them in the application of new technologies, introduce diversity in the teaching of mathematics, as well as to prepare students for a lifelong learning. Encouraging the use of various didactic materials in the learning process opens up the possibility of using computers in the teaching of mathematics, with a special emphasis on the particular IT possibilities, such as certain computer programmes designed for specific areas of mathematics.

While in the teaching of arithmetic we use programmes such as Equation, for writing functions, roots, powers, fractions, and certain elements of mathematical language, for geometrical shapes and structures we usually use Sketchpad and/or GeoGebra. The use of other computer programmes and possibilities, which have a wider application and are not specialized mathematical software, is also indisputable. Therefore, in teaching mathematics we use programmes such as PowerPoint and the Internet search engines, when we utilize them for finding information, or as supplements to didactics of mathematics. . Each of these computer programs can be implemented using Moodle in educational content available on the internet.

What is interesting in computer programmes is the sphere of constant upgrading and improvements, so that students, by learning and using modern computer didactic resources, apart from acquiring mathematical competence, acquire a kind of computer competence as well. By acquiring mathematical and computer competence, students create the best basis, whether from these or some other areas of learning and studying, for a successful beginning of a lifelong learning process. [2]

II. BLENDED LEARNING IN MOODLE SYSTEM OF LEARNING AND TEACHING

„Moodle: Modular, Object-Oriented, Dynamic Learning Environment (Hearrington, 2010.) is a Course Managment System-CMS with open source that can also be described as Learning Management System-LMS or Virtual Learning Environment-VLE. Moodle is a free web application that teachers can use to create effective online learning systems. [3]Moodle has specific Universal Instructional Design-UID which trough this and similar systems offer a wide range of diverse educational opportunities in E-learning. [4]

It consists of didactic materials and activities that enable the achivement of educational goals for each student regardless their age, according to his individual ability to see, hear, speak, move , read , write , understand language , attend , organize and participate in the paper and remeber. The universal design of learning is achived trough the realisation of adaptive features in the curriculum. [5]

Creating a Moodle course (instructional units, materials and teaching activities)can be integrated into various categories: media, tasks, web links, calendars, news, assessment, quizzes, formas and conversations (chat). (Figure 1) The main idea is based on constructivist pedagogy, which starts from active participaton and contribution to student teaching. [6]

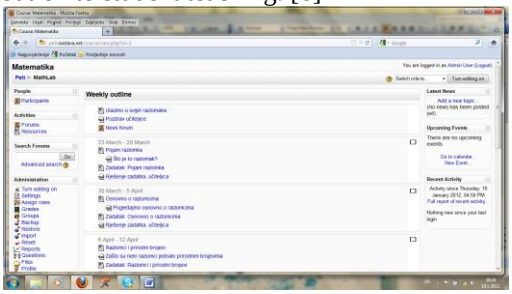

Fig. 1: Mathematical topics in Moodle [7]

III. POWERPOINT IN TEACHING MATHEMATICS

Given the fact that nowadays most schools are equipped with computers, the question arises to what extent can they facilitate learning and mastering the curriculum. Today, computers can be used as a demonstrational teaching tool. By using a computer and a projector, and, more recently, an interactive whiteboard, a teacher is given the possibility to demonstrate a certain mathematical content, phenomenon, or a rule, in front of the whole class. PowerPoint is used for making multimedia presentations, enabling the adding of effects, images, sounds, links. It is used as a supporting tool in presentations and clarifications of various problems. The use of PowerPoint in teaching mathematics is manifold. One of the great examples is the sixth grade teaching material, operations with fractions. An excellent idea for teaching the numerical line is to show examples of a numerical line in PowerPoint, in a way that the numerical line is shown empty first (Figure 2), with, e.g. a sketched unit of length, and then other assigned numbers or fractions are placed on it through a brainstorming exercise (Figure 3).

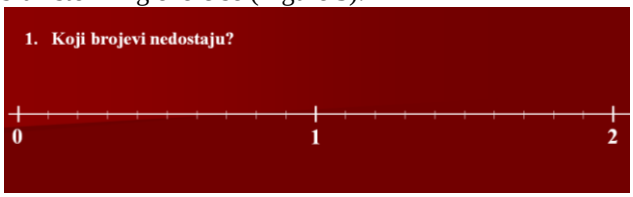

Fig. 2 : Empty numerical line

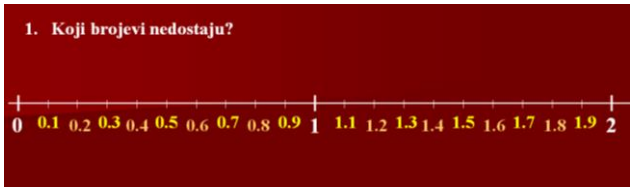

Fig. 1: Filled numerical line

This method is very fun because it provides a teacher with more time for practicing various examples, and oftentimes students find it easier to survey than a traditional drawing on the blackboard.

Another excellent example of a creative learning of mathematics is the teaching of geometric solids in the eighth grade. While introducing the geometric solids teaching unit, starting with the concept of a figure, surface and perimeter, by using PowerPoint we can create a semblance of the third dimension and introduce the concepts of a solid, volume and superficies, by comparing them with each other.

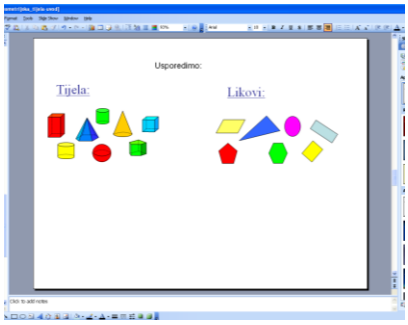

Fig. 2: Comparation of geometrical elements

The advantage of this method is that it is much easier to draw various solids at home, and in comparing them we can go back to any figure or solid (turning the slides backward) and compare them the unlimited number of times, which is impossible when using a standard blackboard (drawings are eventually erased due to a lack of space on the board).

As with any teaching tool, the use of PowerPoint in the classroom has its advantages, as well as disadvantages. When deciding when, how and why to use PowerPoint in teaching, it is necessary to consider whether its use improves the teaching, is the achieving of educational goals more effective, and how we facilitate student learning through its usage.

IV. GEOGEBRA

GeoGebra [8] is a free, dynamic mathematical software which interconnects geometry, algebra and calculus. It has been developed by Marcus Hohenwarter and the international team of programmers, for the purpose of teaching mathematics in schools. With GeoGebra, we can make structures with points, vectors, segments, lines as well as functions, and then change them dynamically by using the mouse. The most important characteristic of GeoGebra is a dual view of objects; each expression in the algebra window corresponds to an object in the geometry window and vice versa.

By using the construction tools on the GeoGebra toolbar, it is possible to make structures on the drawing surface, while at the same time the algebra window shows the corresponding coordinates and equations. GeoGebra has a truly diverse application and is very useful in teaching geometry. Given the fact that the software is free and available to everyone, it can be burned to any school or home computer. In the correlation between mathematics and computer science, it is a good idea to practice previously learnt mathematics teaching material in computer science classes. It is very simple to draw all the polygons, and their inscribed and described circles, which is the material taught in all primary school upper grades.

As the simplest example we will give a triangle construction and drawing of its described circle. The procedure is very simple, and the options used are polygons, bisector length and drawing a circle determined by the bisector and one point (Figure 5)

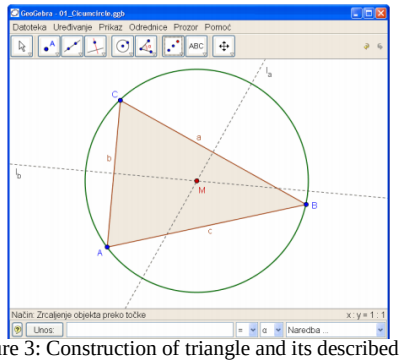

Figure 3: Construction of triangle and its described circle

Another very simple example of using GeoGebra in teaching mathematics is the construction of a circle and its

tangents. First, we input the equation of a circle, then the center and, finally, the tangents (Figure 6).

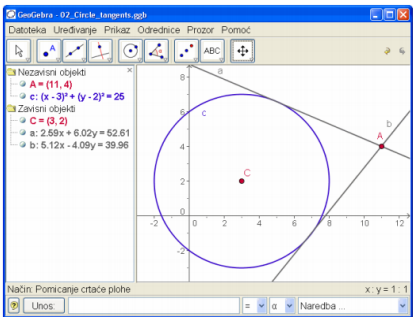

Figure 4: Construction of a circle and its tangents

It is important to note that in order to use GeoGebra, one has to be familiar with some of the basic theoretical knowledge of mathematics, master the teaching material associated, and also have the computer competence. In order to successfully engage in the process of knowledge acquisition, it is important for students to make discoveries and gain knowledge on the basis of their own experiences. GeoGebra is a great program which, due to its dynamic presentation and interactivity of mathematical objects, provides a dynamic virtual environment for research. One of the goals of teaching mathematics is to teach students how to think and enable them to solve problems in their lives, and GeoGebra helps us greatly in that task.

V. INTERACTIVE WEBSITE

One of the questions that has recently started to arise more frequently, is how to teach mathematics nowadays, and to what extent and in what ways to use ICT in mathematics teaching. Teaching mathematics by using a computer does not require any complicated programmes, but very simple browsers such as the Java browser. By installing some of these programmes, it is very easy to have fun with mathematical material in mathematics or computer science classes, or at home. Today, it is possible to find numerous web pages of that type on the Internet, which presents us mathematics in a more fun and different dimension. In that way, learning is more accessible to new generations of students, who are growing up with computers, and computers are a part of their everyday lives. Those web pages are very simple to use, and excellent as the correlation of subjects.

The very GeoGebra that we have already mentioned alone enables the creating of mathlets; learning objects covering a specific topic in mathematics, that are designed as interactive web pages consisting of dynamic elements and accompanying text. By creating such web pages, students experiment and gain new experiences, and most of all, develop their own creativity. Of course, for the creation of interactive pages it is important to be familiar with the contents which are being learned.

Another program for creating interactive web quizzes in the form of web pages is called Hot Potatoes. [9] Hot Potatoes is a set of six programmes for creating interactive contents such as quizzes, crossword puzzles, and it has been developed at the University of Victoria in Canada. Quizzes are created by using XHTML 1.1 code and JavaScript. They are supported by all the contemporary browsers, including Mozilla, Explorer and Safari. The advantage of this programme is that it has the Unicode standard and supports the use of any language, including Croatian. It also does not require any programming knowledge; it is enough to enter information such as texts, questions and answers, and the programme on its own creates web sites that are subsequently published on a certain domain. In the background of the quiz there is a statistics programme which, after the quiz is solved, provides the user with feedback on the percentage of the correct answers. The programme is free and available to everyone. And it is obvious that the interactive contents are an item which, in the future, will play an increasingly important role in learning and teaching.

VI. CORRELATION MODEL OF TEACHING MATHEMATICS AND COMPUTER SCIENCE: METHODICAL TEACHING CONCEPT

Blended-learning as a methodical concept provides a model of teaching and learning in which traditional classroom teaching combined and interlaced with e-learning and m-learning (learning through the internet and mobile devices, author's note) do not exclude one another, but according to the principles of constructivist teaching theory complement with their specificities the creation of the educational process. In an effort to find optimal media and methodology for teaching environment in which the student can express his individuality and creativity, blended-learning provides the ability to retain important aspects of students living and working environment: traditional and modern, where technology is implemented in the well-known teaching environment of his classroom, and not only is familiar to student, it is also a part of his everyday life, not only imperative but also a way the new generation of students live and communicate. Classes formed through this methodological model based on constructivism provide insight into the reactions, opinions and possible changes in student attitudes and motivation regarding traditional approach of teaching and learning mathematics, where the acceptance and implementation of new multimedia teaching solutions through technologies that are part of students' everyday life come as a logical solution to form school climate optimal for every child.

Fig. 7: Blended-learning methodology

Blended-learning methodology: http://www.24x7learning.com/images/blended-learning-methodolog.jpg, 29.1.2012

This teaching model provides a framework to form high-quality modern education, correlated between the subjects of mathematics and computer science. The starting idea of the proposed methodological concept is to find the media and the methodology by which the related areas of mathematics and computer science can be correlated to teach. The system Moodle with the listed software provides research, study and work on the mathematical learning material (for example Sketchpad, GeoGebra, Equation, Powerpoint ...) and offers the opportunity to teach computer science through mathematics, and vice versa. On the one hand, IT provides computer processing solutions of mathematical concepts, on the other hand students studying and exploring mathematical problems using these programs expand and complement the IT competence and knowledge.

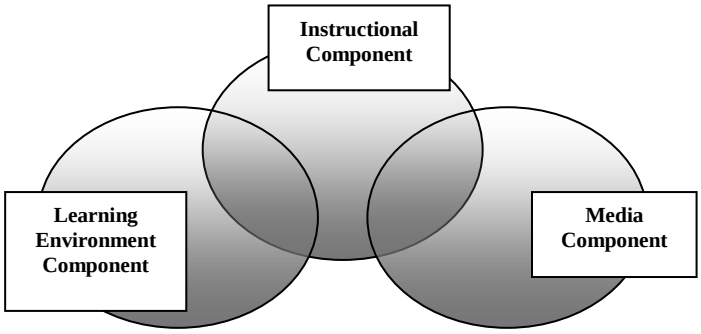

Fig. 8: Blended Learning Model Components (Holden and Westfall, 2010, 39) [10]

Correlation educational model is an idea to join mathematics and computer science teaching curriculum, and can be incorporated into the educational environment to form a joint lesson, teaching both math and computer facilities. The concept of blended-learning provides a framework in which is possible to fit the modern media of communication to the traditional class, making mathematical content available in electronic form, enabled with internet access in classroom, personal computer at home or with mobile device. Optimalization of the teaching process, except to correlate two courses, is an effort to design the learning material and to adopt learning to each child on an individual level (depending on age, prior knowledge, preferences and learning style). Depending on situational elements, it is necessary to make the educational materials available outside the classroom, and regarding child everyday duties and habits, one can study at home computer, or mobile learn studying didactic materials using a mobile device. (Figure 9)

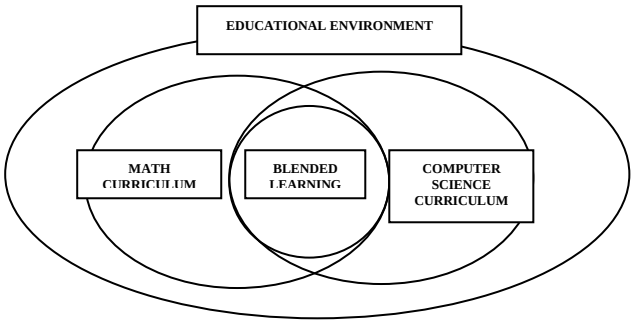

Fig. 9: Correlation educational of mathematics and computer science teaching curriculum

Also, according to the principles of constructivistic [11] theory in which learning and teaching should be construction instead of the instruction, the proposed correlation model provides not only methodical educational sphere, it also contributes to optimize the teaching and communication on multi-level in relation student-teacher, and student-student. Due to a variety of teaching media and teaching methods of correlation, interactivity is implemented by means of communication (mail, chat, forum ...), where participants can comment, criticize and suggest. In addition, there is a possibility for the student to create and update published didactic materials, and in his own individual way, to participate in the making and shaping the teaching and learning process.

VII. CONCLUSION

The modern Curriculum requires methodological improvements that will enable students in primary schools mathematics classes to cope with the teaching material more successfully, which leads to research and designing new forms of a teaching process, in which students will be given a new and different work mode, which would be interesting to them, but also optimal in teaching assignments within which it was constructed.

In that sense, the teaching of mathematics is an inexhaustible source of diverse methodological proposals, especially in the correlation with the subject of computer science. In the computer science sphere, many computer programmes that enable learning various teaching units of mathematics have been designed. [12] Some of these programmes were used in designing the proposed methodological model, replacing the methodological approaches of a traditional mathematics teaching, in order for the teaching process to be conducted under optimal methodological conditions.

The advantage of the methodological model proposed, is also the idea that contemporary students spend much of their working and leisure time in the world of computers. Consequently, there is an assumption that, for the same reason, mathematical teaching units shown in the abovementioned methodological examples could be better accepted than those taught in the traditional way of teaching mathematical contents. In accordance with the technological and, therefore, computer progress as well, we can assume that the generations of students who are evolving accordingly, require a new approach to teaching, which adapts to that progress. [13]

The methodological examples of mathematics lessons that we have discussed, apart from the technological features that each of these computer programmes offers, present two basic, positive methodological aspects: functionality and motivation. Functionality implies striving for optimal achievement of goals and tasks of the lesson by overcoming the shortcomings of traditional teaching, while the achievement of student motivation has been carried out through the correlation between the subject of mathematics and computer science. The aim is to use the aforementioned correlation in this methodological model, in order to completely adapt teaching and learning to communication of contemporary school-age children, by entering the area familiar to students, and that is the area of a “virtual”, computer domain.

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