Report by JICA Trainees from Bosnia and Herzegovina

Development of learning contents with Information and Communication Technology (ICT) and e-Learning Environment for Informatics and Mathematics

Karmelita Pjanić

Pedagogical Academy, Sarajevo

Valentina Mindoljević

Gimnazija Mostar

Ljubomir Petković

Machinist Technitian High School, Prijedor

Bosnia and Herzegovina

August 11, 2005

Center for Research on International Cooperation
In Educational Development

University of Tsukuba

Report by JICA Trainees from Bosnia and Herzegovina

Development of learning contents
with Information and Communication Technology (ICT)
and e-Learning Environment for Informatics and Mathematics

August 2005

Published by
Center for Research on International Cooperation
In Educational Development (CRICED)

University of Tsukuba

1-1-1 Tennodai Tsukuba-shi Ibaraki JAPAN 305-8572
E-mail: criced@human.tsukuba.ac.jp
Printed in Tsukuba, Japan
By Maeda Printing Co., Ltd

CONTENTS:

APPRECIATION

On the beginning we have to express our deep appreciation to Professor Masami Isoda at the Center for Research in International Cooperation in Educational Development (CRICED), University of Tsukuba, who proposed and organized this project. We are not grateful only for organization of this project to Professor Masami Isoda, but for very good guidance trough this course and project from the beginning until its end.

Also, we have to appreciate to Professor Kyoko Kakihana from Tsukuba Gakuin University, and Mr. Hiroaki Kameyama, PhD, on their lessons and guidance.

Our deep gratitude goes for staff of CRICED and other academic advisors.

Realization of this project would not be possible without support of Japan International Cooperation Agency (JICA). We are very grateful to JICA for providing us this unique opportunity to study and work at University of Tsukuba.

Karmelita Pjanić,
Valentina Mindoljević,
Ljubomir Petković
August, 2005

Academic Advisers:

Masami Isoda (Representative and Course Manager)	
	CRICED & Graduate School of Comprehensive Human Sciences University of Tsukuba
Jiro Tanaka	Graduate School of Systems and Information Engineering University of Tsukuba
Tetsuo Ida	Graduate School of Systems and Information Engineering University of Tsukuba
Kyoko Kakihana	College of Informatics – TsukubaGakuin University
Shizumi Shimizu	Graduate School of Comprehensive Human Sciences University of Tsukuba
Morio Yoshie	Academic Computing and Communication Center & Graduate School of Comprehensive Human Sciences University of Tsukuba

Teaching and Technical Staffs:

Hiroaki Kameyama	CRICED & Graduate School of Systems and Information Engineering – University of Tsukuba (until March 2005)
Takeshi Miyakawa	CRICED & Graduate School of Comprehensive Human Sciences University of Tsukuba

INTRODUCTION

Mathematics science, like all sciences, is developing and changing. In the last hundred and fifty years it has changed significantly. New mathematical theories are made, new approaches to old problems, new methods, new symbols and terminology. Old areas of mathematics are now introduced in new, modern and economical ways.

Education of mathematics hasn't followed the development of mathematical science all along the way, but now everywhere in the world new curriculums are developing to adjust mathematics education to problems of general culture and modern science. Social development and new ways of living show the importance of efficiency, usefulness and meanings of mathematics as a form of culture in today's social structure. Also, well known fact is that the Mathematics' biggest importance is in intellectual development of a personality.

Today's world we cannot imagine without the use of information technology and computers. It is everywhere: traveling, administration, all the fields of science for evaluation of data, making up new models, predictions etc. Computer can evaluate a large number of data very quickly, the new language is born based on mathematics which gives the base for the communication between humans and the machines. Occupations are changing according to it.

So the biggest revolution and change has to be done in the field of education. Under the necessary condition for reaching the educational ideal we can assume all the circumstances that allow efficient application of didactic material. Motivation in education must be based on the analysis and synthesis because didactic tools raise the pupils' interest in learning. The most important pedagogical value of computer in the teaching process is giving concrete meaning to the abstract terms.

What is ICT learning? Information and communications technologies (ICT) are the computing and communications facilities and features that variously support teaching, learning and a range of activities in education. It can be used in many educational activities and in many various subjects like:

- broadcast material or CD-ROM as sources of information in history;
- micro-computers with appropriate keyboards and other devices to teach literacy and writing;
- keyboards, effects and sequencers in music teaching;
- devices to facilitate communication for pupils with special needs;
- electronic toys to develop spatial awareness and psycho-motor control;
- email to support collaborative writing and sharing of resources;
- video-conferencing to support the teaching of modern foreign languages;
- internet-based research to support geographical enquiry;
- integrated learning systems (ILS) to teach basic numeracy;
- communications technology to exchange administrative and assessment data.

Use of ICT in mathematics education has a wide range of applications. It can help pupil to:

- experiment and learn from feedback
- think logically and develop problem-solving skills
- observe, explore and explain patterns in number, shape and data
- make and test hypotheses and predictions, which can be based on large amounts of data
- make generalizations that can be based on experimental evidence
- develop mathematical vocabulary and language.

Education with ICT is essential concern in developing further curriculums for the people who are going to live and work in developed society and the modern world. Bosnia and Herzegovina is the country in the heart of Europe with the long tradition of successful educational system that is now undergoing changes and reforms so this country can get fully integrated into European Union and follow the world standards in this field.

Under this background, we have participated to the JICA training course for Bosnian and Herzegovinian teachers, "*Promotion of Information, Communication and Technology (ICT) Education, and Developing Environment for e-Learning in Informatics and Mathematics at Elementary and Secondary Levels for Bosnia and Herzegovina*". This is financed by JICA (Japan International Cooperation Agency) and conducted at the University of Tsukuba in Japan (CRICED – Center for Research on International Cooperation in Educational Development) in cooperation with the Government of Bosnia and Herzegovina in order to provide a training of the new generation of the Mathematics and Informatics teachers and developers of the e-learning environments for the promotion and implementation of ICT learning in Bosnia and Herzegovina. Special objectives of this program are:

- Increasing knowledge on Information and Communication Technology (ICT) within classrooms practice in Mathematics and Informatics
- Knowing how to develop appropriate web sites with the collaboration of programmers, mathematics educators and informatics educators
- Knowing how to use developed innovative sites at elementary classrooms and secondary classrooms for their subject
- Knowing how to develop teaching skills utilizing ICT based on Japanese methods of the lesson study

At the CRICED of the University of Tsukuba, this training course is actually a part of Cooperative Project with JICA financed by the Ministry of Education in Japan. The project aims to promote the cooperative research in the domain of International Cooperation on Education with certain countries or areas (Bosnia and Herzegovina, Central and South America and Afghanistan). Therefore, we are also engaged in this project during the stay in Japan and after going back to our country.

This report presents the activities we have conducted and the results and products we got during the stay in Japan. It consists of three parts, the first is a discription of activities, second is description and comparison of educational systems in Bosnia and

Herzegovina and Japan and third part is about developed contents and implemented environments.

The developed contents and implemented environments are published at the following URLs:

Matematika Online	http://elearningbih.criced.tsukuba.ac.jp/
Informatika Online	http://elearningbih.criced.tsukuba.ac.jp/informatics/
E-learning With Moodle	http://bosnia.criced.tsukuba.ac.jp/moodle/

These websites can be also found at the following URL of CRICED on the Cooperative Project:

http://www.criced.tsukuba.ac.jp/renkei/bih/

1. ACTIVITES

1.1 Training program

The table below shows the principal activities and subjects of the JICA training program during the stay at the University of Tsukuba.

Term	Subject	Contents (Group)
1st stage Basic techniques and development plan of contents (3months)	Introduction and experience of Japanese education (2weeks)	Knowing Japanese education and its theory in Japan, and curriculum reform movement in the world, research on teaching and teacher education for developing ・ School curriculum ・ School subject ・ ICT ・ Mathematics education ・ Informatics education
	Over view of e-leaning environment and application. (2 weeks)	e-learning environment, Internet environment and information education. Basic multimedia technique： ・ LEGO Mindstorm ・ Geometric Construction Tool, Graphing tool, Computer Algebra System
	Developing skills of internet application (9 weeks) with textbooks.	・ HTML, ・ Macromedia Flash, ActionScript ・ Server management with Linux ・ Learning Management System (Moodle)
2nd stage Environment and contents development with applying acquired techniques (six months)	Developing skills depending on each content (two months)	Continuing the development of necessary skills.
	To create e-learning environment and contents development (four months)	・ to create e-learning contents development through the basic technique in three languages in Bosnia and Herzegovina, and English ・ Experiment of distance education between Bosnia and Herzegovina, and Japan using the environment
3rd stage Integrating the results and evaluation (2months)	Integrating the results on web site and evaluation	・ Presentation of final report ・ Presentation at academic meeting, college seminar etc. ・ Evaluation meeting

1.2. School visits

Among activities presented in table there were also organized visits to schools. Visiting schools included all levels from elementary to high school level. Classes of Mathematics and Informatics were observed. Most of the attended classes were conducted using ICT.

Program of visiting schools is given as follows:

- October 21st 2004. Kasukabe High School in Saitama
- October 26th 2004. Okuni Elementary School, Yamato Village
- October 28th 2004. Attached Junior High School of University of Tsukuba
- November 4th 2004. Attached High School of University of Tsukuba
- November 12th 2004. Attached Junior High School of University of Tsukuba
- November 16th 2004. Azuma Junior High School in Tsukuba
- November 19th 2004. Ikeda Attached High School of Osaka University in Education
- November 22nd 2004. Kwansei Gakuin High School in Hyogo
- November 26th 2004. Komaba Junior and High School of University of Tsukuba
- November 29th 2004. Azuma Junior High School in Tsukuba
- December 1st 2004. Komaba High School of University of Tsukuba
- December 14th 2004. Sakado Attached High School of University of Tsukuba
- February 17th 2005. Attached Elementary School of University of Tsukuba
- July 13th 2005. Attached Elementary School of University of Tsukuba
  Attached Junior High School of University of Tsukuba
  Attached High School of University of Tsukuba

Various school visits enable us to see in practice different examples how the ICT could be used in the classroom. We were able to experience several kinds of techniques starting from classical classroom to fully equipped ICT classroom. Also we had a chance to talk and exchange ideas with our colleague teachers and get an insight into Japanese educational system.

1.2.1. ICT in the equipped classroom

Work in the equipped classroom is not an everyday practice. Mostly teaching is done in the classical way and such a classroom is used for the special lessons. With the different tools like camera, projector, touch screen and applied learning system teacher is able to reach and keep active each student. Very important is proper preparation of the working materials to lead students through the lesson and the teacher is able to follow each of the students. Working sheets and changes are instantly available. Such a way allows very dynamic lesson with the interactive involvement of pupils.

Figure 1 shows a lesson of mathematics at the computer room. Every student is sitting in front of his own computer which allows an interactive study.

Figure1. At Kasukabe High School on October 21st 2004

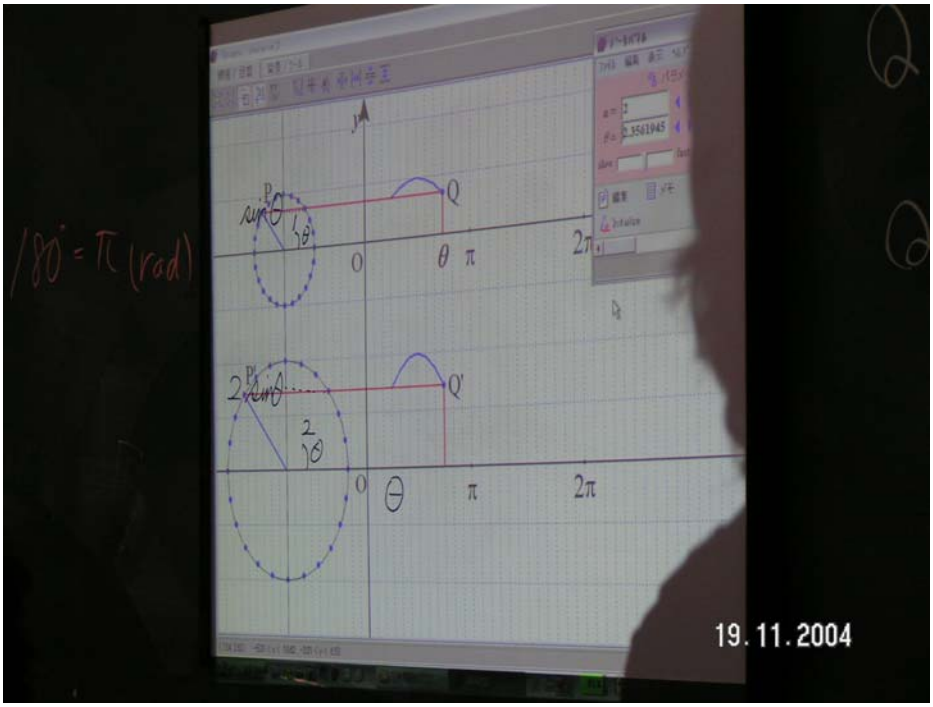
1.2.2. ICT in the classical classroom

ICT learning gives a lot of possibilities for the improvement of the teaching process in the classical classroom. We experienced many different ways of use of computer, projector and various software as the demonstrational or helping tool during the classical lesson. Here are only some of the examples:

- Use of graphing software for demonstrating the properties of the curves in activity such as solving exercises
- Use of projector and data sheets for investigating the relation between numbers in tables and forms of the curves in problem-solving lesson
- Use of projector with graphing software and white board for teaching trigonometric functions and the properties
- Use of graphing software and student's network for making up problems by students themselves
- Use of software for demonstration of space relations in teaching space geometry
- Investigation work in software Mathematica on high level, deeply creative and challenging, exploring statistics
- E-textbooks and use of touch-screen
- Many interactive and dynamic resources on Internet that are used in the classroom as well

Figure 2 shows a mathematics lesson in the classical classroom with the projector and the graphing software Grapes. The blackboard is utilized as a screen for projector.

Figure 2. At Ikeda Attached High School of Osaka University in Education on November 19th 2004.



1.2.3. Open lessons

The practice of open lessons allows demonstration of different techniques among teachers, exchange of ideas and is a good base for discussions, evaluation and development of didactics and methodic.

1.2.4. Problem solving oriented lessons

A problem solving oriented lessons is one in which student becomes aware of a learning problem that they have to solve themselves as they proceed through a learning activity, and then work on solving that problem. Such a lesson needs a great preparation from the teacher, because he is to arise student's interest into the problem and lead the lesson in such steps in order that the students may reach the solution. This kind of lessons are important because pupils not only learn, but find out of the importance of the learning process and also are aware of the applications of mathematics in different situations in real life. ICT learning proves to be a very appropriate tool for such a kind of lesson because it allows student to process a lot of data in a short time, lowers the level of abstraction, enables the interaction and step by step discovery through a direct feedback from the computer or a teacher using ICT materials.

1.3. Techniques for developing teaching materials

During our course we were introduced to different techniques and software useful for developing our contents. Some of them were just introduced demonstrational, and the rest we actively learned, as follows:

- Cabri Geometry II Plus (demonstration)
- Lego Mindstorm Geometric Construction (demonstration)
- Html – tags (active)
- Basics of Java-script (active)
- Study writer (active)
- RoboLab (active)
- Macromedia Dreamweaver (active)
- Macromedia Flash (active)
- Macromedia Fireworks (active)
- Grapes (demonstration)

1.3.1. Demonstrated techniques

We were introduced to the geometric construction software Cabri Geometry II Plus that can be used as a demonstrational tool as well as the active tool for learning and discovering geometrical properties. It is quite more useful for the higher levels of Mathematics, but with the good guidance of the teacher could be implemented very well into the mathematics classroom on the lower level. We experienced some constructing in Cabri Geometry connected with the activities in Lego Mindstrom Geometric Construction.

Grapes, graphing software, showed to be a very useful tool on all levels of teaching and learning mathematics. All the possibilities of Grapes are still investigating and we also agreed to test it and evaluate in Bosnia and Herzegovina in the future development of the project.

1.3.2. Active techniques

In Kasei Gakuen University under the guidance of prof. Kakihana we were introduced to software Study Writer. Main characteristics of this software are that it is very useful for building up quizzes for reviewing the knowledge. It is still developing, but user-friendly and can be easily used by any teacher. It allows the user to predict student's reactions in checking up and prepare appropriate feedback. The main outcome of these lessons is: how to prepare such a quiz, how to predict student's answers, how to plan an interactive lesson.

At the same university we attended lessons in Robo Lab. Building up Lego robots and very easy visual programming is an excellent idea for the extra curriculum activities for the students.

Programming languages and the use of Macromedia applications we have done as the regular lessons under the guidance of prof. Kameyama. From learning basic html tags to Action Script we developed skills for making teaching and learning contents by ourselves, as well as how to build a web-page.

The developed contents and teaching materials will be presented in the Chapter 3.

1.4. Seminars and conferences

During the stay, we have attended several seminars and conferences. These allow us to communicate with the related people and present our results and educational system of Bosnia and Herzegovina. The followings are principal seminars and conferences we attended.

- November 20th-21st 2004.
  Annual Congress of Japan Society of Mathematical Education in Okayama
- November 29th 2004
  International Educational Cooperation Symposium – Problematic and perspective of international cooperation in Mathematics education at University of Tsukuba.
- January 28th 2005.
  International Educational Cooperation Congress about Numeracy in Tokyo
- February 18th, 19th 2005.
  Conference of Scientific Research on Priority Areas – Science Education – at Museum of Emerging Science in Tokyo
- March 28th-30th 2005.
  Interaction 2005, at National Center of Sciences Building in Tokyo
- July 14th 2005.
  1st Bosnia and Herzegovina Seminar, at University of Tsukuba

At the conference held on November 29th 2004, we gave a communication about educational system and actual state of education in Bosnia and Herzegovina (see Appendix 1). On August 3rd 2005, the Final Presentation of this training course was held at the University of Tsukuba. Each of us presented the activities done during the stay of 11 months. The program and the PowerPoint files are attached at the Appendix 2.

More over, we wrote a paper with Takeshi Miyakawa and Masami Isoda for the Japan Society for Science Education 29th Annual Convention which will be held at the Gifu University in Japan on September 9th, 10th and 11th 2005. As we are not able to participate to this conference, Professor Masami Isoda will present it (Appendix 3).

2. DESCRIPTION OF EDUCATIONAL SYSTEMS IN BOSNIA-HERZEGOVINA AND JAPAN

Program Promotion of ICT education included visits to the schools in Japan, observing mathematics classes and exchanging ideas and experiences with Japanese teachers. Those activities gave insight to Japanese educational system and put good base for comparison of school system and mathematics curriculum in Japan with school system and mathematics curriculum in Bosnia and Herzegovina.

2.1. Description of educational system in Japan

Education has been and is an important issue in Japanese society. It is national, prefectural and municipal responsibility. Standards in all levels of education are set by Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT).

Primary education in Japan starts at six years old and ends at eleven years old. Lower secondary education starts at twelve years old and ends at fifteen years old. Primary and lower secondary education are compulsory. Even upper secondary education is not compulsory, according to information provided by Japan Society of Mathematical Education (JSME), almost 100% of population attends upper secondary schools [1].

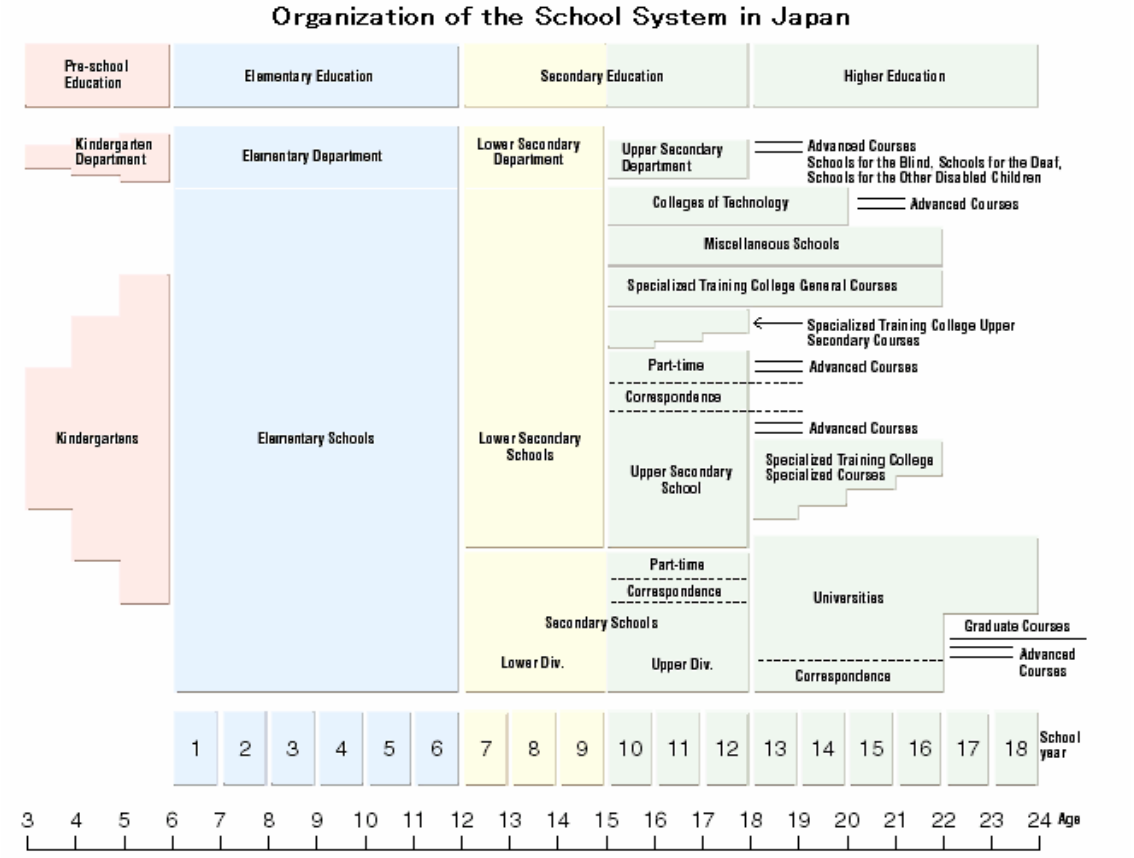
The types of schools for each educational level in Japan are as follows:

* Pre-primary education: Kindergarten; Infant School (until 5 years old)
* Primary education: Elementary school (6 years);
* Secondary education:
    - Lower secondary school (3 years)
    - Secondary educational school (6 years)
    - Upper secondary school (after lower secondary school; 3 years)
    - College of Technology (after lower secondary school; 5 years)
    - Specialized Training School (after lower secondary school)
* Tertiary education:
    - Junior College
    - University
    - Specialized Training School
* Special education: Special Educational School

Those pupils and students who are disabled are integrated in educational system. They are properly educated at schools for the blind, schools for the deaf and schools for the other disabled, or in special classes at elementary and lower secondary schools, depending upon the type and extent of disability, or attend both ordinary schools and special support services in resource rooms if the disability is a minor one.

Organization and structure of Japanese educational system is usually represented by Figure 1.

Figure 1



Source: MEXT, 1994.

Figure 1 shows structure of educational system in Japan and duration of each educational level.

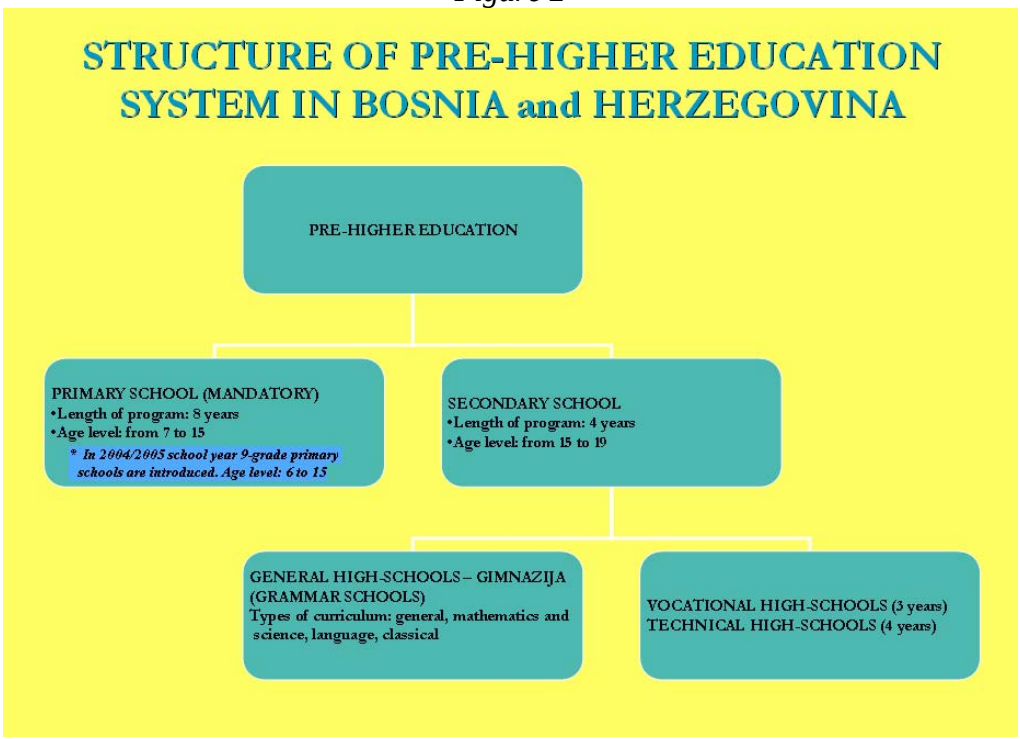
2.2. Description of educational system in Bosnia and Herzegovina

At present time there are 12 Ministries of Education in Bosnia and Herzegovina: Federal Ministry of Education, Ministry of Education of Republika Srpska and 10 Cantonal Ministries of Education. All of them set standards in education. There is no Ministry of Education on state level yet.

Until school year 2004/2005. primary education lasted for eight years. Secondary education is provided by general and technical secondary schools where studies last for four years and vocational schools where studies last for three years. All forms of secondary schooling include an element of vocational training. Pupils graduating from general secondary schools obtain the Matura and can enroll in any faculty or academy by passing a qualification examination prescribed by the institution. Students graduating

technical subjects obtain a Diploma. Students who are finished three years vocational school can not continue their education on the universities.
In the school year 2004./2005. 9-grade elementary school is introduced in order to adjust educational system in Bosnia and Herzegovina to educational system in western Europe.
In visual way pre-higher education may be depicted as shown in the Figure 2.

Figure 2



At the end of this subchapter we will give structure of university studies in Bosnia and Herzegovina. Universities offer 4 stages of studies:

University level first stage: First Degree: Diploma Višeg Obrazovanje (Diploma of Higher Education):
University faculties and academies offer programs that last for two to three years leading to the Diploma Višeg Obrazovanja with a professional title in various scientific and artistic fields. It is not a terminal qualification.

University level second stage: Second Degree: Diploma Visokog Obrazovanja (Advanced Diploma of Higher Education):
Courses leading to the Diploma Visokog Obrazovanja with a professional title last for four to six years during which students specialize.

University level third stage: Third Degree: Magistar:
Studies for the Magistar require two years' further study and the defense of a thesis.

University level fourth stage: Doctorate:
The Doctorate (PhD) is the highest scientific degree. It is the result of independent research. Public defense of a doctoral thesis is required for this degree.

2.3. Mathematics program in Japan

In Japan, the Japanese Ministry of Education sets the number of class periods for the year, overall objectives and the content of subject of Mathematics for every grade. We present here the overall objectives of mathematics in each level excerpted from the English translation of Japanese program by Japan Society of Mathematical Education (2000) and the summary of mathematics curriculum.

Overall objectives of Mathematics in Elementary School level
"Through mathematical activities concerning numbers, quantities and geometrical figures, children should get basic knowledge and skills, should get abilities to think logically and to think with good perspective, should notice the pleasure of doing activities and appreciate the value of mathematical methods, and should get attitudes to make use mathematics in daily life situations." (Mathematics Program in Japan 2000, p.7)

Overall objectives of Mathematics in Lower Secondary School
"For the students to understand deeply the fundamental concepts, principles and rules relating to numbers, quantities, figures and so forth. For students to acquire methods of mathematical expressions and strategies, and to improve their ability to relate phenomena mathematically. For students to enjoy mathematical activities, to appreciate the importance of mathematical approaches and ways of thinking, and to inculcate in them the right attitudes necessary to make use of mathematics." (Mathematics Program in Japan 2000, p.21)

Overall objectives of Mathematics in Upper Secondary School
"To help students deepen their understanding of the basic concepts, principles and laws of mathematics, and to develop their abilities to think and deal mathematically with various phenomena, and thereby to cultivate their basic creativity through mathematical activities, and to help students appreciate mathematical ways of observing and thinking, thereby to foster attitudes which seek positively to apply the qualities and abilities mentioned above." (Mathematics Program in Japan 2000, p.28)

Mathematics curriculum
The elementary school curriculum is specified in Japan for grades 1-6. The goals and objectives of mathematics education at the elementary school level are to develop in children fundamental knowledge and skills with numbers and calculations, quantities and measurements, and basic geometric figures.

In grades 1-3 children learn about the concept of numbers and how to represent them, the basic concepts of measurement, how to observe shapes of concrete objects and how to construct them, how to arrange data and use mathematical expressions and graphs to express the sizes of quantities and investigate their mathematical relationships. They acquire an understanding of addition, subtraction, and multiplication, learn how to do basic calculations up to the multiplication and division of positive whole numbers,

and learn how to apply these calculations. Children also become acquainted with decimal and common fractions during this time.

Children learn basic concepts of measurement such as reading a clock, comparing quantities of length, area, and volume, and comparing sizes in terms of numbers. They are also taught the concepts of weight and time and shown how to measure fundamental quantities such as length.

By the end of grade 4, children are expected to have mastered the four basic operations with positive whole numbers and how to effectively apply them. They also should be able to do addition and subtraction of decimals and common fractions.

In grades 5 and 6, children learn how to multiply and divide decimals and fractions. They are taught to understand the concept of area and how to measure the area of simple geometric figures and the size of an angle, as well as to understand plane and solid geometric figures, symmetry, congruence, and how to measure volumes. Children learn about the metric system during this time. Letters such as x and a are introduced. Children also begin to learn about statistical data by using percentages and circle graphs. Junior high school in Japan consists of grades 7-9. Preparation to get into the best high schools and universities begins at this time. There is tremendous pressure on students to perform well. Students are asked to learn a large amount of material in grades 7-12, which is perhaps one of the major reasons why secondary school classrooms are often subdued. In contrast, elementary classrooms tend to be lively, with a great deal of interaction between students and teachers. However, in either case, classrooms are teacher-directed.

In grade 7, students learn about positive and negative numbers, the meaning of equations, letters as symbols, and algebraic expressions. By the end of grade 8, they are able to compute and transform algebraic expressions using letter symbols and to solve linear equalities and simultaneous equations; they have also been introduced to linear functions, simple polynomials, linear inequalities, plane geometry, and scientific notation.

In grade 9, students learn how to solve quadratic equations (those with real solutions) and are taught the properties of right triangles and circles, functions, and probability.

In high school (grades 10-12), six mathematics courses are offered: Mathematics I, II, III and Mathematics A, B, and C. Although only Mathematics I is required of all students, those students intending to enter a university will usually take all six courses.

In Mathematics I, students are taught quadratic functions, trigonometric ratios, sequences, permutations and combinations, and probability. Mathematics II covers exponential functions, trigonometric functions, analytic geometry, as well as the ideas of limits, derivatives, and the definite integral. Calculus is taught in Mathematics III, including functions and limits, sequences and geometric series, differential and integral calculus.

Mathematics A deals with numbers and algebraic expressions, equalities and inequalities, plane geometry, sequences, mathematical induction, and the binomial theorem. In Mathematics B, students learn about vectors in the plane and space, complex numbers and the complex number plane, probability distributions, and algorithms. Mathematics C consists of a variety of topics, including matrix arithmetic (up to $3x$ 3 matrices), systems of linear equations and their representation and solution using matrices, conic sections, parametric representation and polar coordinates,

numerical computation including the approximate solution of equations and numerical integration.

2.4. Mathematics program in Bosnia and Herzegovina

Overall objectives of Mathematics

Students should require elementary mathematical knowledge needed for understanding phenomena and laws in nature and society, should be able to use mathematics in daily life situations, should develop scientific way to consider phenomena.

Through mathematics education students:

- acquire knowledge necessary for understanding quantitative relations and laws in nature and society;
- get basic mathematical culture necessary for understanding modern economical and technical progress;
- gradually accept elements of mathematical language, develop their ability to express ideas with mathematical language;
- develop mathematical way of thinking, sense for analysis and synthesis, ability for critical evaluation of their work or the work of others;
- get ability to apply their knowledge in newly formed situations and solve problems rationally;
- develop ability for formulating precise expressions both in written and oral form.

Mathematics curriculum

In grades 1-3 pupils learn about the concept of numbers and how to represent them, the basic concepts of measurement, how to observe shapes of concrete objects and how to measure their dimensions. They acquire an understanding of addition, subtraction, and multiplication, learn how to do basic calculations up to the multiplication and division of positive whole numbers, and learn how to apply these calculations. Pupils learn basic concepts of measurement such as reading a clock, comparing quantities of length, area, and volume, learn metric system (1m, 1dm, 1cm, 1mm, $1m^2$, $1dm^2$, $1cm^2$, $1mm^2$) . They are also taught the concepts of weight and time and shown how to measure fundamental quantities such as length. In grade 2 concept of equation is introduced. Pupils are taught to solve simple equations with positive integers.

By the end of grade 4, children are supposed to have mastered the four basic operations with positive whole numbers and how to effectively apply them. At this time notion of fraction is introduced. Pupils also learn about cubic measures ($1m^3$, $1cm^3$…) and how to calculate area and volume of cube and right parallelepiped.

In grade 5 pupils enlarge and systemize their knowledge about sets which is base for formulation and understanding the idea of function. They are taught fractions and decimal numbers including all four operations as well as equations and inequalities with fractions. They are expected to acquire knowledge concerning angles and their measurement.

In grade 6 pupils are expected to understand concept of whole numbers, to master basic operations with whole numbers. They are introduced with classification of triangles and quadrilaterals, basic features of isometrics mappings and congruence. Pupils are taught how to calculate area of triangle and quadrilateral.

In grade 7 irrational numbers are introduced. Pitagora's theorem is taught with emphasis of its application. Pupils learn right coordinate system in detail. By the end of this grade they are expected to understand notion of proportions and polynomials.

By the end of grade 8, they are able to compute and transform algebraic expressions using letter symbols and to solve linear equations, inequalities and simultaneous equations. They are able to construct net of solids and calculate their area and volume.

In grade 1 of grammar school students review and enlarge mathematical knowledge acquired in elementary school. However, at this time students are expected to use strict mathematical language and understand significance of proof in mathematics.

In grade 2 students are mainly concentrated on algebra: complex numbers, quadratic, exponentional and logarithmic functions, equations and inequalities are taught. In order to make understanding of physic easier, basics of trigonometry are taught.

In grade 3 students continue to learn trigonometry as well as vectors. Analytic geometry including conic sections are taught.

Calculus is taught in grade 4, including functions and limits, sequences and geometric series, differential and integral calculus. Some basic of probability are introduced.

Mathematics curriculum for technical and vocational schools are modified depending of the type of each school.

2.5. Differences in evaluation of students achievements in Japan and Bosnia and Herzegovina

One of the important components in the field of education is constant tracking and evaluation of student's results, up growth of their interests and abilities. Ways and methods of tracking and evaluation of student's achievements in schools in Japan and in Bosnia and Herzegovina are different. Japanese prefer written examinations as mode for evaluation of student's achievements in learning while in the case of Bosnia and Herzegovina there is combination of written and oral examinations.

Evaluation of students achievements in Japan

The evaluation of mathematics in the Japanese class adopts following four categories.

- Interest, motivation and attitude in mathematics
- Mathematical ways of observing and thinking
- Mathematical application and expression
- Knowledge and understanding of numbers, quantities and figures

Until 1991, the evaluation had been done relatively, that is, the grades are given depending on the position in the small group (class). Today, it has changed to the absolute evaluation.

The knowledge is just one of criterion for the evaluation. We may say that the evaluation is qualitative. However, we could also say, from the viewpoint of entrance examination, that Japanese school system is test oriented. The entrance examination as a

form of paper test plays an important role. Tests as form of evaluation of student's skills and abilities are introduced as soon as in elementary school level. Although there is no concern about preparing elementary school students for testing oriented toward examinations, elementary school teachers do frequently test students. The purpose of these tests is to evaluate the students and the effectiveness of instruction. Of course, as tests are given by teachers usually for every unit and students are allowed roughly 40 minutes to complete them. Students are not ranked in comparison to other students according to their performance on these tests. At the elementary school, the grades of three levels for each criterion of evaluation are used by teachers to calculate semester grades for report cards.

With transition to junior high school Japanese students quickly become accustomed to taking major types of tests. These major tests, given in both the junior and senior high schools, are called periodic major exams. These exams are conducted in the same manner in most Japanese senior high schools. They are similar in form and content to the entrance examinations students must take to enter high school and college. Periodic exams usually include midterm and final examinations for each of the three semesters during the school year. The major periodic exams are the driving force behind students' coverage of the curriculum and preparation for college entrance exams. At the junior and senior high school, the grades of five levels are used for report cards. The four criterion presented above should be used theoretically.

Evaluation of students' achievements in Bosnia and Herzegovina

Tracking and evaluation of students' achievements in Bosnia and Herzegovina is conducted by written and oral examinations. As for Mathematics in both elementary and high school, written examinations are usually conducted after finishing one topic. In the high school there are also major written examinations at the end of each semester.
Teachers in high school usually use next scales to evaluate students' achievements in written examinations. If "half-results" are point rating, the most common scale for evaluation is as follows:

Number of points %	**Grade**
0 – 50	Not sufficient (1)
51 – 63	Sufficient (2)
64 – 76	Good (3)
77 – 89	Very good (4)
90 – 100	Excellent (5)

If only final result is considered and "half results" omitted criteria are more tempered:

Number of points %	**Grade**
0 – 40	Not sufficient (1)
41 – 55	Sufficient (2)
56 – 70	Good (3)
71 – 85	Very good (4)
86 – 100	Excellent (5)

Teachers in elementary schools use both scales. However, they choose whish scale to use depending of difficultness of test, topic whish is examined. It is not unusual that teachers create scales for each testing.

As mentioned in 2.4. one of overall objectives in teaching mathematics is development of ability for formulating precise expressions both in written and oral form. For this reason oral examinations take important role in all levels of school system. Oral examination can be conducted on each class with aim to track students' understanding of subject as well as students' improvement in formulating expressions in oral form.
Questions asked in oral examinations have to satisfy some standards. They have to be short, precise and understandable for students and they have to concern topics studied in the curriculum. Teachers should follow next scales to evaluate students' achievements:

SOLVING PROBLEMS (APPLICATION OF KNOWLEDGE)

Excellent (5):	Fast, automatically and accurate, generalizing facts.
Very good (4):	Moderately accurate and fast, without help from teacher, comprehend operations.
Good (3):	Able to see relationship between variables, good in solving numerical problems.
Sufficient (2):	Slowly, make mistakes, successfully solve problem only with teachers help. Learn without comprehension.
Not sufficient (1):	Not able to solve problem by oneself or with teachers help. Knowledge is at stage of recognition and recollection.

ARGUMENTATION AND EXPLANATION

Excellent (5):	Expressively accurate, in depth and in width. Deductive thinking.
Very good (4):	Accurate, logic, in depth and with comprehension.
Good (3):	Partially logic and satisfyingly. Good cope of curriculum.
Sufficient (2):	Fractionally, smattering and with mistakes. Ask for help.
Not sufficient (1):	Non logical, without comprehension. Hardly accept new information.

Usage of this scales only have meaning if question asked are adequate and real.
Each student is supposed to be examined orally at least once during semester.
Final grade at the end of school year is derived as average of all grades acquired by written and oral exams.

2.6. Modern technologies in mathematics education

Fast development of informational technologies makes possible development of various kinds of contents for learning mathematics. Huge technical progress in Japan has big impact in education in general and particularly in mathematics education. Various kinds of programs and software are developed in order to make teaching of mathematics easier. Students are also able to approach great number of different mathematical

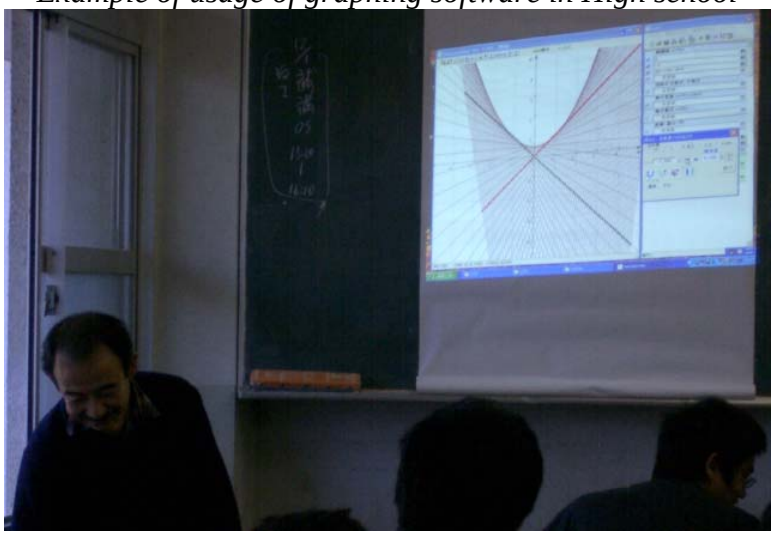
contents in Japanese language on internet. Those contents are created by mathematical educators and companies specialized in programming.

Some examples of implementation of ICT in Mathematics education that could be seen in Japanese schools include usage of camera, projector and working sheets downloaded from Internet, usage of handmade didactic materials in classrooms equipped with information and communication tools. In those classrooms all students have opportunity to actively participate in teachers demonstrations.

Graphics software is helpful tool in teaching functions. It gives opportunity for teachers to avoid time consuming drawing functions on blackboard. At same time, students are not just passive observers but they are actively involved in using software to find out bond between formulae and graphical representation of function.

In teaching analytic geometry we could find examples of using graphing software for demonstrating properties of curves. Such example is illustrated in Figure 3.

Figure 3
Example of usage of graphing software in High school



Here we can see usage of graphing software in exploring properties of parabola. Geometry software offers strong support in teaching geometry in all levels of mathematics education. We can find examples of students' parallel work with dynamic contents on computer and working sheets.

We could notice that different possibilities of teaching and learning mathematics implemented in Japanese schools motivate both teachers and students to achieve better results.

Main obstacles in usage of modern technologies in mathematics education in Bosnia and Herzegovina are shortage of equipment in schools as well as shortage of educated teachers in usage of modern technologies. Also, there are no developed contents of

mathematics in languages spoken in Bosnia and Herzegovina. Development of web site with contents of mathematics in languages spoken in Bosnia and Herzegovina should improve situation in this field.

2.6. Teaching informatics in Bosnia and Herzegovina and Japan

During stay in Japan, our educators and officials from CRICED office organized many school visitation where we attend a lot of classes. Those visitations allow us to compare teaching methodology here in Japan with our back in Bosnia and Herzegovina. Of course there is a lot of differences, on the bottom line one class in Japanese school by itself is quite similar to our class in Bosnia and Herzegovina. The class will be successful or not, depends mostly on teacher but on students also.

Main differences are:

- Grading students
- Three semester in Japan comparing to two in Bosnia and Herzegovina
- Grater number of students in class in Japan

However, there is difference in semesters, but number of weeks per school year is same – 34. Differences in teaching informatics between Japanese and Bosnia and Herzegovina schools are hard to define. First of all, Informatics is relatively new subject in schools. Curriculum is changing dynamically from year to year according to following new technologies. In Japan Informatics is compulsory in first grade of high school. Other two years is optional. In Bosnia and Herzegovina, in most schools Informatics is taught in first grade of high school, but there is schools where informatics are compulsory for three and four years.

Objectives of generalized Japanese curriculum are:
Enable students, through the use of computers, information and communication networks, etc., to acquire basic knowledge and skills to appropriately collect, process and transmit information, and to develop their motivation to utilize information in an independent manner.
First part of curriculum is devoted to introducing IT and utilizing it in solving problems. Then, students are taught how to use communication networks to transmit information. After that, they are taught how to acquire information trough communication networks and databases. Treatment of this chapter is in introducing computer system hardware and operational system.
Next chapter is devoted to types of information and how to utilize appropriate software to manage these information. Treatment of this part is in teaching how to use software packages like Microsoft Office.
To compare with Japanese, I can present more detailed curriculum of Informatics in Bosnia and Herzegovina with number of classes.

Topic	*Number of classes*
1. Computer Systems (Computer Hardware) and Information Systems	12

2. Operative System (Windows)	20
3. Microsoft Word	20
4. Microsoft Excel	20
5. Using Internet and E-Mail	16
6. Project	14

3. DEVELOPMENT AND IMPLEMENTATION OF E-LEARNING CONTENTS AND ENVIRONMENT IN MATHEMATICS AND INFORMATICS

In this chapter contents developed in the third stage of this course will be described. Each of participant develop specific contents in Mathematics and Informatics. First subchapter is related to elementary school level Mathematics contents, second is related to secondary school level Mathematics contents, and last subchapter is related to Informatics contents and Learning Management Systems (LMS).

3.1. Mathematics contents for elementary school level[1]

In developing contents of Mathematics author of this paper used Macromedia Flash MX as the main tool for interactivity. Why Flash?
There are several reasons for using Macromedia Flash MX. One of the reasons is that Macromedia Flash contents can be viewed on nearly all computers. For developers, the ability to create presentations that could be viewed the same on nearly all computers makes technology very appealing. Flash contents have good feature as scalability. Flash is based on vector objects, mathematically defined lines and shapes so most Flash contents can be scaled to any size without distortion. In developing contents using Flash one can create such presentations as:

- Animations that play or stop with a mouse click.
- Slide-show type presentations.
- Learner interactions with true false or multiple-choice type questions (for review purposes) as well as input questions that can be reviewed
- Drag and drop activities.
- Image maps.
- Graphics of mathematical functions.

On the other hand, one has to be aware of limitations of this software. Concerning development of contents, limitations of Flash are, for example:

- Flash developers must manually built support for features such as back button and book marking, otherwise these features are not available for users;
- Flash does not use browser settings for font size so text may appear tiny for some users.

However, good characteristics of Flash prevailed in making choose of software for developing mathematical contents.

[1] Karmelita Pjanić, Pedagogical Academy, Sarajevo, Bosnia and Herzegovina

3.1.1. Description of mathematics contents for elementary school level

As mathematics curriculum for the elementary school level is very broad it was necessarily to select and concentrate only on some topics. Considering fact that elementary school in Bosnia and Herzegovina is organized in two levels – lower grades (1 - 4) where one teacher teach all subjects and upper grades (5 – 8) where each subject is lectured by different teacher, it was also recommendable to develop contents for both mentioned levels in order to promote ICT education among all teachers.

Developed contents can be categorized in two different ways, considering level which contents are assigned for, and considering type of contents.

Considering age level contents are assigned for, two groups of developed contents can be distinguished:

- Elementary addition and subtraction - Grade 1 and Grade 2,
- Fractions - Grade 5.

Considering the type of the developed contents we can differentiate:

- Lessons,
- Exercises,
- Quizzes,
- Games.

Contents are developed both in English language and in Bosnian language.

3.1.2. Contents developed for lower level of elementary school

Contents developed for lower grades of elementary school include topic of initial addition and subtraction. Those contents are oriented toward pupils of Grade 1 and Grade 2 of elementary school. Meaning the age of target users contents are developed in form of games and quizzes. All games and quizzes are constructed by combination of drawing and programming with Action Script.

Contents of initial addition and subtraction include following titles:

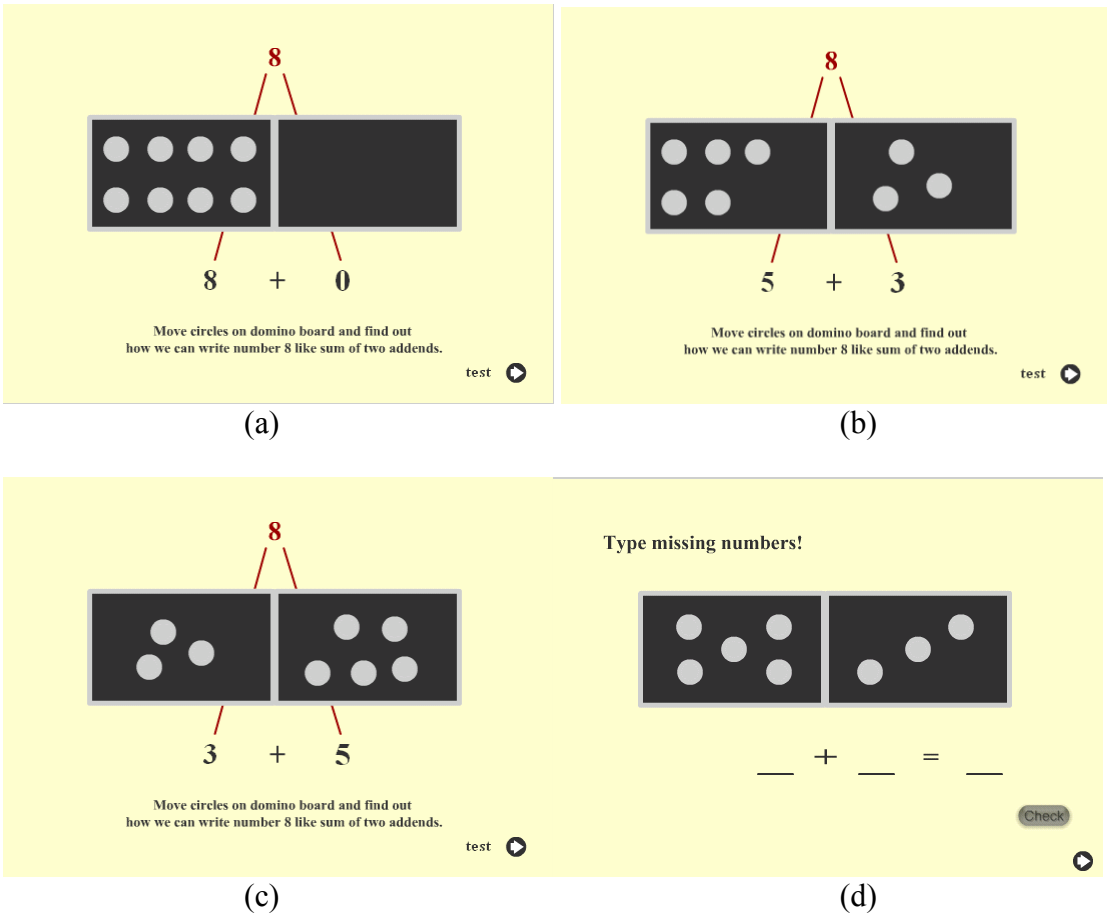
- Addition up to 6
- Addition – number 8
- Write number 7 as sum of three addends
- Write number 9 as sum of three addends
- Examples of counting, adding and subtracting on number line
- Number line – level 1

- Number line – level 2
- Dart.

Exercises of addition positive whole numbers up to 9 are mainly focused in decomposing the sum into the addends. Those activities are very appreciated by teachers and mathematics educators in Bosnia and Herzegovina. Reason for including those activities in mathematics curriculum is obvious. While learning simple addition can become mechanic and monotonous, decomposing sum into the addends initialize students' abilities in analytic and synthetic thinking.

Addition up to 6 and Addition – number 8 are created on same principle, using well known game of dominos as base for development and graphical design. Here, Addition – number 8 will be described. When exercise starts student is asked to move dots on domino board and at same time follows changes in numerical expression below the board (Figure 1(a)). By moving dots on the domino board, one can observe rules of commutation (Figure 1(b) and Figure 1(c)) as well as all possibilities of decomposing number 8 into two addends.

Figure 1
Addition – number 8



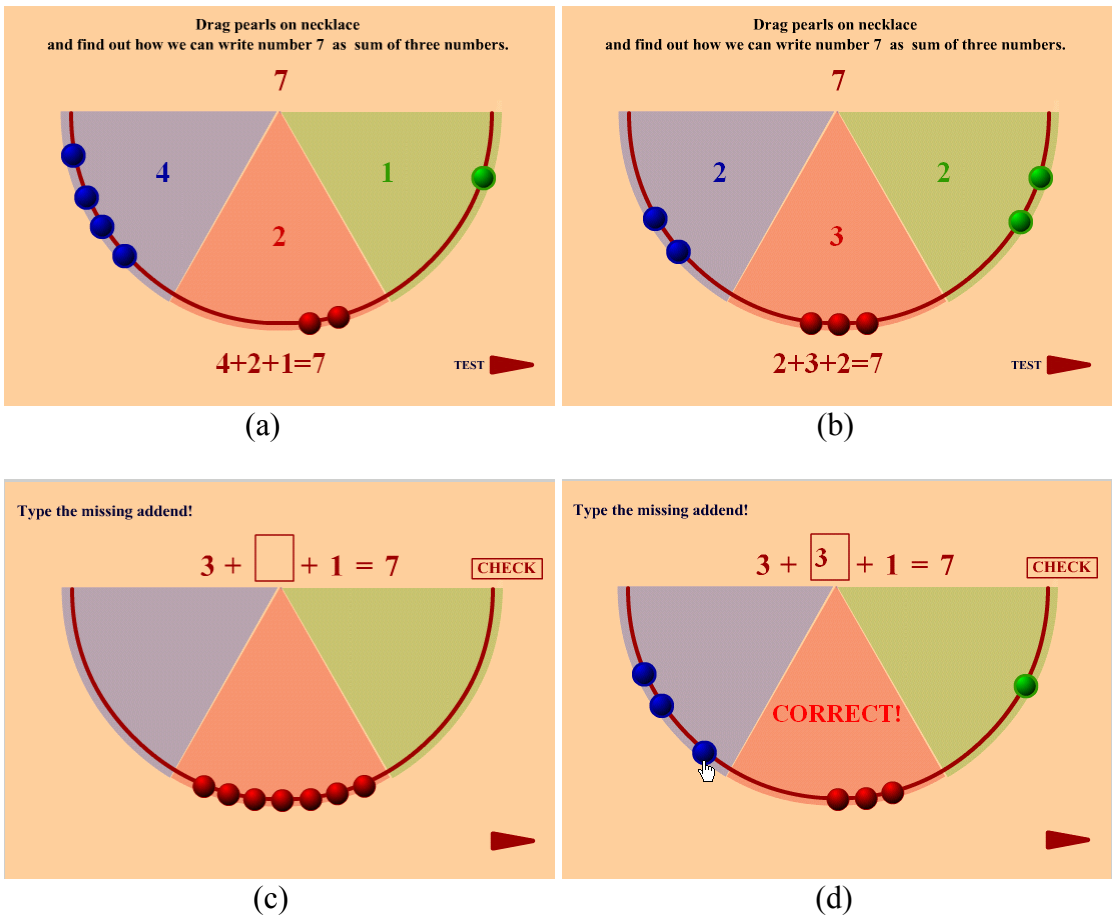
(a) (b)

(c) (d)

These activities should help student to solve tasks in the next stage of this exercise. In this stage student is supposed to "translate" visual information into numerical expression (Figure 1(d)).

Similar concept is used in development of Write number 7 as sum of three addends and Write number 9 as sum of three addends. The first stages of both exercises include student's activities to find out different possibilities to decompose number 7 (number 9) into three addends. Figure 2(a) and Figure 2(b) show some of possibilities of decomposing number 7 into three addends in exercise Write number 7 as sum of three addends. Second stage of those exercises include fill out form questions. Student is asked to input one missing addend or two missing addends in order to get correct numerical expression. After inputting answer one has to move objects on the string to match his/her answer and on that way check if answer is correct. Figure 2(c) and Figure 2(d) show example of question and checked answer, respectively.

Figure 2
Write number 7 as sum of three addends

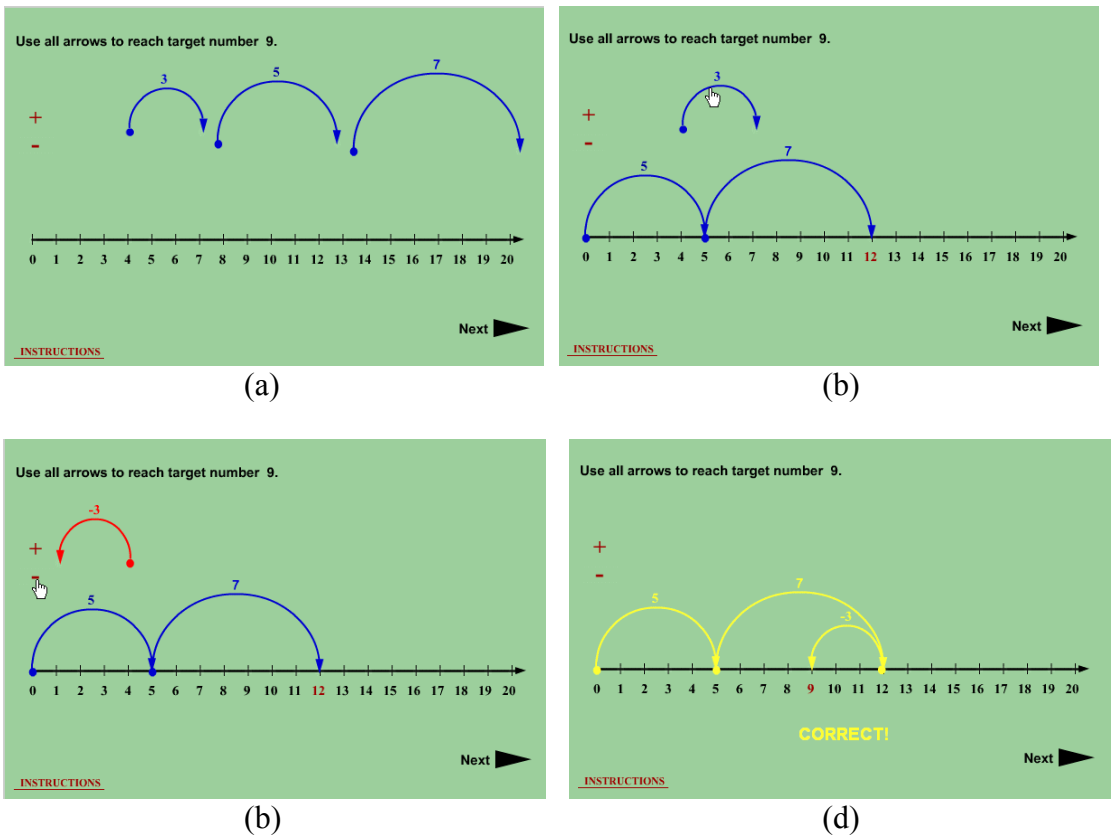


Described contents use set approach in representation of positive whole numbers. Set approach is one of modes of introducing notion of positive whole numbers in the mathematics curriculum in Bosnia and Herzegovina. Another way of introducing

numbers is number approach – using counting without manipulation with real objects and introducing number line. Number approach of introducing positive whole numbers appears more abstract than set approach. Contents of Number line are developed to help students accept number approach. Contents in this group are divided into three units: Examples of counting, adding and subtracting on number line, designed as learning materials; Number line – level 1 and Number line – level 2 designed as games for students. Aim of those units is improvement of students' abilities in adding and subtracting numbers up to 20 and understanding the notion of number line. Unit named Examples of counting, adding and subtracting on number line can be used both by teachers when explain concept of number line in classroom and by students as preparation to approach games Number line – level 1 and Number line - level 2.

Next figure shows four steps in solving one example included in Number line – level 1.

Figure 3
Number line – level 1



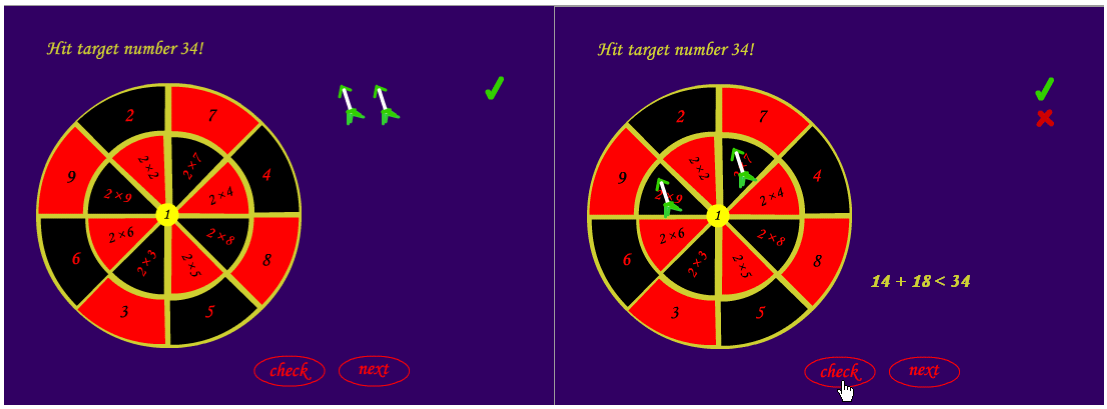
In Number line – level 1, target number and three numbers represented with arrows are given (Figure 3(a)). Student is asked to combine given arrows on number line in order to reach target number. In our example one has to combine addition (Figure 3(b)) and subtraction (Figure 3(c)). During placement of arrows on number line one can follow intermediate results. In the case of correct combination of arrows one will get feedback as shown in Figure 3(d). If combination of arrows is not correct, arrows will not change

their color and student can move arrows from the line and try to find out right combination.
Game Number line – level 2 implements the same approach but on higher ground whereas student is asked to combine four numbers in order to reach target number.

Units Number line – level 1 and Number line – level 2 were subject of experiment conducted in elementary school classroom in Bosnia and Herzegovina. Description of experiment will be given in subchapter 3.2.

At the end of reviewing of contents for lower elementary school level, game named Dart will be described. Approach similar to one implemented in game Number line is used here. In this case student has to recognize fields with different numerical values and combine those numerical values to reach given target number. This game is assigned to second grade students. The aim of this unit is practicing addition combined with multiplication by 2. The game is divided in 5 levels according to difficultness of questions. Level 1 can be seen as introduction into game since here student is asked to distinguish fields with different numerical value. In levels 2 and 3 student is asked to make combinations of two numbers and in levels 4 and 5 student is asked to make combinations of three numbers involving operations of addition and multiplication by 2. Each level is consisted out of 10 examples.
One example from Dart, level 3 are shown in Figure 4.

Figure 4
Dart - game 3



(a) (b)

In Figure 4(a) second task in sequence in Dart, level 3 is represented. We can notice that answer on previous question was correct, according to the sign for correct answer on right side of the window. Appearance of window after one's attempt to solve question is given in Figure 4(b). Here one gets message that he/she selected fields which numerical values give sum less then required. The message is followed with appropriate sign for incorrect answer on the right side of window. In the case of wrong answer such as in Figure 4(b), student is not allowed to try to give answer again in present attempt to the game. He has two options, either to proceed with questions until the end of the game

and check his final result or to immediately quit game and answer all questions from the beginning. This concept of the game may be useful for teachers as they may use this game in the classroom as tool for competition among students. With game designed on this way teachers may follow how much time each student need to solve tasks as well as how many correct answers student can give in the first attempt.

3.1.3. Contents developed for upper level of elementary school

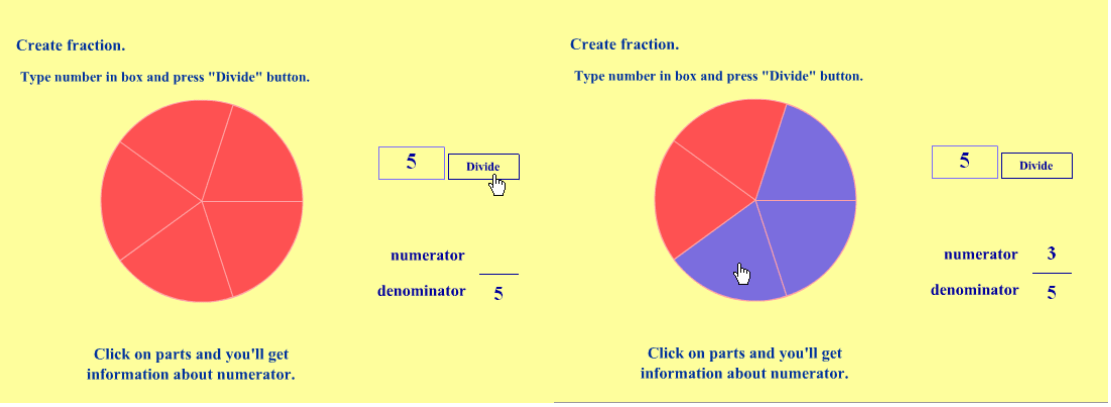
Large portion of classes in 5th grade of elementary school in Bosnia and Herzegovina is dedicated to learning fractions. Students are taught about notion of fraction, renaming fractions, and four operations with fractions.
According to Bosnian curriculum fractions are introduced as part of a whole and as part of a set. In elementary school textbooks in Bosnia and Herzegovina fractions are usually represented visually as part of area of geometric figures or as part of length of segment line. The same visual representations of fractions we may also find in elementary school textbooks in Japan. Considering those visual representations of fraction common for students in Japan and students in Bosnia and Herzegovina as well as for students in other countries, contents in topic Fraction are created to carry on mentioned representations.

Topic of fractions is arranged in two groups:

- Lessons,
- Tests.

Group of Lessons includes interactive materials that teachers may use in classroom to demonstrate notion of fraction as a part of a whole. Two versions of those introductory lessons are made. In one version fractions are represented as a part of area of circle and in another as part of length of segment line. Both materials are to help teachers to demonstrate notion of denominator and numerator in a fraction, also to help students to comprehend those terms easier. Next interactive material in this group is made to show correspondence of proper fractions and points on number line. All those materials are made to follow way of teaching fractions proposed in mathematics curriculum in Bosnia and Herzegovina. In Figure 5 there are shown two steps from interactive material Fractions as part of whole represented with circle.

Figure 5
Fraction as part of whole



(a) (b)

Using this material teacher may introduce denominator as number of equal parts in which whole is divided (Figure 5(a)) and numerator as number of taken (assorted) parts of a whole (Figure 5(b)).
Beside interactive materials, in group of Lessons there are two more units: Renaming fractions in higher terms and Comparison of fractions.

Units for exercising and testing ones knowledge about fraction are following:

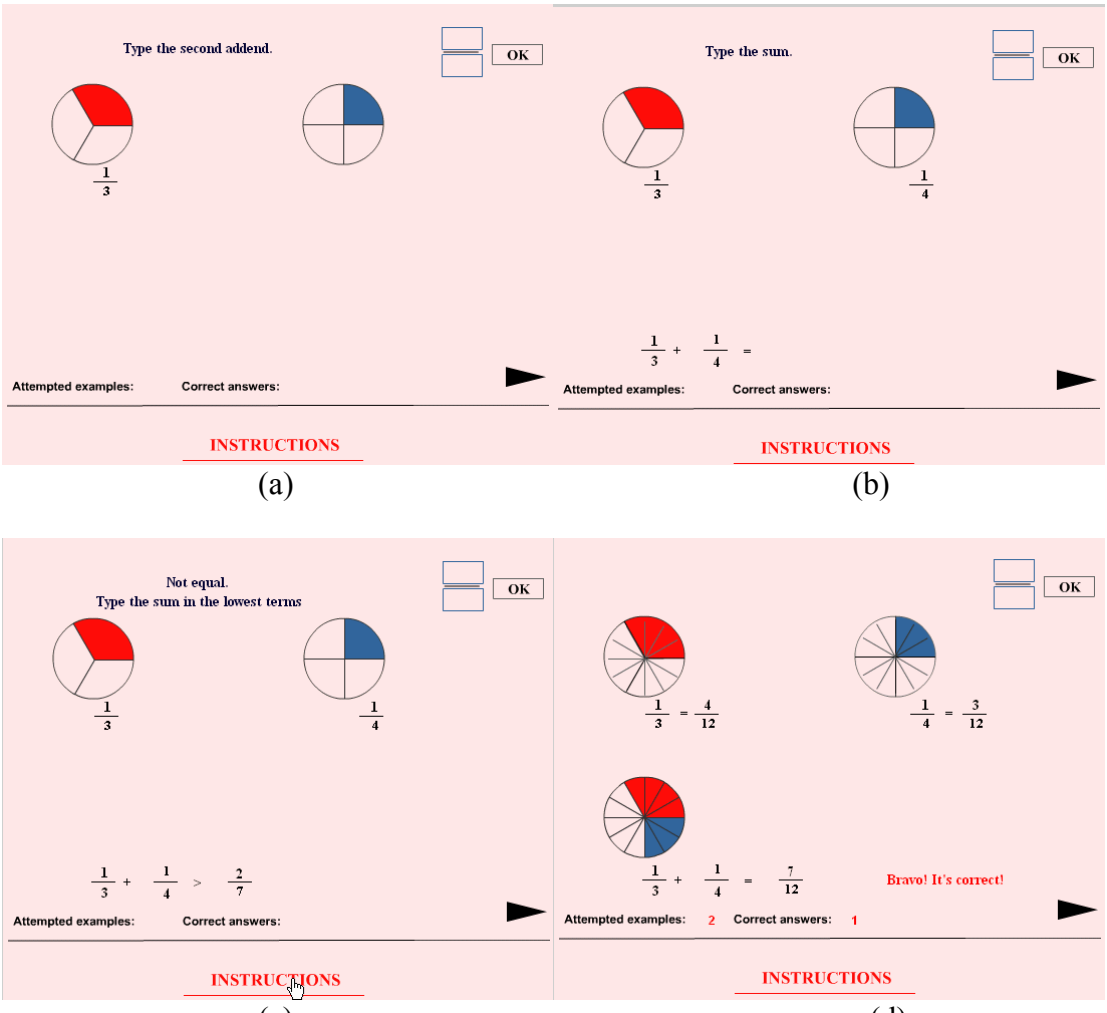
- Identify fraction - illustrated with geometric figures,
- Identify fractions - illustrated with segment lines,
- Rename mixed number to improper fraction - illustrated with geometric figures,
- Rename mixed number to improper fraction - illustrated with segment lines,
- Rename improper fraction to mixed number - illustrated with geometric figures,
- Rename improper fraction to mixed number - illustrated with segment lines,
- Rename fraction in higher terms - illustrated with geometric figures,
- Rename fraction in higher terms - illustrated with segment lines,
- Rename fraction in the lowest terms - illustrated with geometric figures,
- Rename fraction in the lowest terms - illustrated with segment lines,
- Compare fractions - illustrated with geometric figures,
- Compare fractions - illustrated with segment lines,
- Add fractions with the same denominator - illustrated with geometric figures,
- Add fractions with the same denominator - illustrated with segment lines,
- Add fractions with different denominators - illustrated with geometric figures,
- Subtract fractions with the same denominator - illustrated with geometric figures,
- Subtract fractions with the same denominator - illustrated with segment lines,
- Subtract fractions with different denominators - illustrated with geometric figures.

Aim of those units is reviewing and practicing fractions as well as testing ones accomplishments in topics of fractions. Each unit is created on similar way, visualizing

fractions either with parts of geometric figure or with parts of segment line. Units are consisted out of 20 or 25 questions each. Instructions are given with each exercise including explanation about exercise, basic information about particular topic and at least one example solved. During involvement in particular exercise student has information about number of his/her attempted examples and number of correct answers. It has be noted that although student is given illustrations to help him/her answering questions, in some examples student is supposed to find solution using pencil and paper first. This is particularly expected in exercises including addition and subtraction of fractions with different denominators. In those cases, with entering answer student will receive information about steps needed to accomplish correct answer.

For closer insight in principle that those exercise are based on, one example form Add fractions with different denominators will be given and illustrated by Figure 6.

Figure 6
Add fractions with different denominators



At first student is asked to recognize the first and the second addend, each illustrated with part of area of circle. Figure 6(a) shows stage when the first addend is recognized and student is asked to recognize the second addend. When both addends are identified student is asked to enter the sum, as shown in Figure 6(b). If answer is incorrect student is not given a lot of information, as shown in Figure 6(c). In this case student is recommended to read Instructions again and study examples given in Instructions. Finally, in Figure 6(d) is illustrated correct answer. Here, student can confirm all steps in process of calculating sum of two fractions with different denominators. There is information about numbers of attempted examples and correct answers in the bottom of window. As the goal of this exercise is practicing addition of fractions, program tracks only attempts and answers considering finding sum.
Other units in group of Tests are created with same or similar approach.

3.1.4. Experiment with classroom in Bosnia and Herzegovina

Mathematics contents for elementary school level were developed from March 2005 until August 2005. Content of **Number line** described in 3.1.1. was subject of experiment with teacher and first grade pupils in Bosnia and Herzegovina. Experiment with classroom in elementary school "Osman Nakas" in Sarajevo was organized and conducted during the first week of June 2005.

Intentions of experiment: Check how pupils accept new methods of learning mathematics, verifying if contents Number line developed by Flash MX could improve pupils understanding of idea of number line and operations of addition and subtraction presented on number line.

Organization of experiment: Pupils were classified into 3 groups, each group consisted out of 7 pupils. Pupils with different achievements in mathematics were included in experiment. Each group had different approach to the lesson.

- Group1: Pupils were given at first two numbers and asked to combine them by operations of adding and subtracting in order to reach given target number. They had to demonstrate solutions by drawing on blackboard. Next step included combinations with three and four numbers. Pupils were solving the same examples as in content Number line - level 1 and Number line - level 2 but without using computer.
- Group 2: Teacher introduced game Number line. Pupils were asked to solve problems in their notebooks at first and to check answers using computer.
- Group 3: Teacher introduced game Number line and asked pupils to solve problems directly by playing game on computer.

Teacher's observations: Each group of pupils approached contents on diverse way. It brought variations in pupils' activity during the lesson.

- Pupils in Group 1 found given tasks interesting but difficult. They didn't have visual support while solving problems. Instead they had to make visual interpretation of solutions by themselves. Only pupils with excellent grade in math could solve problems successfully.

- There were noticeable differences in involvement of pupils in Group 2 during two fazes of the lesson. While pupils with excellent grades in math were active during whole class, pupils with very good and good grades were active only in the second faze when solutions were checked on computer.
- Solving problems individually and directly playing game on computer was very motivating for pupils in Group 3. At first attempt to solve problem in the game more successful were pupils who already have experience in using computer.

Conclusion: Pupils accepted contents Number line – level 1 and Number line – level 2 very well. They found game interesting and helpful in practicing addition and subtraction on number line. Teacher found that contents of Number line presented as a computer game encourage pupils who have not very good achievements in math to be more active.

In her report, teacher concludes that this kind of contents properly combined with traditional methods of learning could improve pupils' interest in mathematics as well as pupils' understanding of mathematical concepts.

3.2 Mathematics contents for secondary school level[2]

In the development of the web-page are used Macromedia applications: Dreamweaver as the main tool for building up the page, Macromedia Fireworks and Macromedia Flash MX 2004 for all graphical applications. In developing contents I tried to do as different programming as possible and through individual learning from the textbook and internet sites improve my programming skills. So each interactive lesson contains a new element in usage of Action Script: drag and drop properties with functions of "drop target" and "hottest", different kinds of input and multiple choice questions, building up pop-up windows, communication between different Flash files and dynamic animations using mathematical functions. Also I individually learned more advanced topics in using Dreamweaver for building the web page which was beneficial investigation and discovery process connected to the development that I will be able to use in my future work with the students.

3.2.1. Introduction

The idea for the structure of this web-page has developed through our work and is based on the conditions and needs in our country. The project is based on the following objectives:

1. Bosnia and Herzegovina is a small country, so distance or e-learning as it is defined could cover only a small percent of population, especially on the level of elementary and secondary school.
2. There is no actual cooperation and communication of Mathematics and Informatics teachers on the state level. Cooperation in educational field is very important for the future development of our country.
3. There is no a web-page with contents of Mathematics and Informatics on the regional level and in languages spoken on the territory of Bosnia and Herzegovina.
4. Contents of this web-page should help teachers and students to introduce ways of teaching according to modern technologies and help to provide interactive materials in languages spoken in Bosnia.
5. Multilingual page should also provide exchange of information and cooperation on international level

3.2.2. Main structure of the web-page

The front page should contain language menu (Bosnian languages, English, Japanese) and animation.

[2] Valentina Mindoljević, Gimnazija Mostar, Bosnia and Herzegovina

Main page should contain general information about the contents of the page itself: all main topics, updates, menus, news. The main menu leads the user to contents of Mathematics or Informatics.
Main page for Mathematics should be separated into following parts: elementary school, secondary school, Mathematics education, history of Mathematics, competitions, and forums.
Main page for Informatics should have the same menu except for elementary school and history.

Figure 1. The front page

3.2.3. The structure of the contents

Contents for both subjects will mainly be separated into following parts, according to the topic:

- Lectures
- Interactive materials
- Tests and quizzes
- Games
- Problems
- Applications

Lectures can be structured similar to the lectures in the textbooks with main explanations on the topic, something like e-textbook for any user interested in these subjects.
Interactive materials are covering lectures contents but with the different approach. User is not only thought, but through given materials discovers the solution or conclusion by himself. These materials are suitable for individual learning as well as for the work in

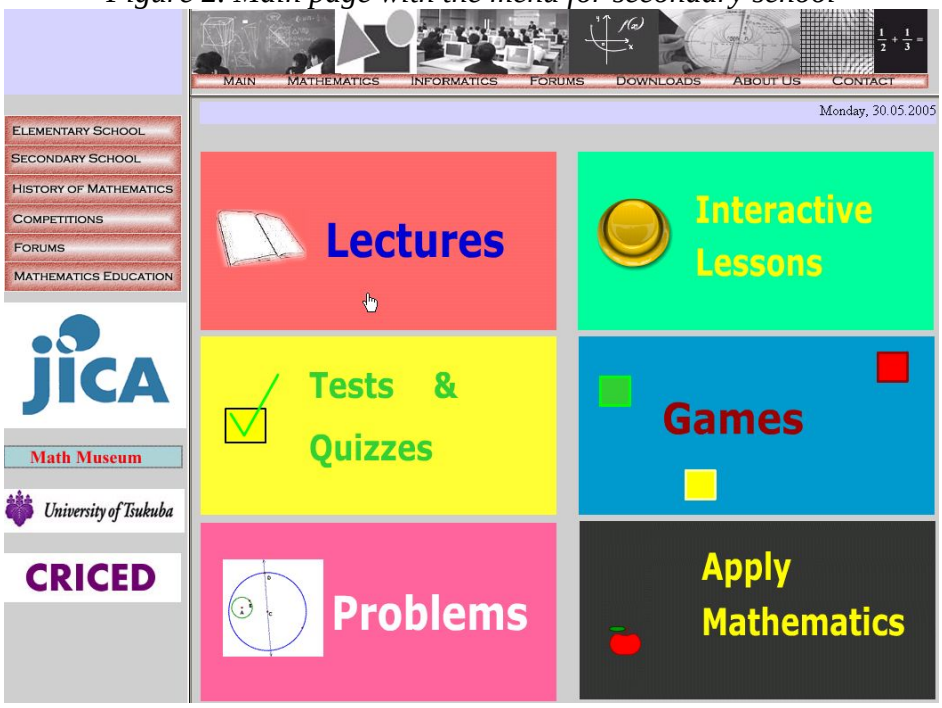
the classroom with the teacher's supervision or together with printed worksheets as demonstrational materials in the teaching process.

Tests and quizzes are structured for revising the knowledge individually or with teacher's supervision.

Games based on the mathematical knowledge are interesting way for practicing and revising the learned topics.

Problems and applications encourage users for discovering and using learned materials, lowering the level of abstraction and broadening the sense of usage of Mathematics in different fields and in everyday life.

Figure 2. Main page with the menu for secondary school



3.2.4. Other contents of the web page

As it is planned to be general page for Mathematics and Informatics and education in this field, the page should contain texts and information on different topics connected with it. That should be interesting parts of history of Mathematics, news like discoveries, articles on the topic of education, applications, happening connected to Mathematics and Informatics education like competitions, seminars, symposiums.

Forums should be places for information and idea exchanges. Two forums are planned: one for students and one for teachers. This should broaden the cooperation on the both state and international level.

Downloadable materials for teachers should be available. Teachers can download dynamic or interactive contents and use them in the classroom together with prepared printed materials for each lecture.

The web-page is now published and is reachable on the web-address:

http://elearningbih.criced.tsukuba.ac.jp/

3.2.5. Contents of Trigonometry

The contents are based on the Mathematics curriculum of Bosnia and Herzegovina. Students are introduced trigonometry in the second grade of secondary school for the first time. Topics for that grade include trigonometry of an acute angle based on ratios in right triangle. Students learn the definition of trigonometric functions in the right triangle, main properties of trigonometric functions and trigonometric equalities for acute angle, applications in plane and space geometry.
In the third grade term of trigonometric functions is broaden on the set of real numbers and definition is based on unit circle. All contents of trigonometry for secondary level are introduced in that grade.

The main idea for the online contents is to give to the user:

- Lectures with all contents easily available on one web-page and in languages of Bosnia and Herzegovina
- Interactive lectures for individual learning or learning in classroom with the supervision of a teacher.
- Tests, quizzes and games on a given lecture for revising the knowledge
- Applications of learned materials in other subjects and everyday life

Curriculum contents

- Definition of the trigonometric functions of an acute angle in the right triangle
- Properties of trigonometric function of an acute angle
- Table of trigonometric functions for angles of 30°, 45° and 60°
- Basic relations between trigonometric functions
- Application on the right triangle
- Application in plane geometry
- Unit circle
- Definition of trigonometric functions on unit circle
- Properties of trigonometric functions (odd and even functions, period)
- Reduction formulas
- Addition theorems
- Trigonometric transformations
- Graphic of trigonometric functions
- Trigonometric equations and inequities
- Sine, cosine and tangent theorem and application
- Applications of trigonometry

3.2.5.1. Definition of Trigonometric Functions of an Acute Angle

Aim of the lecture: After this lecture the user should be able to define trigonometric functions of an acute angle in the right triangle, know the main properties of these functions and apply it in problem solving exercises.

Lecture should contain the reminder of the geometrical properties of a right triangle and its elements. Elements of right triangle are then used for the definition of trigonometric ratios. It is important to give not only symbolic ratios, but also ratios with written elements (adjacent and opposite catheti, hypotenuse) applicable on any right triangle. Complement angles and connection with function-co function definition should be mentioned. At the end of the lesson user is led to the interactive lesson to discover main properties of trigonometric functions.

Interactive lesson uses two parts: dynamic right triangle and questionnaire for the observation data.

1. DYNAMIC TRIANGLE has two mobile points (A and B). By moving these points it is possible to change sides and acute angles' values. These changes are numerically presented underneath the triangle as well as the changes of the values of trigonometric functions for both angles. The **aim** of the lesson is that an user by observing numerical data discovers properties of the trigonometric functions of an acute angle as: increasing and decreasing of the functions according to the change of an angle, connection between values of trigonometric functions of complement angles, codomen of trigonometric functions, equalities and inequalities between values of function and its co function. **Approach** is based on the self discovery through observation of numerical data and conclusions based on the new lesson as well as on the previous knowledge of geometry.
2. QUESTIONARY is divided into following parts:
    - Use dynamic triangle and numeric values to determine how are values of different trigonometric functions changing according to the change of an angle
    - Use dynamic triangle and numeric values to determine connection between the functions of complement angles: for one given angle determine complement and values of complement functions, do the same for any chosen angle, hint to observe values for more angles, dragging expressions to make equalities as conclusion, add words to make conclusion.
    - By moving points determine range of values for different values
    - Fill in the blank field to explain mathematically why is the range in observed borders. As it is hard to examine written explanation checking of an answer is based on the number of the characters in the field. If a user writes enough number of characters he can proceed to the next page and compare answer with the given explanation.
    - User is asked to adjust the value of an angle in the triangle on the value smaller or greater of 45° and compare the values of different functions in these ranges. They are asked to explain mathematically why is that so and then to compare the result.

Figure 3. Dynamic triangle

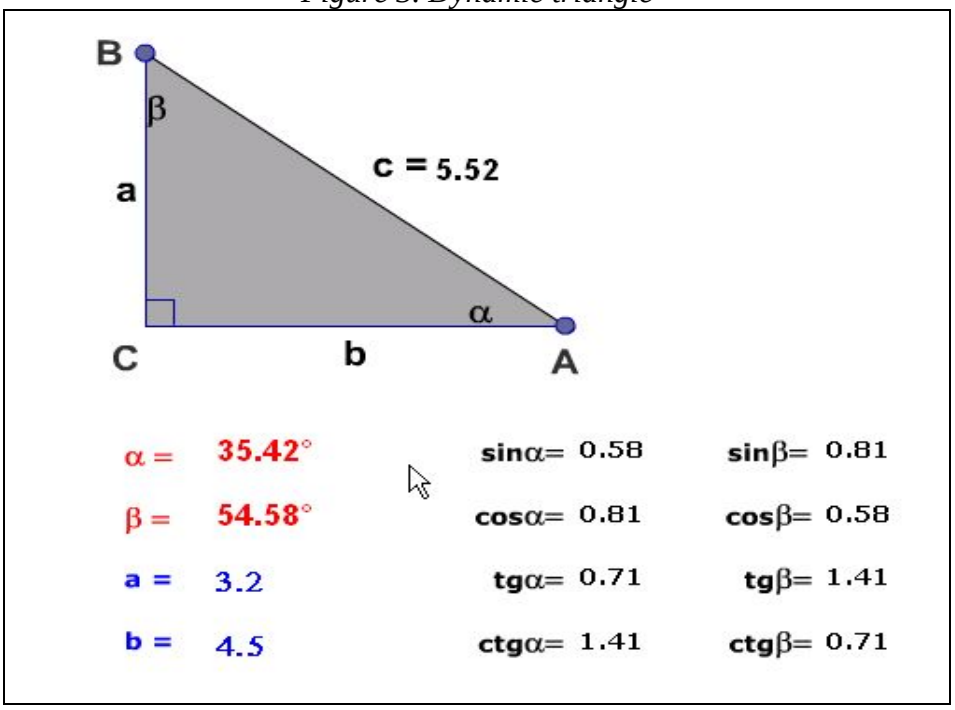
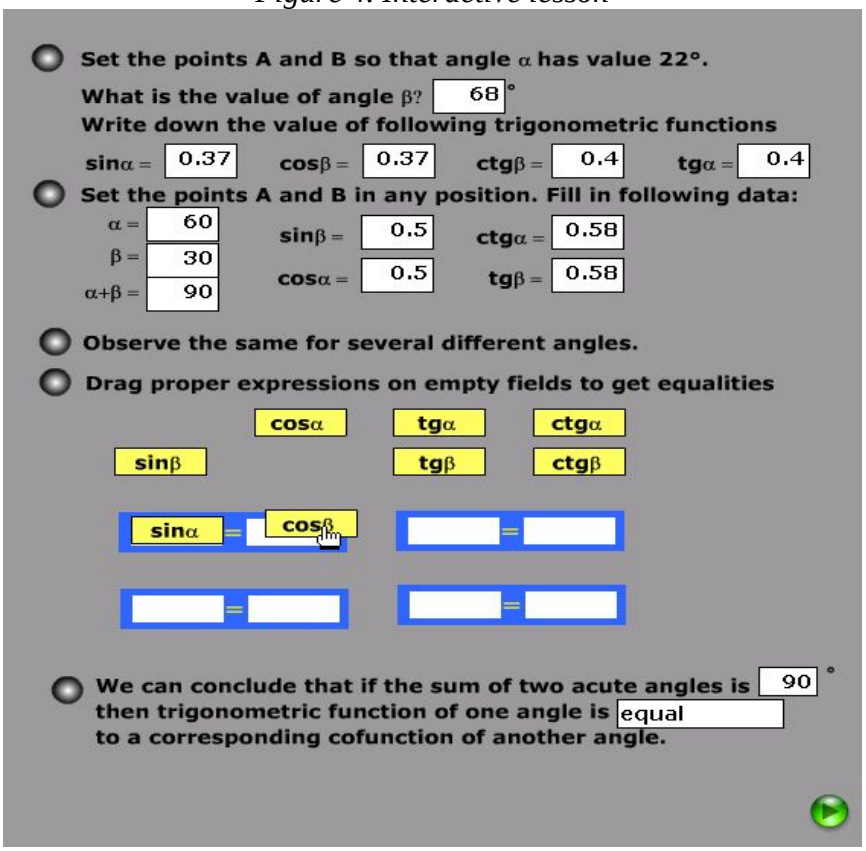


Figure 4. Interactive lesson



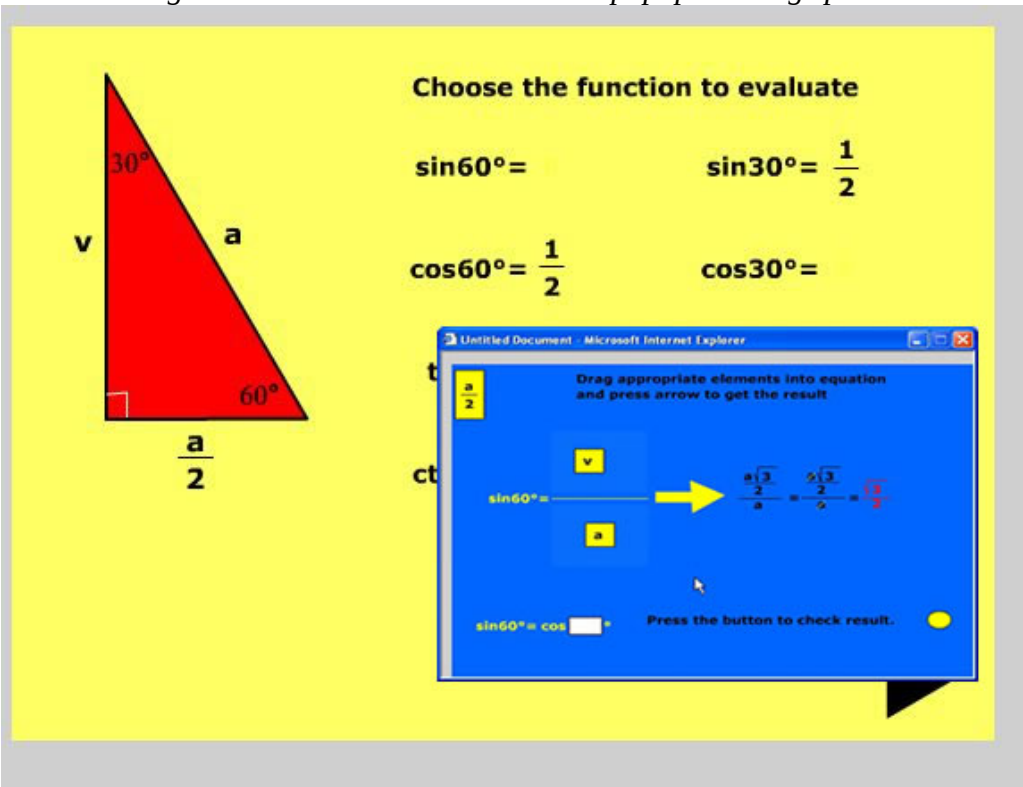
Test includes application of learned contents both from the lecture and interactive lesson. It should contain exercises with similar triangles, evaluating ratios, using Pythagorean Theorem, naming complements and values of the functions in that case, comparing values of different functions according to the 45° angle. In this part user shouldn't use dynamic triangle as it is a test of knowledge.

3.2.5.2. Trigonometric functions of the angles of 30 °, 45 ° and 60 °

Aim of the lesson: This lesson should visualize for the students how the values of trigonometric functions for the angles of 30 °, 45 ° and 60 ° are evaluated. Triangles containing these angles are the standard geometrical objects and student should know the ratios of their sides. Through the lesson student not only gets the values written in the table, but in the process of discovery learns and remembers how to get these values out of geometrical properties.

Lecture just gives the main information on such triangles, pictures and ratios of the sides, as well as the table with the value of all trigonometric functions for all angles.
Interactive lesson after the introduction gives a student a choice of triangles with angles whose functions he wants to evaluate. In each of choices there is an initial animation to introduce appropriate geometrical figure to be used. If the student answers the questions correctly he can start the movie with another animation in which right triangles are extracted and main geometrical properties of the used figures are given. With the drag and drop menu student can build equations and formulas while watching geometrical figures. At the end student gets a menu for evaluating values of the functions. By the click a pop-up window with the working area appears so the student is able to observe a given right triangle and at the same time to drag and drop expressions to get the correct equation. If the answer is correct the solution is automatically written in the field of the lower document by pressing the button in pop-up window.

Figure 5. Interactive lesson with the popup working space



3.2.5.3. How to measure the radius of the Earth

Aim of the lesson: This lesson is under the chapter "Apply Mathematics". It is separated into four parts:

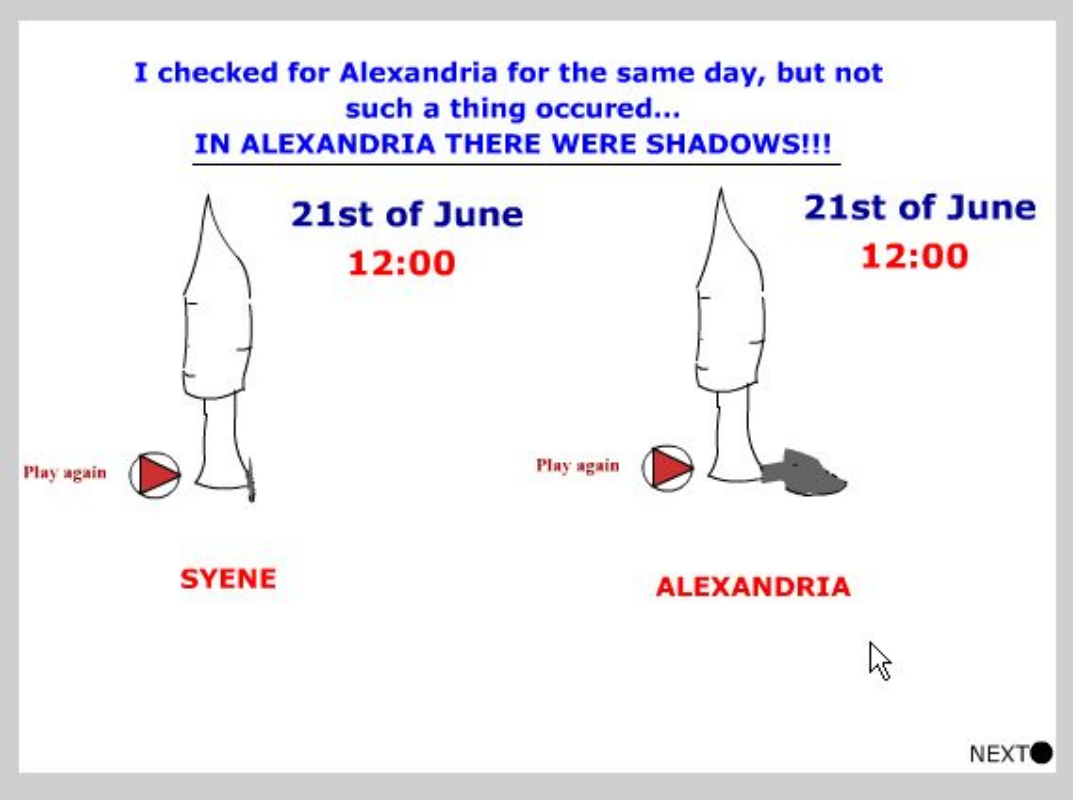
- History – how Eratosthenes got the idea to measure the radius of the Earth
- Mathematical explanation of the method Eratosthenes used
- Mathematical explanation in how we can do it now days
- Practical advices for the measurements

In the lesson student finds out how one of the greatest discoveries in history is done with the simple trigonometry. Interesting story from the history is given to arise student's interest, then mathematical explanation. Student can do the same thing using very simple tools and at the same time use the web page to get and evaluate data with another person involved in the project. After doing this project student should know:

- To explain geometrical conditions in which Sun beams fall in different parts of the Earth
- Explain how the Earth radius was measured more then 2000 years ago
- Be able to determine local noon
- Be able to do scientific measurement and get conclusion through the logical thinking and use of mathematics

History part tells the story of the life of Eratosthenes and leads a student to the way of thinking and mathematical knowledge at this time. Also it gives an example how the little details could lead to great discoveries. In this part there are animations applied to demonstrate some events that led to the idea that the Earth was round.

Figure 6. Animation showing differences between events in two different locations

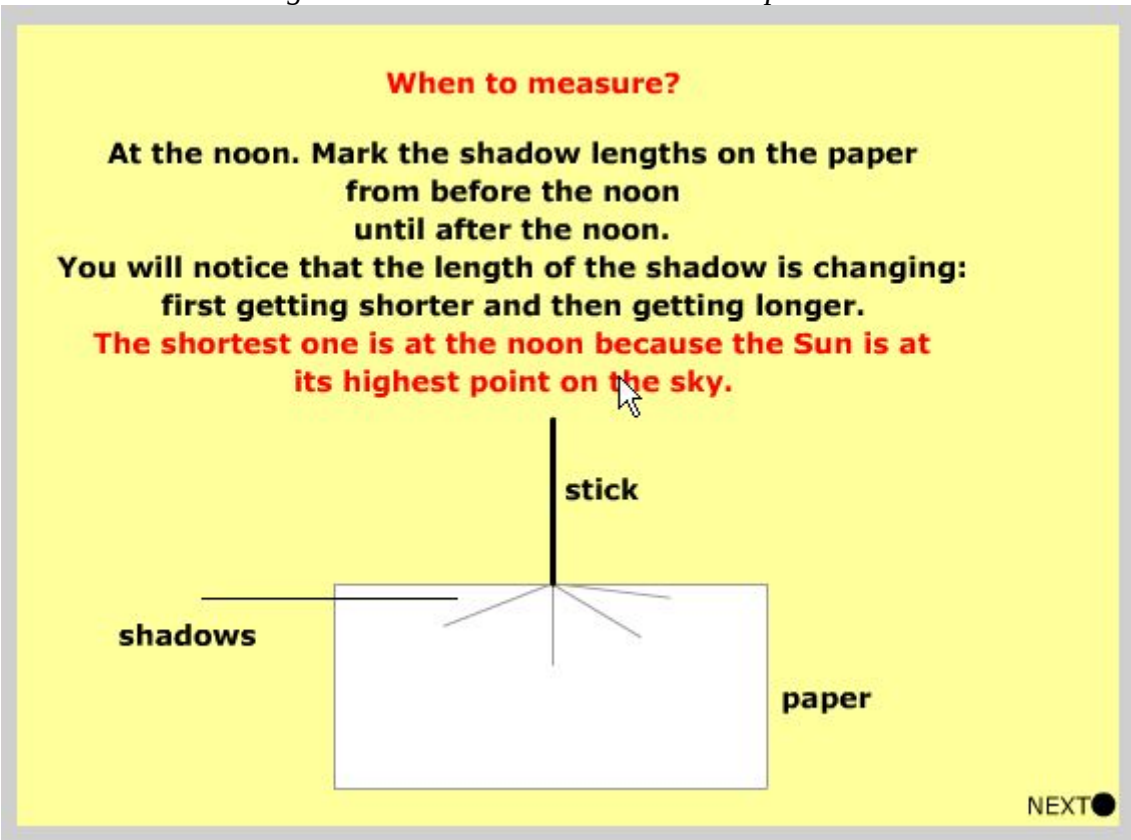


Mathematical explanation explains to the student what geometry and trigonometry was used at that time to determine the radius of the Earth. The animation is used to evaluate the formula for the radius.

Mathematical base to do the experiment gives to a student an idea how the same measurement could be done without knowing the place where the Sun beams are perpendicular to the Earth surface. Also the assignment is given to a student with the instructions how to do it.

Practical instructions give to a student advices in materials to use, how to make the experiment and how to use this page to evaluate data.

Figure 7. Practical advices to do the experiment



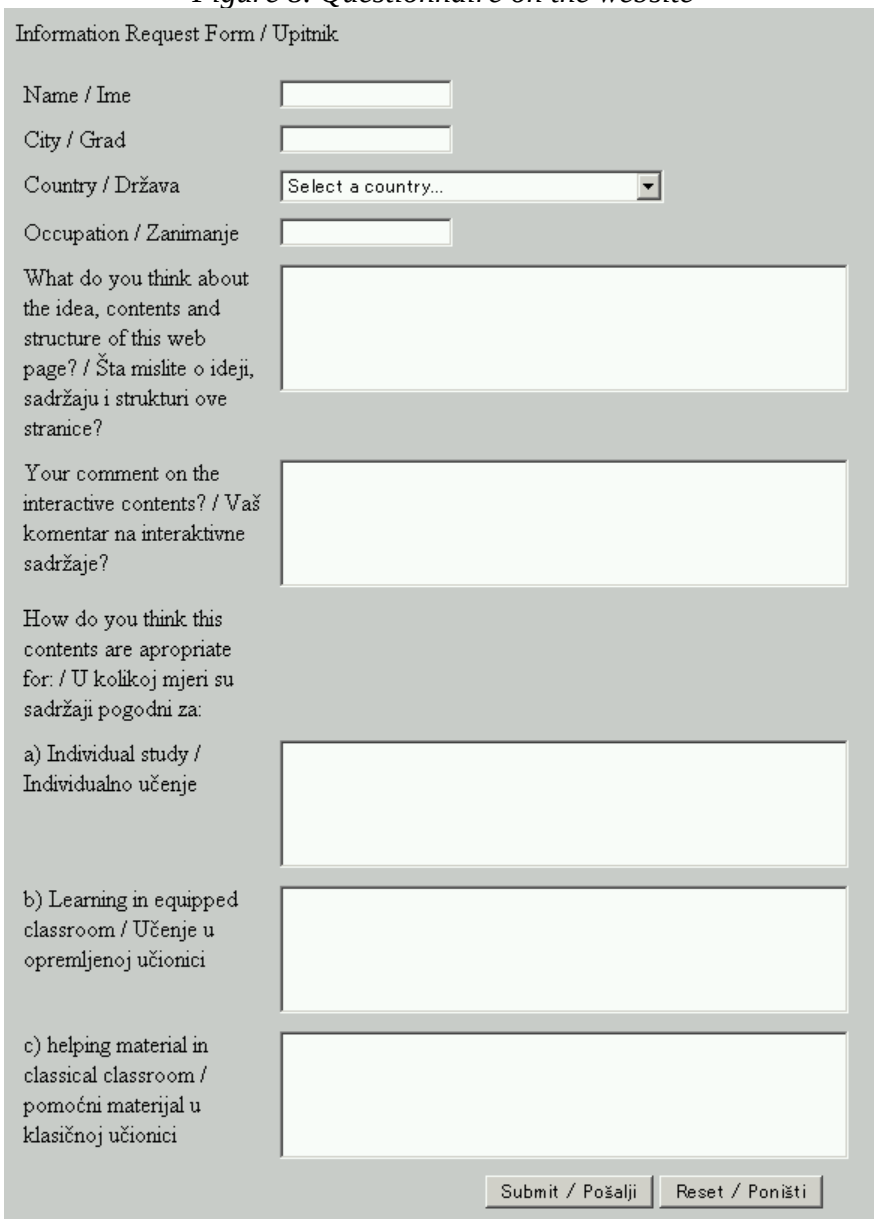
3.2.5. Experimental use of website

I wasn't able to do an experiment in the classroom because the informatics classroom in my school was still not used by all the students except for the extracurriculum informatics course. So, I put a questionnaire on the webpage "Matematika Online" and sent link to many teachers, students, random users and asked them to fill in and send me feedback. Out of their answers I got following conclusions:

- The web-page is users friendly and easy to navigate
- Contents of mathematics are very useful for the individual learning, altough it shouldn't be the only way of learning
- Contents of mathematics are very useful as a helping material in the classical classroom and teachers are looking forward to be able to download the same
- No many answers for the equipped classroom because not many were able to use such a classroom and work with the students that way
- Exercises should be harder
- More interactive materials should be put in with many examples from the real life and situatins
- Maybe the colours of the main page should be different

Of course, the webpage is still in the experimental stage so such a feedback is very good to determine actions in the future development: what contents to concentrate on, what kind of information to put in, on what parts of webpage to put the priority on.

Figure 8. Questionnaire on the website



3.3. Implementing E-Learning Environment in Informatics[3]

During this course, E-Learning environment in informatics is implemented in two ways. One is developed web site with informatics contents, and another is established Learning Management System (LMS) *Moodle*. Informatics is relatively new subject in schools, and curriculum is changing from year to year, therefore is very hard to choose topics for E-Learning contents. In this case we select two topics: *Microsoft Word Basics* and *Microsoft Excel Basics.* The main reason is quite simple – those topics are most common in all curriculums of informatics in Bosnia and Herzegovina and Japan. Another reason, comparing to mathematics contents, is that mathematics is taught for at least 11 years through elementary and secondary level of schools, but informatics in most cases only one year.

3.3.1. Contents structure

Informatics contents are, as it is already mentioned, divided in two main topics: *Microsoft Word Basics* and *Microsoft Excel Basics.* Those topics are divided into lessons. *Microsoft Word Basics* consists from seven lessons, and *Microsoft Excel Basics* consists from four lessons. Each lesson has three types of contents:

- Static – HTML text organized like textbook and workbook
- Dynamic demonstrative – Animated demonstrative lessons of processes described in static part.
- Dynamic interactive – Animated interactive lessons of processes described in static part and demonstrated in dynamic demonstrative part – student has to practice how to accomplish tasks described and demonstrated in previous parts.

Microsoft Word Basics lessons are shown below:

1. Lesson One: Microsoft Word for Windows
2. Lesson Two: Things You Need to Know
3. Lesson Three: Microsoft Word Basic Features
4. Lesson Four: More Basic Features
5. Lesson Five: Working with Paragraphs
6. Lesson Six: Tab Key, Bulleting, Numbering, Undo, Redo, Printing, and Help
7. Lesson Seven: Tables

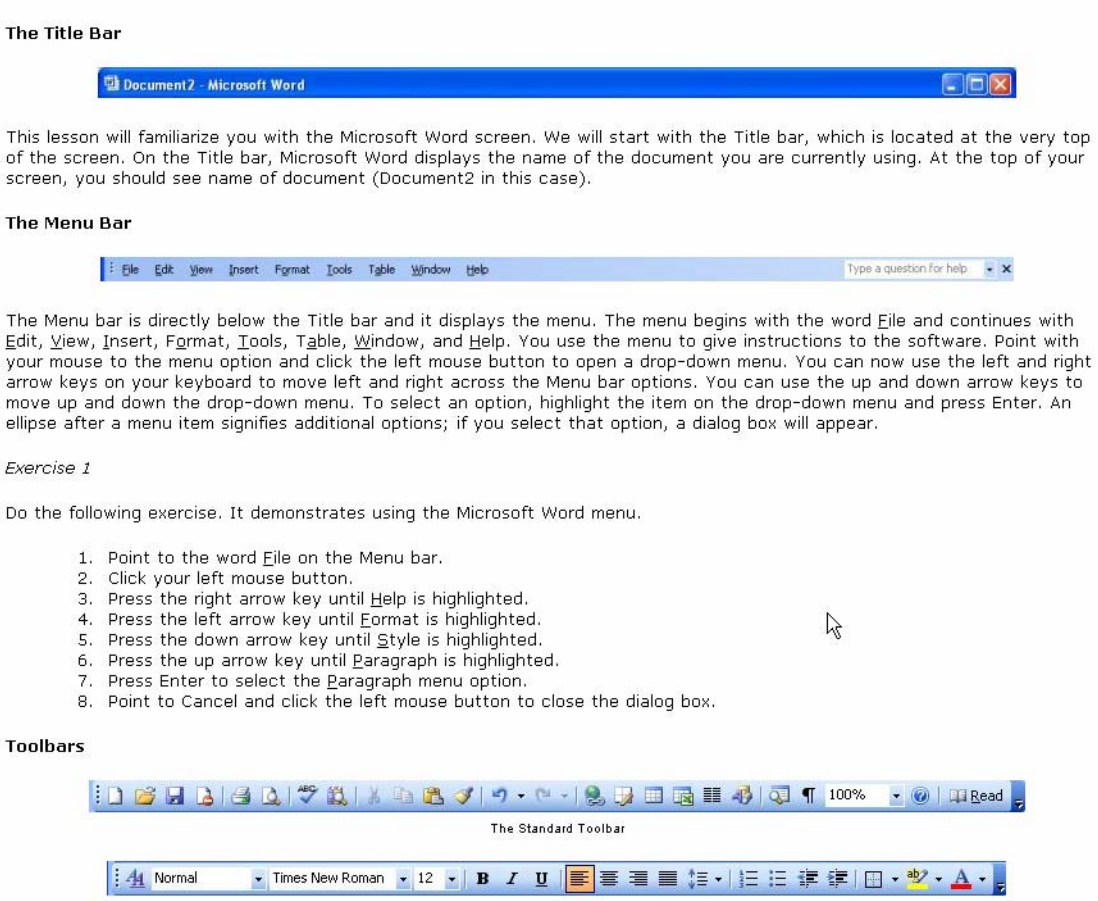
Microsoft Excel Basics lesson are shown below:

1. Lesson One: Entering Text and Numbers
2. Lesson Two: Formatting Text and Performing Mathematical Calculations
3. Lesson Three: Numbers and Mathematical Calculations
4. Lesson Four: Creating Charts

[3] Ljubomir Petković, Machinist Technitian High School, Prijedor, Bosnia and Herzegovina

It has to be mentioned that lessons are designed for absolute beginner of using computer, so first lesson of each topic is describing main parts of software window. So, first lesson of *Microsoft Word Basics* is describing where is title bar, menu bar, toolbar, text area and status bar. Further in the lesson is described how to use menu bar and toolbar. Those descriptions are common for various number of software and for standard Windows applications. According to that we can say that first lesson is also teaching how to use any Windows application. Further lessons are focused on *Microsoft Word* or *Microsoft Excel* features. Next picture shows part of first lesson of *Microsoft Word Basics.*

Figure 1.



The Title Bar

Document2 - Microsoft Word

This lesson will familiarize you with the Microsoft Word screen. We will start with the Title bar, which is located at the very top of the screen. On the Title bar, Microsoft Word displays the name of the document you are currently using. At the top of your screen, you should see name of document (Document2 in this case).

The Menu Bar

File Edit View Insert Format Tools Table Window Help Type a question for help

The Menu bar is directly below the Title bar and it displays the menu. The menu begins with the word File and continues with Edit, View, Insert, Format, Tools, Table, Window, and Help. You use the menu to give instructions to the software. Point with your mouse to the menu option and click the left mouse button to open a drop-down menu. You can now use the left and right arrow keys on your keyboard to move left and right across the Menu bar options. You can use the up and down arrow keys to move up and down the drop-down menu. To select an option, highlight the item on the drop-down menu and press Enter. An ellipse after a menu item signifies additional options; if you select that option, a dialog box will appear.

Exercise 1

Do the following exercise. It demonstrates using the Microsoft Word menu.

1. Point to the word File on the Menu bar.
2. Click your left mouse button.
3. Press the right arrow key until Help is highlighted.
4. Press the left arrow key until Format is highlighted.
5. Press the down arrow key until Style is highlighted.
6. Press the up arrow key until Paragraph is highlighted.
7. Press Enter to select the Paragraph menu option.
8. Point to Cancel and click the left mouse button to close the dialog box.

Toolbars

100% Read

The Standard Toolbar

Normal Times New Roman 12 B I U

If you look at figure above, you can see that among describing main parts of *Microsoft Word* window is also small step-by-step exercise how to use the Microsoft Word menu. Similar approach is applied in *Microsoft Excel Basics* first lesson also. At the end if this lesson, student can find link to demonstrative and interactive lesson where he can see and point where basic parts of the Microsoft Word window are.

Other lessons in *Microsoft Word Basics* are focused on the Microsoft Word features. In this paper there is no place to show all lessons, but one appropriate example could be shown. Let us have look on fifth lesson: *Working with Paragraphs.* This lesson is teaching manipulation with paragraphs. The lesson covers next features:

- Space Before and Space After – Space before and after each paragraph

- Line Spacing – spacing between lines in a paragraph
- Indentation – first line indentation, whole paragraph indentation from each side left and right
- Alignment – paragraph alignments

Figure 2.

8. Click on OK.
9. The first line of your paragraph should now be indented .25 inches.

Special Note: To remove the first line indent:

1. Place the cursor anywhere in the paragraph.
2. Click on Format.
3. Highlight Paragraph. Press Enter.
4. Click on the Indents and Spacing tab, if that tab is not in the front.
5. Click in the Special pull-down menu; then click on None.
6. Click on OK.

Indentation

Indentation allows you to indent your paragraph from the left or right margin. The following examples show different types of indentation.

Example -- Indentation

We will use this paragraph to illustrate several Word features. It will be used to illustrate Space Before, Space After, and Line Spacing. Space Before tells Word how much space to leave before the paragraph. Space After tells Word how much space to leave after the paragraph. Line Spacing sets the space between each line within a paragraph.

We will use this paragraph to illustrate some additional Word features. It will be used to illustrate first-line indent. With first-line indent, you can indent the first line of your paragraph. We will also look at Indentation. Indentation enables you to indent from the left or right margins of your document.

Exercise 4

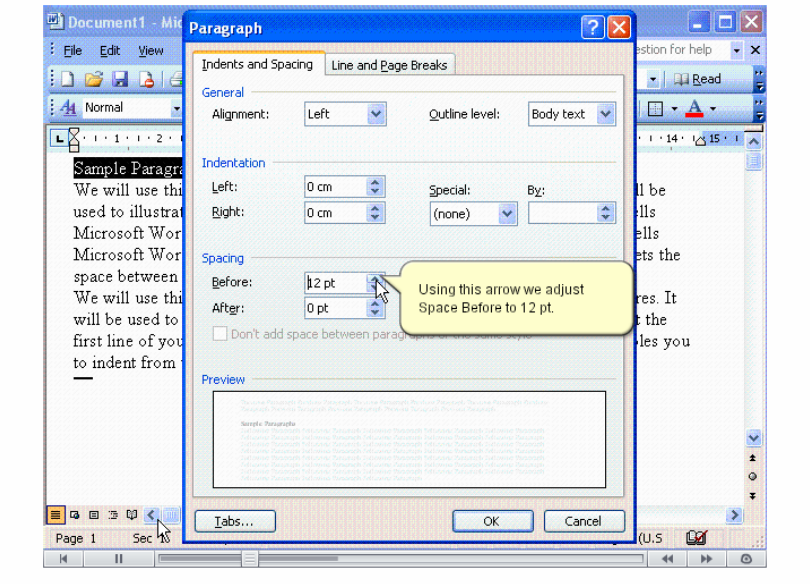
1. Highlight the second paragraph, beginning with "We will use" and ending with "of your document."
2. Click on Format.
3. Highlight Paragraph. Press Enter.
4. Type **1"** in the Left field.
5. Type **1"** in the Right field.
6. Click on OK.
7. Your paragraph should now be indented one inch from both the left and right margins, as in the example.

Alignment

Microsoft Word gives you a choice of several types of alignment. Left-justified text is aligned on the left side. It is the default setting.

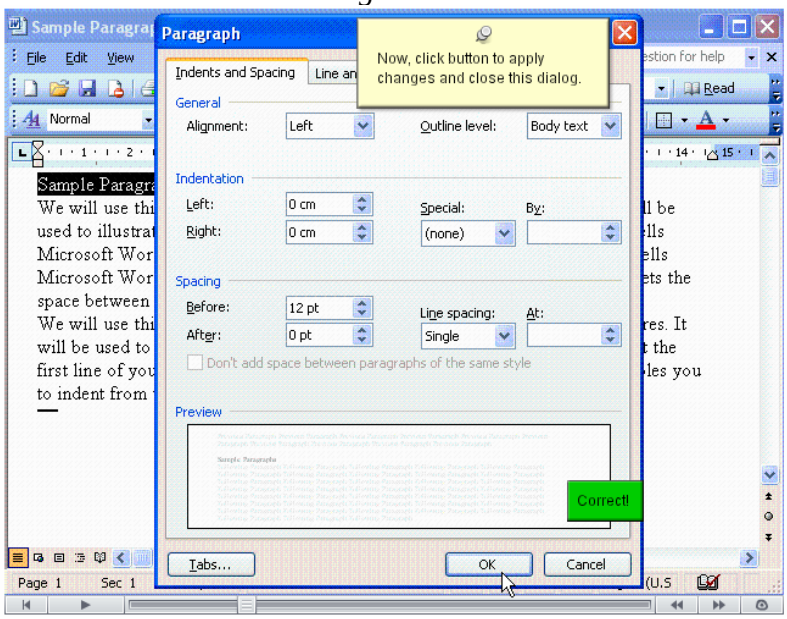
In part of lesson above it is shown structure of lesson. After short definition of a feature is step-by-step exercise how to apply mentioned feature. In that manner all topics are taught. At the end of this lesson student can find links to two demonstrative and two interactive lessons which are demonstrating practice of manipulating with paragraphs. Next figure is showing one frame from demonstrative lesson how to apply Space Before.

Figure 3.



Animation of process is additionally described with tips written in yellow clouds like on the figure above. Interactive lesson is similar, but there student is asked to click on proper place so the process could be accomplished. If student click properly, he will be informed that is correct and next slide will automatically displayed. In case he clicked wrong, he will be asked to repeat action. One frame (slide) of interactive lesson is shown below.

Figure 4.



Sample slide above shows applying changes in Paragraph dialog with message that student has pressed correct button to do it.

In *Microsoft Excel Basics* lessons same approach and structure is used. Those lessons cover quite basics of the Microsoft Excel. Students can learn there until applying basics

formulas and functions, cell addressing, cell formatting and simple chart inserting. Advanced features like using VBA and making Excel applications, advanced formulas and functions, etc. are not covered.

3.3.2. Accessing informatics contents

There is two way to access described informatics contents. One is trough developed web site currently located at:
http://elearningbih.criced.tsukuba.ac.jp/informatics/
Another is trough established learning management system (LMS) *Moodle.* Learning management system will be described later in this paper. Currently contents are developed in two languages: English and Bosnian languages. There is plan for translation in Japanese, also. Physically contents are located at server which is connected to Japanese academic network at Tsukuba University. This way, contents are accessible all around world. It is needed to be mentioned that amount of contents and probably web site to access it will be changed during the 2006 year because next group of participants who will work on it will develop their own contents. Let's have look at website front page in English.

Figure 5.

On figure above, it is shown page with topics. Topics are ordered by lessons first *Microsoft Word Basics* and then *Microsoft Excel Basics.* Below each lesson are links for dynamic demonstrative and interactive contents which can be accessed directly without opening static lesson page. Dynamic demonstrative and interactive pages will be opened

in new window. Right side is reserved for news related to informatics. On top of page menu is located. First menu item is *Home.* Clicking on this item will cause opening first page where language selection is. Second menu item is *Topics* which opens page which is shown on figure above. *Forum* menu item opens in new window simple forum for exchanging opinions and discussing. *Related links* item is linked to a page with links to related parties in this development and pages related to informatics. Last item, *Contact us,* is just a with email links to author and system administrator of this website.
Let us describe some technicalities about website and contents. Today, in Japan, almost everyone has high speed internet connection, especially schools and other educational institutions. Even so there is need to optimize contents to be opened faster as it is possible. On the other hand, in Bosnia and Herzegovina high speed connection are still not available. Average school, if it has internet connection at all, share one 64 Kbps connection to all computers in computer classroom. These conditions dictate that contents have to be optimized as much as it possible. What that means? It means that file size of lessons has to be smaller as it is possible. In that manner static lessons which are developed have average size about 100Kb. Dynamic demonstrative and interactive animations is expected to be large, but for developing are used flash animation so average size of those animations are around 300Kb. Comparing to 10Mb which would be needed for ordinary animation file it is quite difference. For illustration, if we have situation that only one computer in one moment with 64Kbps connection accessing one average flash animation file of 300Kb size it will take around 20 seconds to open it. In the case of ordinary animation file of 10Mb size, it will more than 10 minutes. If we put all together we got size for whole website which is around 30Mb.

3.3.3. Learning Management Systems

There are view definitions what is Learning Management System:

- Internet based software that deploys, manages, tracks and reports on interaction between the learner and the content & the learner and the instructor. In particular, learning management systems perform student registration, track learner progress, record test scores, and indicate course completions, and finally allow instructor trainers to assess the performance of their students.
- A software application which records student records and learning resources, such as courseware, course packages, books, classrooms, and instructors.
- Infrastructure platform through which learning content is delivered and managed. A combination of software tools perform a variety of functions related to online and offline training administration and performance management.

There different points of view on learning management systems. Most of them consider it as good improvement in learning and education in general. Other, maybe still conservative, consider it as bad, or not so good way for learning. According to them there are advantages and disadvantages of learning management systems. Let us first describe advantages.

The advantages begin with access to the training itself. Good learning management systems will allow you to sort through global online catalogs for complete access to all the learning available to you and then easily filter through this information

to select the courses that match your specific needs for training and certification. You can access all of your learning resources through a single point of access.

A second advantage of an LMS for the individual is the ability to understand your current skills before you embark upon learning. Comprehensive learning management systems are typically populated with a number of assessments in the area of technology and soft skills. This tool allows you to gain a better understanding of where you are today to determine which courses are needed to reach your learning goals. The better learning management systems will also allow you to construct development paths for yourself and view your own progress against your goals. You can piece together courses, classes or reading documents into whatever format you want in order to build your own individualized learning path.

A third advantage of learning management systems for individuals is their capability to dramatically personalize the learning. Sophisticated learning management systems allow learners to leave their own notes inside the learning, create bookmarks, personalize content pages and favorites and list the activities they want to undertake. This system allows you to create your own home page and list those courses and activities in which you are currently engaged. It will also automatically alert you when a new program or certification that you are interested in is made available. Many learning management systems also unlock the ability to collaborate with your peers, both within your organization and across the industry, through threaded discussions, live chats or mentored sessions. The ability to get access to personalized training information and expert resources and support through a single point of entry is incredibly powerful.

Last, but perhaps the most advantageous, is the ability of an LMS to allow you to fully manage and track your own learning. The best learning management systems have a documented transcript progress to serve as a dynamic record of your learning. It keeps track of everything you do—all of the classes attended, all of the e-learning courses taken, what stage you have reached within the course, assessments taken and all other activities. The power of these transcripts is their ability to show how much you have invested in learning and how much has been achieved. Clearly, this is an enormous advantage when applying for promotions, seeking a new job or approaching the organization about furthering your training.

In many ways, a good LMS provides as many benefits to the individual as it does to the organization because of the power it gives individuals to tailor, customize and track their own learning. For those of you who have the opportunity to take advantage of an LMS, either within your organization or those provided by training vendors, I strongly encourage you to take the time to understand how much value these platform technologies can provide to you as a learner. The ability to dynamically build training paths, to customize the learning to best meet your needs, to gain a single point of access to all the of the resources you need to be successful, and finally, to provide you with a single unified transcript that is a summary of your investment and your success in your development can go a long way toward helping you achieve your goals in the IT industry.

On the other hand, some disadvantages, or second opinion on learning management systems are following.

The tools we use define the manner in which we undertake learning tasks. Using a structured tool like an LMS drives/dictates the nature of interaction (instructors-learner, learner-learner, learner-content).

The interface - generally, the initial reactions to the interface is confusion for many learners. I've instructed with various platforms, and the most difficult/disorienting challenge for new learners is figuring out how the interface works and where to get the information she/he needs. This confusion is due to two flaws in the LMS: 1) LMS' try to do everything - simpler tools, with the intent of performing one task seem to be easier for end users to understand, 2) LMS' are designed as a learning management tool, not a learning environment creation tool (interface design explores the importance of social considerations: the key criteria in interface design is obviously "what does the end user want/need to do". Current LMS interface design relies too heavily on "what do the designers/administrators want/need to do").

Only recently (and in limited ways) have LMS vendors started extending tools and offerings beyond simple content sequencing and discussion forums. WebCT and Blackboard have recently formed partnerships with synchronous tools to allow for easy integration across platforms. It's progress, but still within a "locked-down, do-it-our-way" platform.

Large, centralized, mono-culture tools limit options. Diversity in tools and choices are vital to learners and learning ecology. Over the last several years, I've encountered many instances where an instructor was not able to achieve what she/he wanted with course design due to the limitations of WebCT. In essence, the LMS determines what an instructor could do. It should be the other way around - instructor needs first, tool selection second.

3.3.4. Moodle as Learning Management System

Moodle (Modular Object-Oriented Dynamic Learning Environment) is one of many learning management systems can be found on the market (internet). What are characteristics of Moodle system? There are a lot, but let us mention important:

- Free
- Open Source
- Multilanguage ability (43 languages)
- 50.000 registered users
- Low hardware and software requirements.

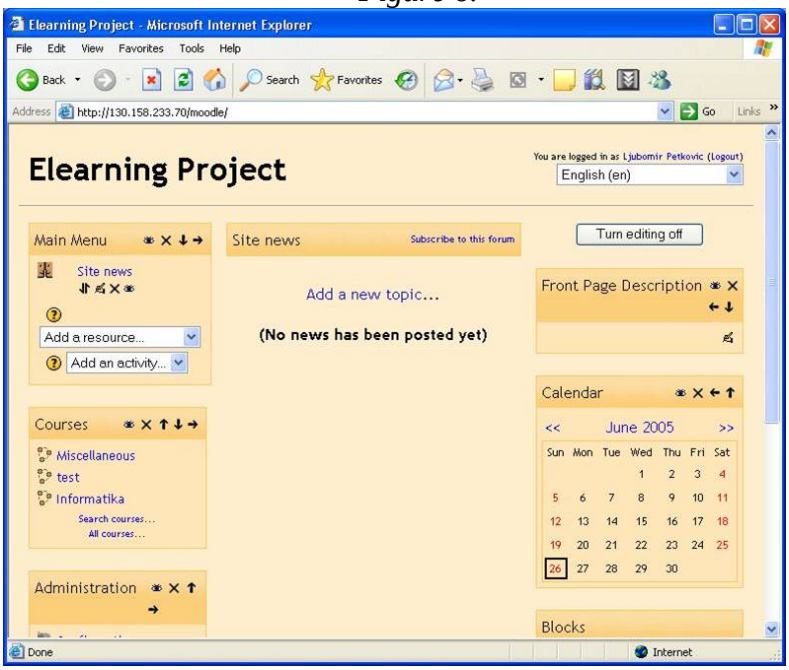
Now, let us mention some more important Moodle features.

- Flexible array of course activities - Forums, Journals, Quizzes, Resources, Choices, Surveys, Assignments, Chats, Workshops
- All grades for Forums, Journals, Quizzes and Assignments can be viewed on one page (and downloaded as a spreadsheet file)
- Full user logging and tracking - activity reports for each student are available with graphs and details about each module (last access, number of times read) as well as a detailed "story" of each students involvement including postings etc on one page
- Mail integration - copies of forum posts, teacher feedback etc can be mailed in HTML or plain text.
- Students can upload their assignments (any file format) to the server

- Chat module allows smooth, synchronous text interaction
- Different types of forums are available, such as teacher-only, course news, open-to-all, and one-thread-per-user
- Quizzes - Teachers can define a database of questions for re-use in different quizzes
- Quizzes are automatically graded, and can be re-graded if questions are modified
- Quiz questions and quiz answers can be shuffled (randomized) to reduce cheating
- Supports display of any electronic content, Word, PowerPoint, Flash, Video, Sounds etc

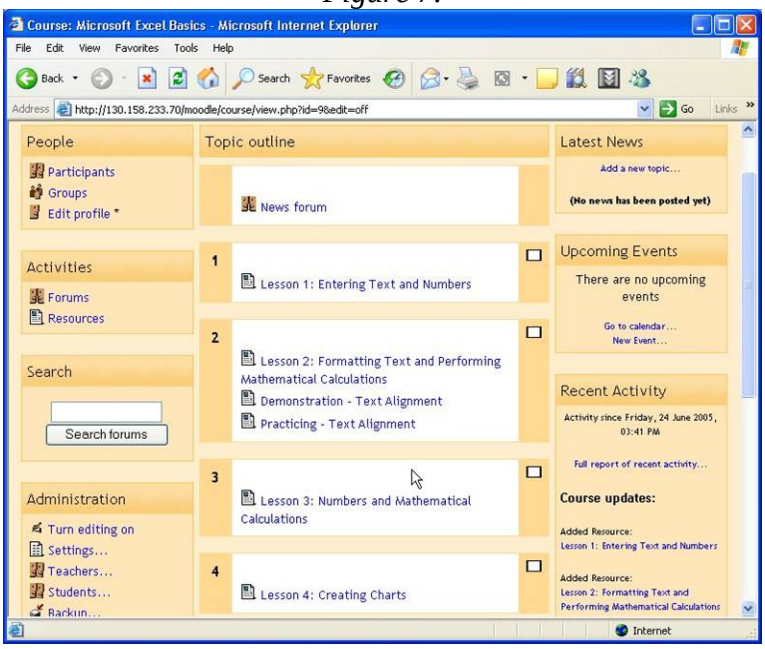
On the next figure you can see Moodle main window. There are many toolbars, actually, this is from administrator point of view. What is important is toolbar where user can choose course and drop-down menu for language selection in right upper corner.

Figure 6.



If user open appropriate course, topics list will be open. There user (student) can select topic. Any student activity will log.

Figure 7.



On the upper figure is shown that lessons are grouped. In this example *Microsoft Excel Basics* are published.

One important feature of Moodle is easy creating of quizzes. Moodle support different types of questions:

- Multiple choice
- True/False
- Short answer (text answer)
- Numerical
- Calculated
- Matching
- Description
- Random

Forms for creating questions are very intuitive and easy for question design. Moodle allows to create library of questions and randomly or not choose questions from library and create quizzes. In case of randomly created quiz cheating is reduced, but statistics of answering on particular question will not be available.

All those Moodle features make it very appropriate environment for publishing distance learning contents. According to that, Moodle is used to conduct experiment with Bosnia and Herzegovina students. Students were accessing contents trough the Moodle.

3.3.5. Using Moodle and contents in experiment

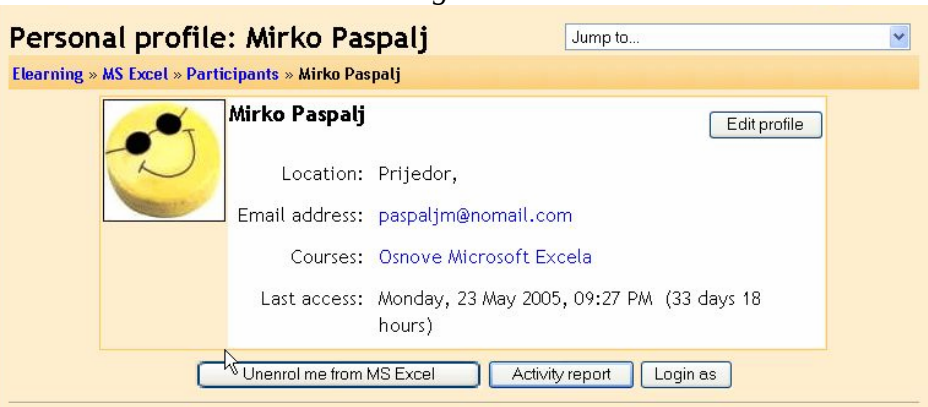
One of important points in this project is testing the contents and e-learning environment in real school. The school which cooperates with us is Electric Technician

High School, Prijedor, Bosnia and Herzegovina. So, we can consider this experiment also as one good example of cooperation. Target group were three classes of first grade students in mentioned school. Student age at first grade high school in Bosnia and Herzegovina is 14. Experiment was conducted in May 2005. In that time, by curriculum, students are learning about Microsoft Excel. Therefore, in experiment we use contents *Microsoft Excel Basics.* The contents were published trough Moodle learning management system.

Using Moodle learning management system give us this way good feedback how each student access the contents. That means that each student has to be identified somehow. As Moodle provide good user management system, before experiment we create account for each student. Also, we enable access to contents only for logged students, so that way we were insured nobody else accessing contents.

Students were using contents for 6 classes (one class 45 minutes) with assistance of their teacher for studying about Microsoft Excel. During those two weeks, Moodle system logs every student activity.

Figure 8.

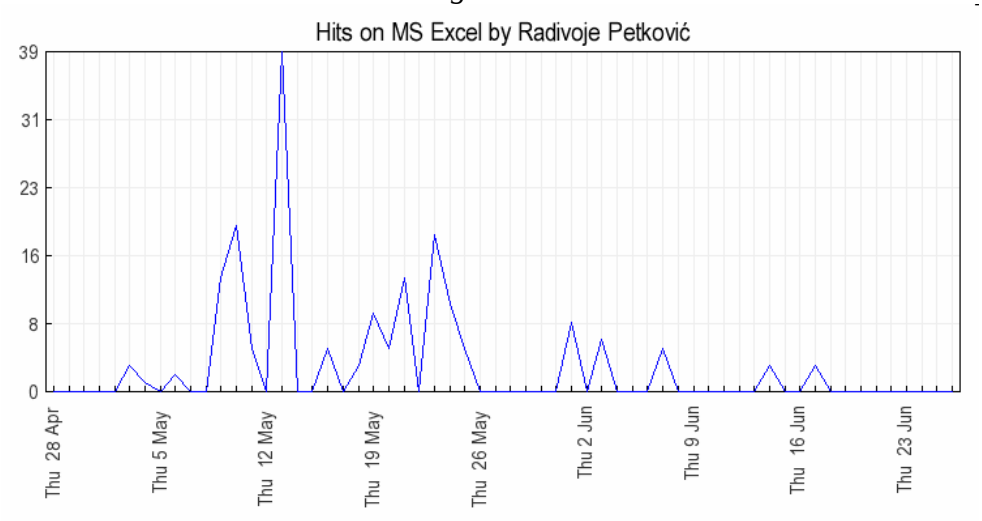


On figure above we can see Moodle page with user personal profile. There is basic data about user (student), and button *Activity report* which will open preview of logs about current user. If we press that button we will get report shown on figure below.

Figure 9.

Figure is truncated because of space, but we can see how much are particular contents visited by specified student. Also, there is activity graph which can be generated for specific period and specified student. Next figure shows us graph of hits of one student to any contents in this course.

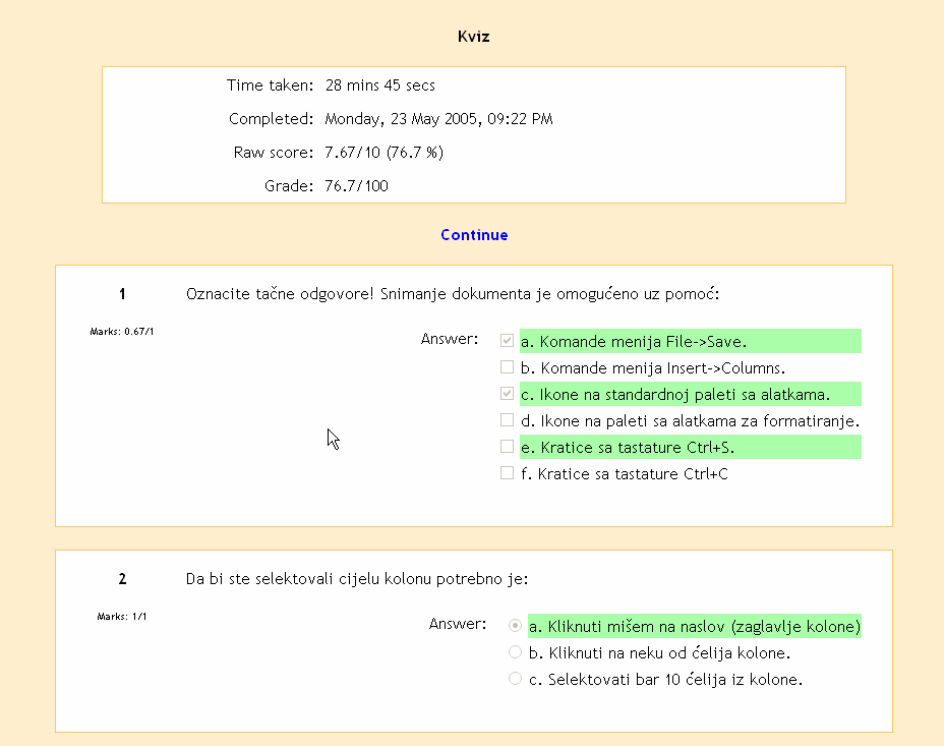
Figure 10.



The most important advantage of Moodle system is good support for developing and conducting quizzes. So, in this experiment each student attempts a quiz. Grades they got in this quiz are included for they final grade, so they were motivated to do it as good as they can. On the other hand, because of that, quiz questions are generated randomly from groups of questions. So, for each question from 1st to 10th Moodle choose one from the library of 5-10 questions. That way we quite reduce cheating, but we are loosing

statistics how students answered on particular question. Next figure shows us part of student quiz attempt.

Figure 11.



This is report how student answered quiz, but quiz by itself is not much different. Difference is that correct answers on figure above are marked with green, and student's answer is gray. In this case, first question has one mistake (unchecked answer e.), but second is correct. Total score is 76.7% and student solves this quiz in 28 minutes and 45 seconds.

On the end, we have list of all enrolled students which were attempted quiz in list like on figure below. Statistics of student's attempts can be exported in Microsoft Excel document, also.

Figure 12.


Kviz
Overview
Regrade attempts
Detailed statistics
Simple statistics
Name
Attempts
Last attempt /1
Slobodan Savic
60.0 23 May 2005, 08:53 PM (26 mins 23 secs)
60.0
Ljubomir Petkovic
60.0
Jovan Oroz
80.0 23 May 2005, 08:54 PM (26 mins 8 secs)
80.0
Dragana Pilipovic
76.7 23 May 2005, 08:53 PM (28 mins 45 secs)
76.7
Marijana Hrvacanin
36.7 23 May 2005, 08:54 PM (28 mins 42 secs)
36.7
Igor Šolaja
83.3 23 May 2005, 08:54 PM (29 mins 42 secs)
83.3
Predrag Cetic
56.7 23 May 2005, 08:54 PM (30 mins 46 secs)
56.7
Mirko Paspalj
46.7 23 May 2005, 08:54 PM (33 mins 31 secs)
46.7
Radan Panic
43.3 23 May 2005, 08:53 PM (33 mins 58 secs)
43.3

4. CONCLUDING REMARKS

In further actions, after finishing this course we have obligations to continue our work on e-learning environment. There are view ways we will do it:

- Assistance to new participants
- Popularization of developed contents on seminars in Bosnia and Herzegovina
- Applying new developed contents in Informatics class
- Installation of Moodle system to school local networks
- Continuing good cooperation along with contact persons which where invited here.
- Continue to make contents and finish contents in trigonometry according to the curriculum given above
- Continue to work on administrating the web-page "Matematika Online" and upload contents
- Start another web-page with the contents of Physics as an extra curriculum activity with the students
- Introduction of e-learning in curriculum of Mathematic Teaching Methodology on Pedagogic Academy in Sarajevo
- Continuing development of e-learning contents with interested students on Pedagogical Academy in Sarajevo

There will be two ways in assistance to new participants. One is to introduce them in course before their departure to Japan: to show them our work, to give them advices how to continue it, to establish cooperation etc. Another way is to support them on their conducting of experiment with their contents with our classes.

Popularization of developed contents will be conduct through seminars which we will participate. We have to relay on our contact persons who were invited here in Japan to recommend us as participants on seminars and symposiums.

The main obstacle in implementing completely this project is not having equipped classrooms and ITC tools in the schools in Bosnia (i.e. projector) so one of the main aims is to promote the project among people who could help improving conditions

Work on the education of teachers, because very soon if we want to follow the world education trends every teacher should be able to prepare and plan lesson using ICT.

Broaden the communication should make Mathematics education a dynamic and challenging field both for students and teachers.

5. REFERENCES

1. **Mathematics Program in Japan - Elementary, Lower Secondary and Upper Secondary Schools,** Japan Society if Mathematical Education (JSME), 2000.
2. **Elementary School Teaching Guide for the Japanese, Course of Study: Arithmetic (Grade 1-6),** Ministry of Education, Culture, Sports, Science and Technology of Japan (MEXT), 1989. (English translation by CRICED, 2005.)
3. **www.mext.go.jp –** official web site of Ministry of Education, Culture, Sports, Science and Technology of Japan
4. **MATEMATIKA 4,** Textbook for 4th grade of High School in Mathematics, Neven Elezović i Branimir Dakić, Zagreb 2003.
5. **The Mathematics Experience,** Group of Authors, Houghton Mifflin Company, Boston, 1992.
6. **INFORMATIKA I,** Textbook for 1st grade of High School in Informatics, L. Budin, Element, Zagreb, 1996

APPENDIX 1

We presented the educational system in Bosnia and Herzegovina on the occasion of International Educational Cooperation Symposium organized by CRICED at the University of Tsukuba. In what follows, the program and our PowerPoint file of presentation are attached. The detail of this symposium can be also found in the following URL: http://www.criced.tsukuba.ac.jp/math/20041129/

International Educational Cooperation Symposium
Problematic and Perspective of international cooperation in mathematics education

Date:	Monday, 29th November 2004
Time:	13:00-17:00
Venue:	Master Program Building 8B210, University of Tsukuba (1-1-1, Tennodai,Tsukuba-shi, Ibaraki-ken)
Organizer:	CRICED – University of Tsukuba

Program:

13:00 - 13:10 Opening
13:10 - 14:00 Brief report for mathematics and information education in Bosnia Herzegovina
Valentina MINDOLJEVIC (Gimnazija Mostar)
Ljubomir PETKOVIC (Machinist Technitian High School, Prijedor)
Karmelita PJANIC (Pedagogical Academy)
14:00 - 14:50 Brief report for primary and secondary school mathematics education in Malaysia
Wan Zah & Rohani Ahmad Tarmizi (Universiti Putra Malaysia)
14:50 - 15:10 Break
15:10 - 16:00 Brief report for primary and secondary school mathematics education in Chili
Cristian REYES (Ministry of Education in Chili)
Malva VENEGAS ASENJO (Ministry of Education in Chili)
16:00 - 16:50 Brief report for primary and secondary school mathematics education in Japan
Masami ISODA (CRICED - University of Tsukuba)
Yutaka OHARA (CRICED - University of Tsukuba)
Takeshi MIYAKAWA (CRICED - University of Tsukuba)
17:00 - 17:10 Closing

APPENDIX 2

The followings are program of the final presentation of JICA training program of Bosnia and Herzegovina and the PowerPoint files used by three of us at the presentation. The final presentation is organized by CRICED.

JICA Training Program Final Presentation

Date: 3rd August, 2005
Time: 14:00 ~17:00
Place: Advanced Research Building A107

- ✓ **Opening remarks**

  Jiro TANAKA (University of Tsukuba)

- ✓ **Presentation**

  Karmelita PJANIC (Pedagogical Academy)
  Promotion of ICT Education and Developing Environment for E-learning in Mathematics at Elementary Levels in Bosnia and Herzegovina.

  Valentina MINDOLJEVIC (Gimnazija Mostar)
  Promotion of ICT Education and Developing Environment for E-learning in Mathematics at Secondary Levels in Bosnia and Herzegovina.

  Ljubomir PETKOVIC (Machinist Technitian High School, Prijedor)
  Promotion of ICT Education and Developing Environment for E-learning in Informatics in Bosnia and Herzegovina.

- ✓ **Closing remarks**

  Hiroaki KAMEYAMA (Fujitsu Laboratory)
  Kyoko KAKIHANA (Tsukuba Gakuin University)

APPENDIX 3

We wrote a paper with Prof. Takeshi Miyakawa and Prof. Masami Isoda for the national conference which will be held in September 2005 in Japan. As we will not be in Japan at that moment, Prof. Isoda will present the paper. In what follows, the detail of the conference and the paper submitted are shown.

Japan Society for Science Education 29th Annual Convention

Theme: Seeking science education research which collaborates with society's needs

Date:	September 9(Fri) - 11(Sun) 2005
Place:	Faculty of Education – Gifu University (1-1 Yanagido Gifu-City 501-1193)
Organizer:	Japan Society for Science Education
Sponsor:	Gifu University, Gifu Prefecture Board of Education, Gifu Tourist Convention Center, Learning System Research Committee, etc.
Website:	http://project.crdc.gifu-u.ac.jp/~jsse29/eng/

APPENDIX 4

We attach here the English translation of Course of Study for upper secondary schools in Japan. This is excerpt related to Informatics.