

## INTRODUCTION

Mathematics science, like all sciences, is developing and changing. In the last hundred and fifty years it has changed significantly. New mathematical theories have been made, new approaches to old problems, new methods, new symbols and terminologies. 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 one's personality.

We can not imagine today's world without the use of information technology and computers. It is everywhere: traveling, administration, all fields of science for data evaluation, new model making, predictions etc. Computers can evaluate large amounts of data very quickly; a new language is born based on mathematics which gives a base for communication between humans and machines. Occupations are changing according to it.

So the biggest revolution and change has to be done in the field of education. Under necessary conditions for reaching the educational ideal we can assume all the circumstances that allow efficient application of didactic materials. 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 computers in the teaching process is giving concrete meaning to abstract terms.

What is ICT learning? Information and communication technologies (ICT) are the computing and communication facilities and features that variously support teaching, learning and a range of other 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 inquiry;
- integrated learning systems (ILS) to teach basic numeracy;
- communication technology to exchange administrative and assessment data.

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

- experiment and learn from feedback
- think logically and develop problem-solving skills
- observe, explore and explain number patterns, shape and data
- make and test hypothesis 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 an essential concern in developing further curriculums for those who are going to live and work in developed societies and the modern world. Bosnia and Herzegovina is a country in the heart of Europe with a long tradition of successful educational systems that is now undergoing changes and reforms so that it can fully be integrated into European Union and follow the world standards in this field.

This program has been held in cooperation with JICA (Japan International Cooperation Agency), Japan's University of Tsukuba (CRICED - Center for Research on International Cooperation in Educational Development) and Government of Bosnia and Herzegovina to provide a training of the new generation of the Mathematics and Informatics teachers and developers of 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 and informatics educators
- Knowing how to use developed innovative sites in elementary and secondary classrooms for their subject
- Knowing how to develop teaching skills utilizing ICT based on Japanese methods of the lesson study

This report presents activities, results and products we conducted during our stay here in Japan. It consists of three parts, the first is chronology of course activities and study trips, second is about developed contents and implemented environments while the third is about our concluding remarks.

# 1. Activities

## 1.1 Training program

Term	Subject	Contents(Group)
<b><u>1<sup>st</sup> stage</u></b> 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 <ul style="list-style-type: none"> <li>▪ School curriculum</li> <li>▪ School subject</li> <li>▪ ICT</li> <li>▪ Mathematics education</li> <li>▪ Informatics education</li> </ul>
	Over view of e-learning environment and application. (2 weeks)	e-learning environment, Internet environment and information education. Basic multimedia technique : <ul style="list-style-type: none"> <li>▪ LEGO Mindstorm</li> <li>▪ Geometric Construction Tool, Graphing tool, Computer Algebra System</li> </ul>
	Developing skills of internet application (9 weeks) with textbooks.	<ul style="list-style-type: none"> <li>▪ HTML,</li> <li>▪ Macromedia Flash, ActionScript</li> <li>▪ Server management with Linux</li> <li>▪ Learning Management System (Moodle)</li> </ul>
<b><u>2<sup>nd</sup> stage</u></b> 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)	<ul style="list-style-type: none"> <li>▪ to create e-learning contents development through the basic technique in three languages in Bosnia and Herzegovina, and English</li> <li>▪ Experiment of distance education between Bosnia and Herzegovina, and Japan using the environment</li> </ul>
<b><u>3<sup>rd</sup> stage</u></b> Integrating the results and evaluation (2months)	Integrating the results on web site and evaluation	<ul style="list-style-type: none"> <li>▪ Presentation of final report</li> <li>▪ Presentation at academic meeting, college seminar etc.</li> <li>▪ Evaluation meeting</li> </ul>

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

Program of visiting schools is given as follows:

- December 21<sup>st</sup> 2005. Sawara Senior High School
- January 17<sup>th</sup> 2006. Attached Elementary School of University of Tsukuba
- January 18<sup>th</sup> 2006. Attached Junior High School of University of Tsukuba

Attended seminars and conferences:

- January 11<sup>th</sup> 2006. Professor Becker's Seminar
- January 15<sup>th</sup> 2006. APEC-Tsukuba International Conference
- February 2006 Professor Arcavi's seminar
- March 2006 3<sup>rd</sup> International Forum on Basic Education Development in Developing Countries
- June 21<sup>st</sup> 2006 British Council Forum
- July 8<sup>th</sup> 2006 Teacher Uehara's seminar
- July 26<sup>th</sup> 2006 2<sup>nd</sup> B&H seminar
- August 18<sup>th</sup> 2006 Japan Society for Science Education Conference

## ***1.2 Introduced techniques for developing teaching materials***

During our course we were introduced to different techniques and software useful for developing our contents, as follows:

- Cabry Geometry II Plus (demonstration)
- Html – tags (active)
- Geometric Inventor (active)
- Macromedia Dreamweaver (active)
- Macromedia Flash (active)
- Grapes (demonstration)

### **1.2.1 Demonstrated techniques**

We were introduced to geometric construction softwares, Cabry Geometry II Plus and Geometric Inventor that can be used as demonstrational tools as well as active tools for learning and discovering geometrical properties. They are useful for lower and higher levels of Mathematics, with good teacher guidance.

Grapes, a graphing software, showed to be a very useful tool on all levels of mathematics teaching and learning.

### **1.2.2 Active techniques**

Programming languages and the use of Macromedia applications we did as part of regular lessons during our training program. 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 our own web-pages.

## **1.3 School visits**

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

### **Equipped classroom**

Work in the equipped classroom is not an everyday practice. Teaching is mostly done in the classical way and such a classroom is used for special lessons. With different tools like camera, projector, touch screen and applied learning system teacher is able to reach out to and keep active each individual student. Proper preparations of working materials are significant for guiding students through the lesson which also enable the teacher to follow each student. Working sheets and changes are instantly available. Such preparations allow very dynamic lessons with the interactive involvement of students.

### **Classical classroom**

ICT learning gives many possibilities for the improvement of the teaching process in classical classrooms. We experienced several different ways of using a computer, projector and other software as a demonstrational or helping tool during classical lessons. Here are only some of the examples:

- Use of graphing software for demonstrating properties of curves in activities like solving exercises
- Use of projector and data sheets for investigating the relation between numbers in tables and forms of curves in problem-solving lessons
- Use of projector with graphing software and white board for teaching trigonometric functions and their 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 at a higher level, deeply creative and challenging, exploring statistics
- E-textbooks and use of touch-screen
- Many interactive and dynamic resources on the Internet that are used in classrooms as well

### **Open lessons**

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

### **Problem solving oriented lessons**

Problem solving oriented lessons are ones in which students become aware of learning problems that they have to solve by themselves as they proceed through a learning activity, and then work on solving those problems. Such lessons need extensive teacher preparations, because they must arise student's interest into the problem and lead students to reach the solution. These kinds of lessons are important because students do not only learn, but find out the importance of learning processes and also become aware of different mathematical applications in various real life situations. ICT learning proves to be a very appropriate tool for such kinds of lessons because it allows students to process data in short time, lowers the level of abstraction, enables interaction and step by step discovery through a direct feedback from the computer or a teacher using ICT materials.

Public High School (Sawara Senior High School)

Attached schools of University of Tsukuba (Elementary and Junior High)

#### **1.3.1 PUBLIC HIGH SCHOOL (Sawara Senior High School)**

On Wednesday, December 21, 2005 we had the opportunity to visit Sawara Senior High School in Sawara. Our arrival was at 9:40 in the company of KUSUMOTO -san, JICA Training Coordinator.

The school director greeted us along with one master degree student from Tsukuba University.

The first difference we noticed was the taking off of shoes and putting on slippers upon entering the school.

First classes we attended were Mr. KONDO's two mathematics classes about sectors including proportional compasses and slide rules. The classroom was equipped with two cameras, projector, two projector screens, overhead projector, TV and DVD. The number of students in class was around 40 and they were all given study material upon entering the class. Students were dressed in school uniforms which is another difference we spotted. The teacher opened the lesson with questions to see if the students understood the topic matter covered in the last class. We noticed that one student answered both questions being given to the whole class.



**Photo 1:** Mr. KONDO teaching about sectors

Students were then given around 5 minutes to solve certain worksheet problems to which answers were demonstrated by different students.

Continuing to work on the problems, the teacher demonstrated answers using a sector and compass. Students showed interest in the matter being covered and were all paying attention to the teacher's words.

Not forgetting, since this was a special class being taught by a master degree student, there were two assistants walking around, helping the students and taping the lesson throughout the class.



**Photo 2:** *Students working on worksheet problems*

Later on, during the lesson, teacher asked various oral questions to which he demonstrated a Power Point presentation step by step. The concept of parallel lines was not too well understood by most of the class, so the teacher was able enough to lead them to the right answer.

At the end of the class, approximately 5 minutes before the school bell rang; students were handed out some sort of a short quiz. It was clear to us that students weren't trying to copy each others work, but did the problems on their own and on completion handed the quiz sheets back to the assistants.

The second class we attended was carried out by the same teacher in the same class. So, after a 10 minute recess the topic on sectors was just continued with the similar lesson pattern.

In Japan, one lesson lasts 50 minutes with a 10 minute recess, while in Bosnia and Herzegovina; a lesson lasts 45 minutes with a 5 minute break between classes.

The third class was taught by Mr. IWAI – san and the topic being covered was Pascal's triangle. This lesson was done for second grade students and its objectives were for students to understand the import of



mathematical induction by focusing on the 12<sup>th</sup> consequence in the Pascal's triangle.



**Photo 3:** *Mr. IWAI teaching about Pascal's triangle*

Mr. IWAI- san explained the origin of the concept of mathematical induction and the notations being used today as opposed to the old notations used by Pascal.



**Photo 4:** Mr. IWAI asking questions

During the lunch break, we attempted to ask Mr. KONDO some questions regarding grading and lesson planning, but he could not give us exact and 100% correct answers since he is still a master degree student, so it was suggested that we ask these questions later during the meeting with the school's director.

The fourth class we attended was the informatics study class. We were taken to another part of the school and to the computer lab. All students were doing the assigned task of building a presentation about their school in Power Point. We noticed that there was a computer for every student and that the computer lab was well equipped. To be exact, there were 63 PC computers in 6 rows. The teacher had her own computer connected to the projector. She informed us that the system was down, so she was unable to demonstrate certain things she had in mind.

The teacher has the ability to check students' desktops as well as their activities in whole, so in case that a student is doing something prohibited she can intervene. We were impressed by this.



***Photo 5: Informatics class in session***

She also informed us that the students already learned Microsoft Word, Excel, Internet and finally put all the knowledge gained so far to make Power Point presentations.

Throughout the lesson, we observed students work and were pretty impressed by the knowledge and interest that they have. Few students caught our attention since they searched on the internet for Bosnia and Herzegovina using Yahoo Search as soon as they heard where we were from. A few pages with pictures of different B&H cities, country sides, etc were displayed and the three of us were able to show them a little preview of our country. The students were eager to hear all the information that we gave. They said that one day they hope to visit, which would be a delight for all of us.

Olivera – san and Anton – san also showed web pages of their schools in B&H.



**Photo 7:** *Olivera – san showing interest in textbook materials*

After attending all of the classes, we went to meet the director of the school in his office. We were greeted by two other teachers from the school, mathematics teacher and informatics teacher. We sat down and started our question and answer session regarding the teaching system they use.

We asked the following questions:

1. Grading system: how is it being carried out?
2. How many grades during one semester?
3. How often is testing done?
4. How is it carried out; written and oral exams?
5. Is there a final exam?
6. What type of homework is given and how often?
7. How is the final grade given?
8. Are students classified into different groups, or are all given the same problems?
9. Type of teaching method: individual, group ...
10. Are there extra classes for slower and more advanced students?
11. What materials are used for lesson planning? (just books or some additional materials)
12. Lesson time planning?(how many minutes for intro,contents...)

We found out that there are 8 examinations in one year when it comes to mathematics. Besides these exams, teachers pay attention to student attitude, participation and homework, so the final grade is formed according to all of these.

In case of informatics study, there are 3 examinations in one year, in which 50% of the grade is based on the paper test and the other 50% is based on reports, attitude and presentations. When certain projects are assigned, students have the chance to grade each other. Only leaders of project groups get to present the final work.

In Sawara Senior High School, students are not classified into different groups according to their level of knowledge when it comes to second and third grades in mathematics, while in the first grade there are different groups.

As for informatics study classes, there are usually two teachers present to guide and teach, one for more advanced and one for less advanced students. This is because some students learn by themselves at home and are ahead of the rest, so they should be given somewhat harder work.

The teaching materials being used are mainly books for mathematics and as for informatics study application software books are also in use.

All in all, it was a very interesting and fruitful experience for all of us. We were able to gain a further insight into the Japanese education system especially in our fields of interest, mathematics and information study.

We are thankful to all that made our visit possible.

**Our conclusions and remarks:**

School grounds are well maintained and kept. There's plenty of greenery and nature for students to enjoy during their lunch breaks. In Bosnia, this depends upon the school; some are well kept while others still await funds for restoration.

We noticed the difference in the class duration since in Japanese schools a class is 50 minutes long with 10 minute recess while in Bosnian schools a class is 45 minutes with a 5 minute recess. We do not think this is a big difference at all.

The number of students in one class, which comes to about 40, is quite big. We feel that smaller groups should be made even though students seemed to be tentative in class.

Students are very polite and quiet, which is not really the case in Bosnian schools.

The idea of having assistants in classes is a very good idea since they can help slower and more advanced students without holding the rest of the group down.

Not forgetting that it was clear to all of us that teachers came well prepared to class. A lot of effort was put into planning lessons and materials for students which are handed out as soon as they enter the classroom.

### **1.3.2 Attached schools of University of Tsukuba (Elementary and Junior High)**

On Tuesday, January 17, 2006 we had the opportunity to visit Tsukuba Fuzoku Elementary School that is an attached elementary school of University of Tsukuba. It was established for people in the local area and is one of the oldest schools. It recently celebrated its 133rd birthday. Teachers can stay up to a year observing lessons and the school publishes a magazine that is used to help in teacher training. There are, in fact, 11 different schools attached to the University of Tsukuba like boys' schools, primary and high schools.

Our arrival was at 9:00 a.m. in the company of APEC Conference participants. All of us met at the Ichigaya Station from which we took a metro ride to the Gokokuji Station in the company of MIYAKAWA-san, ISHIKAWA-san and Prof. ISODA-san. It took us some 15 minutes to reach the school from the station by walking.

Other CRICED staff members greeted us upon entering the school grounds and gave directions to the amphitheatre where mathematics classes would take place.

This time it was familiar to us to take off shoes and put on slippers upon entering the school.

### ***THE FIRST CLASS***

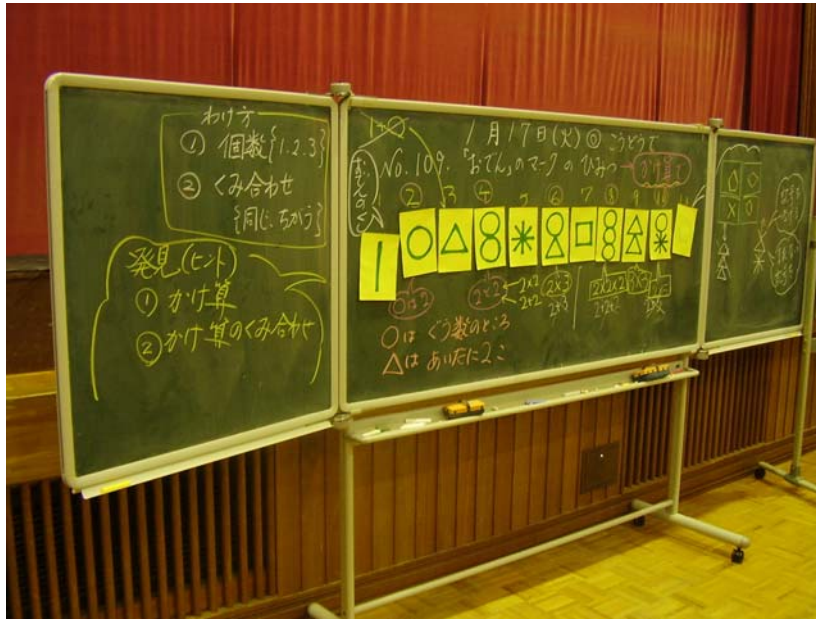
First class we attended was Mr. TSUBOTA-san's mathematics class about prime and composite numbers. He has published a book "*Hands on Mathematics*" and has been involved in many different projects for expanding teacher training.

Once the students came in they greeted all the observers and sat down in their chairs. Mr. TSUBOTA-san gave 12 different symbol cards, among which 2 were empty, to students and they were randomly placed on the board. There was a group discussion about the meaning of these cards and students came up with various interesting answers such as representations of secret code, human being, oden, fish cake, etc. After hearing interesting student's responses the teacher told them that card symbols represented mathematics symbols. The 2 empty symbol cards were isolated on another board. Upon teacher's request, a boy went to the board and drew in the symbols that he thought should be placed on the empty symbol cards. He was asked to explain the reason behind choosing these particular symbols. Other students gave their ideas and opinions as to what symbols should be drawn.

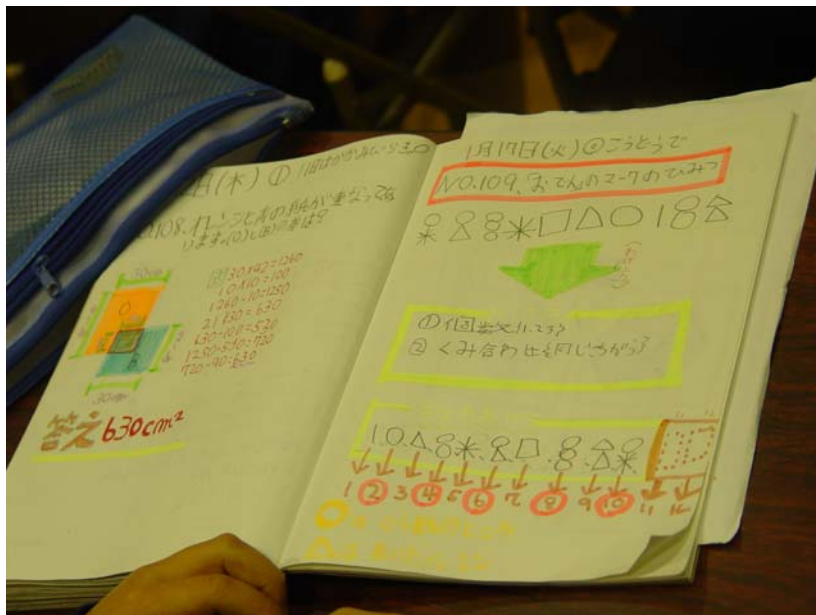


Then they tried ordering symbol cards into groups according to their designs. Mr. TSUBOTA-san helped them out by ordering the cards into a natural sequence of numbers up to 12.





One of the students came up with an idea that all the even numbers in the symbol cards had circles, so he encircled them on the board. Another student noticed that the triangle appeared in every other two symbol cards.



After a group discussion with their teacher's guidance, students concluded that  $4 = 2 \times 2$  and  $6 = 2 \times 3$ , so the symbol cards with a combination of symbols represent multiplication. Some students did have a hard time accepting the idea of multiplication, as their first



natural response was addition. Because of this conclusion, they realised that the number 11 must have a new symbol, but not 3 triangles attached since that would represent the number 27. Since 11 is only divisible by 1 and itself, one of the students realised that a completely new symbol must be introduced, independent of the previously used which is also the case for numbers 1, 2, 3, 5, and 7.

The symbol for the number 12 was easily guessed by most of the students after all of class discussions; however, one student seemed to struggle with the idea since he was insisting on addition. There were different correct answers given for 12.



As homework, the teacher handed out students worksheets.

## THE SECOND CLASS

The second class we attended was Mr. HOSOMIZU-san's mathematics class about circles in grade 4.

The aim of the class was for students to discover that the circumference depends on the diameter and the ratio of the circumference to the diameter is constant.



First of all, the teacher asked students to give different combinations of numbers whose product was 232. After that he distributed a coin of 1¥ to each student and asked them to measure how long the circle was around the coin. Most of the students measured that the circle was 3 cm, some of them measured 4 cm, but a few of them said 5 cm.

The correct answer was more than 6 cm. The teacher then showed them the correct method for measuring the circumference.



The teacher wanted the students to use their intuition for discovering how the circumference depended upon the diameter. So, he took a dish with a small tag attached and asked three students to the board to predict the position where the dish would make a full circle. Upon the teacher's request, each student marked a position of the full circle.



After that the teacher asked other students what they thought was the correct position. Most of the students agreed with the middle position. So, the teacher started to roll the dish and took a little break on the half circle and again asked students which answer was correct. Some of the students responded that the first position was right.

After the full circle, the teacher and the students concluded that the first position was almost correct. Then, two students measured the length from starting point to the endpoint and translated it to the board.

The same method was repeated twice by the teacher, but this time he used a very big wooden lid and a normal sized plate.





Used math equipment was replaced by the teacher with the same sized paper circles, in different colours, and placed on the board as well as the length of a full circle measured by the students. Finally, the term of the circumference, as the length around the circle, was introduced by the teacher and the students concluded that the bigger circle had a bigger circumference.

After that, the teacher demonstrated a model with a bicycle having large tagged wheels.

The most important thing was that the majority of students correctly predicted the position of one full bicycle wheel circle.

### ***THE THIRD CLASS***

On Wednesday, January 18, 2006 we had the opportunity to visit Junior High School at Otsuka that is an attached junior high school of the University of Tsukuba. Our arrival was at 9:00 a.m. and this time we came on our own. Prof. MACHI-san greeted us upon entering the school grounds and gave directions to the gymnasium where mathematics classes would take place. All of the APEC participants were already seated once we arrived. First class of the day we attended was Mr. SUZUKI-san's mathematics class about geometric constructions. Once





the students came in they greeted all the observers and sat down in their chairs. Mr. SUZUKI-san gave worksheets to all the students and asked whether they had the necessary math tools for drawing. Then he gave them a task to determine the diameter of *Landolt's Ring*, without cutting and folding, which we had the opportunity to observe. Students used a variety of methods, and Mr. SUZUKI-san supervised all the students and helped with short suggestions in case of need. Also, some students used their books for searching the solution. All of them wrote their own ideas and methods in notebooks, as well as their explanations of why they thought their method was correct.

After 15 minutes the teacher called one student to present his method on the board. First, the teacher wanted to use one special overhead projector, but because of some technical problem and on Prof. ISODA-san's suggestion, he decided that the student should only use the board. The student demonstrated his method which was a second method predicted in the teacher's lesson plan.

Then, the teacher asked why he thought that this was the correct method. The student explained the procedure; he drew two parallel lines, and then as a way to determine the centre of symmetry, found the point of intersection of a pair of segments connecting corresponding points (diametrically opposed). So, he was able to determine the diameter of *Landolt's Ring* very easily.



After this presentation, another student came to the board and presented his own method, for which there were a lot of questions from other students. Then, the third student came to the board and showed his method; he actually drew two perpendicular bisectors of the figure, and then using the point of intersection as the centre, he determined the diameter.

After this presentation, to the board came the fourth student and presented his method. First, he drew two chords, **AB** and **BC**, and then determined perpendicular bisectors of these chords, so by using the point of intersection as the centre, he determined the diameter. Actually,

the student demonstrated method which was the third method predicted in the teacher's lesson plan. She explained her method very well, but a more detailed explanation was given by the fifth student, who also drew the third chord **CD**, and then perpendicular bisector of this chord, and finally got the same point of intersection as the centre of this figure.



After all of these demonstrations and discussions, the teacher gave instructions for the next lesson, and explained that they will discuss shown methods more deeply, and will also conclude which method is the most acceptable.

## THE FOURTH CLASS

Second class of the day we attended was Mr. OHNEDA-san's mathematics class about volume of tetrahedron with congruent faces. Once the students came in they greeted all the observers and sat down in their chairs. Mr. OHNEDA-san declared in brief the theme of the lesson, and specified the definition of tetrahedron with congruent faces.



He had a few models made from paper, and also gave empty sheets of paper to students so that they could make models for themselves.



He asked students what kind of space figures they would have if they folded sheet of paper, and then used the board for demonstrating a model made from that sheet.

Then, he unpacked the model using the board, so he could show which lines were parallel, and which triangles were congruent (similar). By simply substituting numerical values to one length ( $l = 1$ ), he got values of all other lengths ( $\sqrt{2}$ ). After that, he drew a tetrahedron with congruent faces **ABCD** on the board, and gave students a task to determine the volume of that tetrahedron.



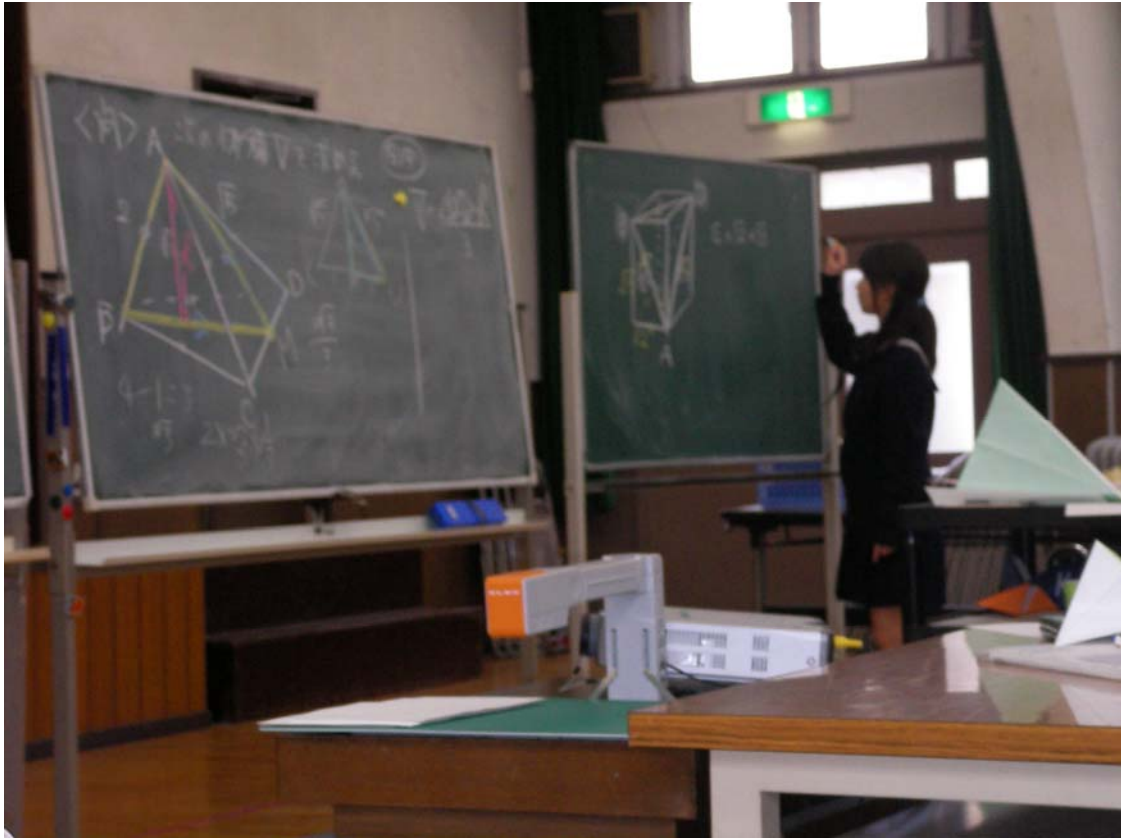
After 15 minutes, one student came to the board and explained his method. First of all, he connected points **A** and **M**, which is the half point of length **CD**, and then calculated the length of line **AM** by using Pythagoras's theorem. Because he found that the length of line **AM** was equal to 2, he concluded that the triangle **ABM** was equilateral. Now, he easily founded the length of the height of that triangle, which is actually the height of a tetrahedron **ABCD**. He calculated that height was equal to  $\sqrt{3}$ , and then gave an answer to the teacher's question:

$$V = \frac{\Delta BCD \times h}{3} = \frac{\Delta BCD \times \sqrt{3}}{3}.$$

After this explanation, a second student explained her method; she imagined the tetrahedron **ABCD** as a part of a regular prism. First, she drew the picture, and then substituted numerical values of lengths **AB**, **CD**, **AD** and **AC**. Next, she calculated other lengths in a regular prism, and the volume of that regular prism. In volume calculation of a tetrahedron she made a mistake, but she also fixed that mistake, and finally got the correct result:

$$V = 2\sqrt{3} - \left( \sqrt{2} \times \sqrt{2} \times \sqrt{3} \times \frac{1}{3} \times \frac{1}{2} \right) \times 4 = \frac{2\sqrt{3}}{3}.$$





After these explanations, the teacher explained in detail that volume of a tetrahedron with congruent faces is a third of the volume of a regular rectangular prism. He also used paper models in his explanation. Next, the teacher showed another method for determining the volume of a tetrahedron with congruent faces with the edges of  $\sqrt{5}$ ,  $\sqrt{10}$ ,  $\sqrt{13}$ . Now, he used a system of equations:

$$\left. \begin{array}{l} a^2 + b^2 = 5 \\ b^2 + c^2 = 10 \\ c^2 + a^2 = 13 \end{array} \right\} \Rightarrow a^2 + b^2 + c^2 = 14 \Rightarrow a = 1, b = 2, c = 3 \Rightarrow V = 2.$$

## **CONCLUSION**

The Japanese educational system has successfully shifted from a traditional classroom that is still very typical in Bosnia and Herzegovina. It is able to focus on a student-centred classroom that focuses on students' engagement in mathematics activities. This involves significant collaboration between teachers.

Japanese mathematics lessons, especially for elementary grades, which we had the opportunity to attend, include a significant amount of problem solving. This type of structured problem solving approach is designed to create interest and stimulate creative activity in mathematics through students' collaborative work in the classroom.

Each lesson is designed around solving a single problem so as to achieve a single objective in a topic. Therefore, teachers must carefully select a problem and activity for the day. Sometimes, teachers may give extended problem or exercises after a major problem solving.

As we learned, lessons usually start with students individually working to solve a given problem using their own mathematical knowledge so that they can re-invent ideas and mathematical concepts by themselves. Then, students bring various approaches and solutions to classroom discussion. The teacher then leads them in a whole-class discussion so as to compare individual approaches and solutions. This is a powerful way for students to develop their mathematical abilities with conceptual and procedural understanding. Towards the end of a lesson, a teacher often summarizes the lesson to help students achieve the objective of the lesson and asks them to reflect on what they have learned during the class.

However, boards are not excluded during mathematics lessons. It is an important skill for teachers to develop, so developing a plan for using the board is a major component of lesson planning. Japanese teachers use the board so as to:

- keep a record of the lesson
- help students remember what they need to do and to think about
- help students see the connection between different parts of the lesson and the progression of the lesson

- compare, contrast, and discuss ideas that students present
- help to organize student thinking and discovery of new ideas
- foster organized student note-taking skills by modelling good organization.

With all of this being said, the school visits we had the opportunity to go to gave us an in depth insight of Japanese classrooms and teaching techniques. We found them to be very fruitful and hope to continue learning more during our stay here.

## 1.1 Seminars and Conferences

- Professor Becker's – January 2006.
- APEC –Tsukuba International Conference – January 2006.
- Professor Arcavi's – February 2006.
- 3rd International Forum on Basic Education Development in Developing Countries - March 2006.
- British Council – June 2006.
- Teacher Uehara's – July 2006.
- 2nd B&H seminar – July 2006.
- Japan Society for Science Education Conference – August 2006.

### 1.1.1 Professor Becker's Seminar

On January 11, we had the opportunity to attend a lecture given by Prof. Becker from the United States on the topic "*A Perspective on Teaching Mathematics in the School Classroom*". The lecture began at 10:00 a.m. and many university students and professors came to attend it. It was a very interesting talk and a great insight to the current teaching method being used in schools all over the U.S.

Prof. Becker started his presentation with a few words of philosophical wisdom which caught our attention.

Vision without action is merely a dream

Action without vision is passing time

Vision with action can change the world



Picture 1.

He mentioned at the beginning of his talk that the research done by Japanese scientists had a profound effect on his teaching method as well as on the training of future teachers. New Curriculum Teaching Method (*NCTM*) standards in the U.S. are related to the following

- Curriculum Standards
- Evaluation Standards
- Teaching Standards
- Assessment Standards

Curriculum standards present a vision of the content of mathematics that the mathematical science education community wishes to bring forth in school classrooms. Reforming school mathematics is an important goal. Calls for reform are urgent, but certainly not new. So, in many countries official reform documents have been published (e.g. Netherlands, Japan, UK, Australia, and some other countries).

Common “philosophy” in all of these documents represents a shift in paradigms, no longer a view “teaching as treatment and learning as effect”. Students are viewed as learners who actively construct mathematics.

The underlying assumption is that what we teach and how students experience it are primary factors that shape students understanding and beliefs of what mathematics is all about. From a pedagogical stance, students pick up their sense of a domain from their experience with it.

An alternative is to create an instructional environment in which students are at a level appropriate for them – doing mathematics. That is, engage selected aspects of “math culture” in the classroom.

Research done by Japanese in the 1970s and 1980s led to the “*open approach*” method whose objectives are:

1. Describe “open approach”.
2. Describe lesson plans and record.
3. Illustrate approach with examples.
4. Illustrate approach to assessing students’ work.

Lesson organization is considered to be extremely important. It should be done by a group of teachers working together. It involves the following steps:

- I. Introduce the problem
- II. Understanding what to do
- III. Problem solving by students [heart of the approach]
- IV. Comparing and discussing students’ ways of solving
- V. Summary of lesson

Lesson plans are also very important in this approach to teaching:

- Choose a problem situation
- Develop a detailed plan for teaching the lesson

- Write down all anticipated student responses to the problem situation, as part of the lesson plan which helps the teacher to develop a good understanding of the problem situation and its solution(s) and to be prepared to deal with students' responses. This is crucial in assessing student learning.
- Provide for students to think in their own natural mathematical ways about the problem situation.

Lesson records involve:

- Several teachers select the problem situation
- The teachers discuss the problem situation and its answers/solution approaches
- One teacher writes the lesson plan
- That teacher teaches the lesson with the other teachers observing
- After the lesson, the teacher writes a complete record of the lesson
- All teachers meet to discuss the lesson record, and improve the lesson plan

This leads to:

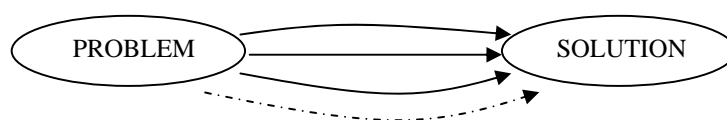
#### TEACHER IMPROVEMENT AND CURRICULUM IMPROVEMENT

Assessment of learning

1. *Fluency*: This deals with the number of different correct answers, different solution approaches, or problems formulated by an individual student (or group). It is assessed quantitatively by simply counting the number.
2. *Flexibility*: This deals with the mathematical quality of a student's (or group's) responses – how many different mathematical ideas are discovered by the student (or group). It is assessed qualitatively mostly; however, it can also be assessed quantitatively by assigning points to a student's (or group's) responses.
3. *Originality*: If a student (or group) develops a unique idea not found by other students (or groups), originality should be given a very high assessment; i.e. responses of very high mathematical quality should be acknowledged and recorded as a very high assessment.
4. *Elegance*: This deals with the degree of elegance in a student's (or group's) expression of thinking in mathematical notation. This may be difficult to assess objectively; nevertheless, it has potential as part of assessment.

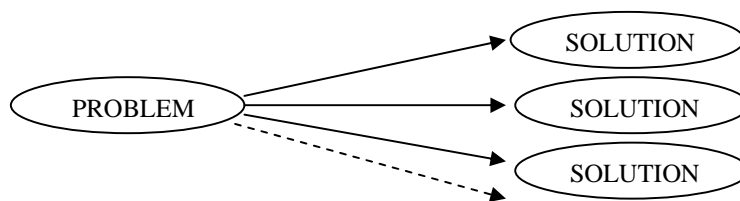
Openness in mathematical education can be shown by the following examples:

1. One problem.....One solution



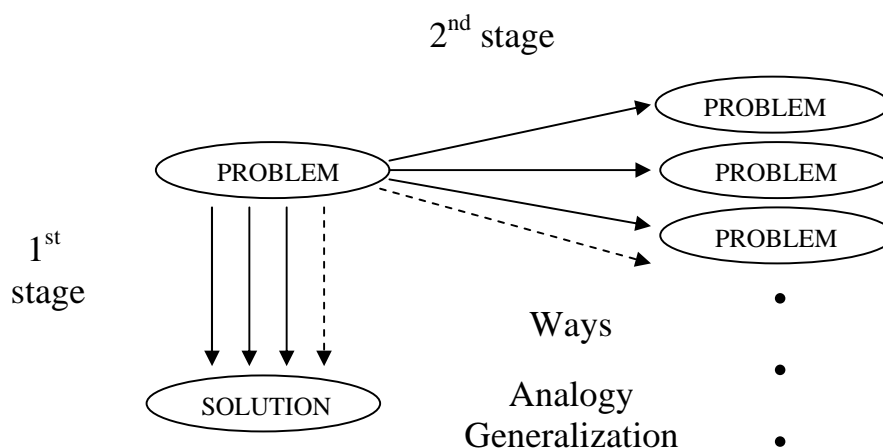
Ways  
PROCESS IS OPEN

2. One problem (open ended)..... several or many solution (answers)



Ways  
END PRODUCT ARE OPEN

3. One problem.....several problems  
("from problem to problem.....the developmental approach")



Ways to develop are open

### *NCTM Curriculum standards (Grades K-12)*

There are five standards called process standards which appeared in the late 1980s. They are:

1. Mathematics as problem solving
2. Mathematics as communication
3. Mathematics as reasoning
4. Mathematical connections
5. Making representations

Prof. Becker continued with three mathematical examples which are:

1. Which is larger:  $\frac{4}{5}$  or  $\frac{3}{4}$ ?
2. Christmas tree problem
3. Squares are made using matchsticks as shown in the figure below. When the number of squares is five, how many matchsticks are used?

Students were given the task to find the general rule, whether they are related to the concept of limits and some other problems. Another very important task students were given was to formulate their own problems of their own like the one they solved without having to solve them.

Depending on their level, students formulate problems which are hard to make sense in the begging followed by problems with insufficient information followed by complete problems followed by nice problems followed by highly creative problems.



*Picture 2.*

As one of the conclusions, Prof. Becker said that we should work at changing “closed” or “traditional” problems to “open-ended” problems. So, we can make these kinds of problems into ones where the PROCESS is open, or the END PRODUCTS are open or the WAYS TO FORMULATE new problems are open.

Therefore, we have seen that there is a way to make the transition from the recommendations of the reform documents (e.g. Principles and standards for School Mathematics) to actual implementation of them in school classrooms, that is, by using the “open approach” to teaching mathematics.



As a concluding moral of the talk we have the following theorems:

1. Mathematics is a living, breathing, and exciting discipline of sense-making. Students will come to see it that way if and only if they experience it that way in their classroom.

### **1.1.2 APEC –Tsukuba International Conference – January 2006.**

In January 2006 we have the opportunity to attend a 5 day long APEC – Tsukuba International Conference and meet professors and math educators from pacific countries, like Australia, U.S.A, Thailand, Singapore, Malaysia, Hong Kong, Indonesia, Chile...

On the first day, we attended talks on “Improving the quality of education for developing Numeracy on education for all” As a general conclusion we learned that teachers need to provide opportunities that will stimulate the learners to be active and learn mathematics in an active rather than a passive way. Problem-based learning plays a key role in an active learning classroom.

On the second day, we attended talks on “Innovative teaching mathematics through Lesson Study” which was very informative about the progress and challenges in the U.S and whether they are similar to those found in other countries.

For many, the primary purpose of international studies is not for countries to compete with each other, so any changes in educational policies should take into account the rich data set as well as the different cultural values that generate such richness.

On the third and fourth day of the Conference we attended specialist sessions on Lesson study at attached Elementary and Junior High schools of the University of Tsukuba which we thoroughly wrote about in the chapter “School visits”.

### 1.1.3 Professor Arcavi's Seminar

On February 15, we had the opportunity to attend a one hour lecture given by Prof. Abraham Arcavi from Israel on the topic "Symbol sense". The lecture began at 10:00 a.m. It was a very interesting talk and a great insight into the different elementary school problems.

Prof. Abraham Arcavi is currently working on the curriculum development for mathematics in Israel. He is also researching science education by exploring the so called fields "Symbol sense" and "Number sense".

We were introduced to a very basic problem

$$\left. \begin{array}{l} 237-29 \\ 237-31 \end{array} \right\} \begin{array}{|l|} \hline \text{Which result is bigger, without} \\ \text{using subtraction?} \\ \hline \end{array}$$

This example easily demonstrates the concept of "Number sense". The idea is that students can use this sense to figure out, without calculations, which result is bigger.

We quickly moved on to "Symbol sense" with many basic but very insightful mathematical problems.

#### **Example 1:**

Solve the following equation  $5x + 4 = 6x$ .

In this small problem, a student suggested that an  $x$  on the left side of the equation should come, without performing the usual calculation. So, Prof. Arcavi told us that this is reading through symbols, understanding and seeing the bigger picture.

#### **Example 2:**

Solve the following equation  $\frac{2x+4}{6x+12} = 3$ .

A student noticed that  $6x + 12$  is 3 times bigger than  $2x + 4$ , which means that this equation does not make sense and can not be solved.

Performing typical math rules and calculations we come to the same conclusion:

$$2x + 4 = 3(6x + 12)$$

$$2x + 4 = 18x + 36$$

$$-16x = 32$$

$$x = -2$$

The answer makes no sense, as the denominator in a fraction can not be 0.

**Example 3:**

Next, we worked on an example of “Magic Square”

2	3	4
5	<b>3</b>	1
<b>2</b>	3	<b>4</b>

Solve the magic square given 2, 3, and 4 so that the sum of numbers in each row is 9.

$$S = 9$$

7	1	5
2	<b>5</b>	7
<b>4</b>	8	<b>2</b>

Solve the magic square given 4, 5, and 2 so that the sum of numbers in each row is 14.

$$S = 14$$

As we can see, the second example is not possible. Let's write the magic square using symbol notations:

S-b-c		S-a-b
b+c-a	<b>b</b>	a+b-c
<b>a</b>		<b>c</b>

After a bit of thorough discussion we come to a conclusion that for the magic square to work, a condition  $S = 3b$  must be fulfilled.

**Example 4:**

What do you get if you take an odd number, square it, and subtract 1?

An odd number can be written as  $2n-1$ . When we square it, we get the expression  $(2n-1)^2$ . Finally, when we subtract 1, we get  $(2n-1)^2-1$ . After expanding the expression we arrive at the  $4n^2-4n = 4(n^2-n)$ , which tells us that the result is divisible by 4.

A student also noticed that  $4(n)(n-1)$  means that,  $n$  is any natural number. If it is even, then  $n-1$  is odd so, the result must be divisible by 8.

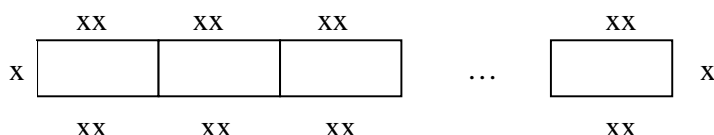
Therefore in the end, the given expression can be written as

$$8\left(\frac{n(n-1)}{2}\right)$$

This gives us triangular numbers like 1, 3, 6, 10 ...

**Example 5:**

If  $n$  is the number of tables, how many chairs are there?



The number of chairs is given with  $4n + 2$ .

Another student came up with a different formula  $5n - (n - 2)$ . By asking how the student obtained this formula we are talking about un-modeling.

Un-modeling is the reverse process, deriving the idea and concept of the result from mathematical model.

When it comes to “Symbol Sense”: Reading through symbols there are some important points to consider. They are:

1. Equivalent expressions
2. Choice of variable
3. Un-modeling

## SUMMARY

Prof. Arcavi’s lecture was a very interesting one, and it brought in a lot of new ideas as to how we should bring mathematics closer to the natural way of student’s thinking.

He introduced different characterizations of “Symbol Sense” which is important in understanding Algebra and identifying things. This in turn helps to develop a sense of meaning which is essential in any field of study.

As a result, mathematics is one step closer to pupils and is not feared as much.

### 1.1.4 3<sup>rd</sup> International Forum on Basic Education Development in Developing Countries

In the first half of March, we had the opportunity to attend the 3<sup>rd</sup> International Forum in which the previous group of participants from Bosnia and Herzegovina participated in with presentations regarding their work and activities they continued upon their return.

We also presented to them our completed course training activities and future plans.

During this time they gave us instructions and advice regarding our individual project topics, which were very helpful to us.

Since then, we have kept in touch regarding the experiments we held in elementary and secondary schools in Bosnia and Herzegovina.

### 1.1.5 British Council

In June we had the opportunity to attend an educational forum regarding the use of ICT in UK. Our Peruvian colleagues accompanied us and below is the schedule of the program.

Time	Contents
13:30~14:20	BC English Language Education demonstration by English teacher BC Service of Japan to academic society in Japan, especially, giving information by use of ICT etc.
14:20~14:30	Chairperson: JSiSE (Japanese Society for Information and Systems in Education) Chairman of internationalization committee Toshio Okamoto Greeting: JAPET (Corp. Japan Association for Promotion of Educational Technology) Chairman Takashi Sakamoto British council Sub-representative Lesley Hayman
14:30~17:30 Keynote report Panel discussion	14:30~15:30 DfES (Department of Education and Skills) Kevin MacLaine (Chief of accomplishment of strategy of educational technology) <div></div>
	15:30~16:30 BECTa (British Educational Communications and Technology Agency) Nel MacLaine (Educational practice superintendence)
	16:30~17:30 Panel discussion Specified panellist: Takashi Sakamoto (JAPET)、Kiyoshi Nakabayashi (NTT Rezonant) Expected content: Structure and leadership improvement curriculum of ICT guidance ability, State-of-the-art training technique, Mechanism and practice evaluation of curriculum online, Digital contents, Educational effect evaluation research on ICT, Support technology, All Britain digital environment, ICT and Pedagogy (e-Pedagogy) etc.

### 1.1.6 Teacher Uehara's Seminar

On July 08, we had the opportunity to attend a five hour lecture given by Prof. Eigo Uehara on a few very useful and interesting topics that he daily uses in his teaching practice with his students. It was a great insight into the different methods and programs used to bring mathematics closer to students and make their learning experience filled with fun.

Prof. Eigo Uehara is currently working at the Onogami Elementary School.



We were first introduced to an example of “Fractions” using Action Script in Flash MX program. Prof. Uehara worked with us, step-by-step in which we created new FLA files, build up necessary layers, movie clips and eventually code. We manipulated different situations by changing the values of variables  $n1$  and  $n2$ .

Because of some technical problems we started experiencing Prof. Uehara decided to pass on his original file version that we had been working on during the lecture.

In the end, we all had files in which we could change the value of fractions that would be graphically represented just below the input fractions. With the mouse we had the chance to move the blocks within the square box.



For lunch break we went to the familiar Chinese restaurant near by to our university. Prof. Isoda and a visiting professor from Chile also came along with us.

It was an enjoyable lunch break especially since we had the opportunity to chat and catch up on things with everyone.

Upon our return from the restaurant, we started with the second session of the lecture. We started working on the so-called “dbook”. Its purpose is to turn a typical textbook into a digital one which can provide many more options making the usual lesson a lot more fun and interesting for the students.



Working on a few scanned pages we noticed that dbook has a lot of activities to offer such as the option which enables a user to open any textbook and scan it with a copier. This can cause some difficulties since the picture of the lower left can turn out blurry with shades and skewness. Therefore, it is advised to cut it like a picture of the lower right.



Some of the possibilities we all had the opportunity to try out on the white board that dbook has to offer, with Prof. Uehara's help, are drawing shapes, writing text, paint, animation files with drag and drop options, JPEG, BMP images, etc.

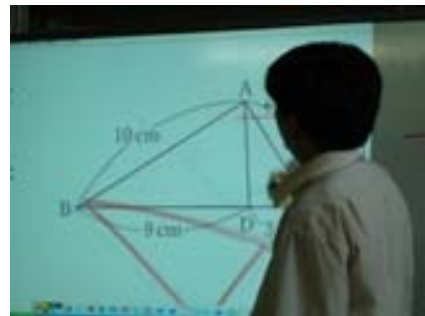
In order to make all of this possible, the white board has to come with a special digital pen and projector attached to the board.



Finally, we were introduced to “*Geometric Construction Language*” also known as GCL in short form developed by the system of “production/writing NPO yuurappu” supervised by Iijima laboratory of Aichi University of Education and Prof. Eigo Uehara of Onogami Elementary School.

It is a description language for Flash geometrical IT contents which are developed by a user. Because GCL is based on XML, it is superior to readability and it has open specifications which are rich in extendibility. So, the user can expand it more originally.

GCL data can be written by a text editor. It offers possibilities of tools for drawing figures, along with the changing tool, point tool that allows naming of different types of points, their reflection, rotation etc. A user can also put in images, characters and construct lines, rays, segments, perpendicular bisectors, angle bisectors, tangent lines, etc.



## SUMMARY

Prof. Uehara's lecture was a useful insight into the various possibilities that can be incorporated into daily teaching practice, and it brought in a lot of new ideas as to how we should bring mathematics closer to the natural way of student's thinking.

We are sure to use the materials with the CD he provided us with in our future work.

### **1.1.7 2<sup>nd</sup> B&H seminar**

Three professors from Bosnia and Herzegovina were invited to CRICED from three main cities Sarajevo, Mostar, and Banja Luka.

A seminar was held from 23<sup>rd</sup> July to 30<sup>th</sup> July in order to discuss and establish an academic relationship between universities in the domain of mathematics and informatics education.

We discussed about the direction of the ongoing project and decided about the activities we will conduct till the end of the course.

The three of us also had the opportunity to present our work in Power point regarding the developed individual projects so that everyone could better understand our activities and contents.

We gave them an insight into the explanation of our backgrounds, objectives, overview and some principles of developments.

### **Program**

**Date:** 26th July 2006

**Time:** 10:00 - 17:00

1. Opening
2. Mathematics and Informatics Education of Bosnia and Herzegovina
  - Prof. Petar MARIC (University of Banja Luka)
  - Prof. Ivan PAVLOVIC (University of Mostar)
  - Prof. Amer KRIVOSIJA (University of Sarajevo)
3. Contents Development for e-Learning
  - Olivera BANJAC (Machine High School, Prijedor)
  - Anton VRDOLJAK (Faculty of Civil Engineering, University of Mostar)
  - Nadia BOUZ-ASAL (Faculty of Natural Sciences, University of Sarajevo)
4. Contents Development in CRICED
  - Takeshi MIYAKAWA (CRICED)
  - Kazuhiro AOYAMA (CRICED)
  - Kimiho CHINO (CRICED)
  - Masami ISODA (CRICED)
5. Closing



### **1.1.8 Japan Society for Science Education Conference**

## **1.2 Study trips**

- Ishikawa – February 2006.
- Aichi, Kyoto, Nara, Osaka, Hiroshima – May 2006.
- Hokkaido – July 2006.

### **1.2.1 Ishikawa (Motoki Miura's Lecture)**

On Saturday, February 25, 2006 we had the opportunity to visit *School of Knowledge Science JAIST* during our study trip to Kanazawa city.

Our arrival was at 9:00 a.m. in the company of our professor Machi-san.

We had the opportunity to attend "*The 3<sup>rd</sup> Conference on the Support Systems for Knowledge Creation, 2006*". Many researchers and professors presented their interesting ideas and accomplished work.

After the conference, we headed over to Motoki Miura-san's research lab where he is currently working on his latest project known as the ***AirTransNote***.



**Photo 1:** *Mr. Motoki MIURA*



**Photo 2:** *Mr. MIURA talking about main goals of his work*

## **INTRODUCTION**

The purpose of learning as we know is to get into the habit of learning.

The significance of group learning is to share ideas inspired by other's opinions and collaborative activities. This is a great way to learn how to communicate with others as well as to respect friend's views.

Most of classes, even in Japan are "tell/transfer" knowledge based although creative thinking is emphasized to make students participate in collaborative learning.

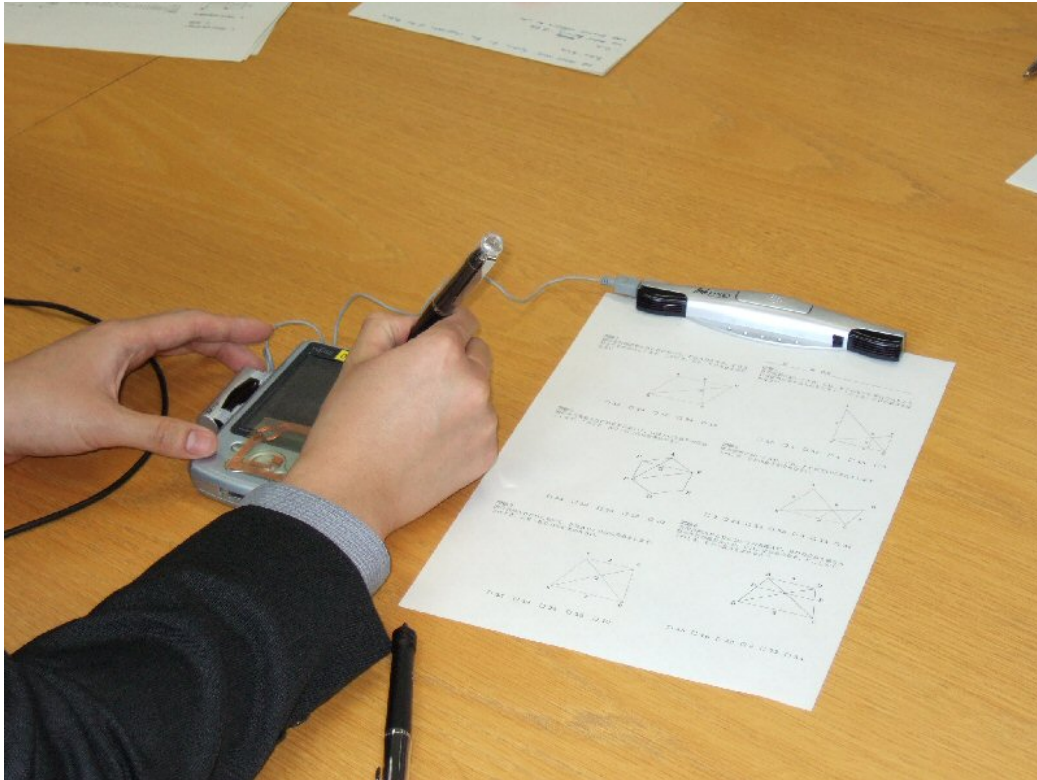
In order to develop and implement a method and system which naturally supports effective/active learning of students, a question arises whether PCs are suitable for the conventional classroom.

Since PCs require special skills, students must learn the usage in advance. Even the PC-based operations like the mouse/keyboard/tablet are not natural.

As a solution to this problem Motoki Miaura-san is working on the use of a digital-pen and PDA instead of PC.

### **AIRTRANSNOTE SYSTEM**

*AirTransNote* is a computer-mediated collaboration system in development for the conventional classroom. It provides real-time note sharing in a way that notes written by students on paper can be transmitted to teacher's computer.



**Photo 3:** Mr. MIURA demonstrating the use of PDA and digital-pen

In turn, the teacher can:

- browse
- show
- store
- analyze

student notes immediately.

Therefore, the teacher can explain more answers than by using the traditional blackboard. The sound/text feedback can be very helpful for students and quite alleviating for teachers.

The reason why paper-centric approach was chosen is because

- ❖ It fits the conventional lecture style
- ❖ It is natural and intuitive
- ❖ It frees the student from the need to handle PC, which requires special skills.

The 1<sup>st</sup> prototype of *AirTransNote* required a manual initial setup by tapping. The revised version enabled initial setup by pressing start-up button and automatic connection to teacher's PC. RFID TagReader was added to teacher's PDA so that individual student work could be zoomed in.



**Photo 4:** Olivera-san using PDA with RFID TagReader

In March 2004, a feasibility study had been carried out in a Math class among 40 1<sup>st</sup> year high school students. There was a mixed reaction regarding the *AirTransNote* system among students.

Some students thought that the system on its own was very interesting and exciting, which made them more active in class. They also noticed that the teacher was able to give comments regarding their work. On the other hand, some students found the ballpoint pen unsuitable for their typical math work since they were unable to erase mistakes. They were unhappy about the desktop space being occupied by the system and they discovered it to be quite difficult and strenuous to understand and use.

So, as an overall survey result, 95% of the students seemed to have enjoyed the system while 70% felt stressed out while using the system.

This information should be used to further improve the system and future plans.





**Photo 5:** *Nadia-san testing AirTransNote system*

## **CONCLUSION**

The lecture regarding *AirTransNote* system was very interesting and refreshing for all of us. We hope to see the system in use in the near future for promoting active and collaborative learning among students.

Therefore, we found our visit to be very fruitful and hope to see Miura-san soon during his visit to Tsukuba University.

### **1.2.2 Aichi, Kyoto, Nara, Osaka, Hiroshima**

#### **KANSAI STUDY TRIP REPORT**

On May 8, 2006 after having packed our entire luggage we took a JICA bus ride to Hitachino Ushiku station and met up with Yahara-san for the Kansai study trip. We took a train ride to Ueno station from which we took our first Shinkansen ride ever.



The ride was very interesting and exciting for us, about 1½ hours long, so we made a short movie of our travel in the comfort of its seats. We arrived at Chiryu station from which we took a bus ride to visit the *Aichi University of Education*.



Our lecture was an enjoyable discussion session of the work we had completed up to that point of our individual projects with Prof. Yasuyuk Iijima and a group of his students. Prof. Iijima talked about his work which he earlier presented at the APEC conference we attended in IFIC. Some of his students presented their post graduate work using Flash MX program. It was a very fruitful visit for exchanging ideas between us all.



After catching a bus and train ride we finally made it to Kyoto where we checked in to the El Inn Hotel. We decided to take dinner and stroll around the surrounding area that was filled with amazing temples and shrines. We bought one day pass bus tickets which would ease our Kyoto free activity sightseeing tour the next day.

Early in the morning, around 7:30 we checked out of the hotel and left our bags inside the station's coin lockers. We decided to split up, Olivera-san and I went on one side while Anton-san went on the other side to pursue sightseeing interests. It was a very busy and hectic day for us all trying to visit as many temples as we possibly could. We first went to Nijo Castle and because we were among the first visitors, we had to wait a few minutes for it to open. We were able to visit the Ninomaru Palace and all of its chambers. It's interior design was overwhelming along with its historical importance.

We then took a bus ride to the Kinkakuji Temple where we took many pictures like all visitors by the elegant and breath-taking Rokuon-ji Temple. We then went to Kyoto Imperial Palace and the Imperial Park where we enjoyed a short ice coffee break in the shades of numerous tree trunks. Unfortunately, it was not possible to go inside the palace since it is not open to the general public.



From there we took a bus ride to the Kiyomizu Temple which is one of the most celebrated temples of Japan. Kiyomizudera stands in the wooded hills and offers visitors a nice view over the city from its famous wooden terrace. Below the terrace,



you can taste the spring water, which is said to have a healing power.



At 16:30 we met at the JR Station with Yahara-san and boarded a train headed for Osaka. We then walked to the JICA bus stop and eventually arrived at the JICA Osaka center. We received a warm greeting by JICA staff members at the reception desk who introduced us to some rules and regulations and provided us with room keys. After having unpacked, we went downstairs to the dinning room and had dinner with Yahara-san.

Early in the morning after breakfast we checked out of the JICA center and headed for Nara. We were disappointed to have not had the opportunity to see Osaka other than the images from the train and bus windows.

In Nara, we experienced a slight rainfall, but we managed to visit the most important sights Nara has to offer. We first visited the Kofukuji temple which stands at the entrance of Nara Park. The Horyuji temple situated near by is designated as a [UNESCO world heritage site](#). We also saw other main attractions in the same area such as [Todaiji](#), [Kasuga Taisha](#), and Nara National Museum. Nara Park is home to hundreds of freely roaming deers. I had a close encounter with one inquisitive deer which managed to tear my paper bag containing lunch.



The park with deers and the Todaiji temple are one of Japan's most famous and historically significant landmarks. Todaiji houses Japan's largest Buddha statue (Daibutsu) and it is also the world's largest wooden building.



University.

After a few hours we took another shinkansen ride to Hiroshima city. All of us were excited about the idea of visiting this historical place that is known around the world. We took a taxi ride to JICA Hiroshima center and settled in for the night. All of us put our cameras for charging so as to take as many pictures and movies that we could the next day since we were planning to visit the Memorial Museum after our lecture with Prof. Takuya Baba at the Hiroshima

The lecture was very insightful about the research work *“International Comparative Studies on Influence of Teachers’ Views about Education on Mathematics Lessons at Primary Schools”* Prof. Baba has been working over the last few years.

After an hour long bus ride we visited the Memorial Museum with Yahara-san. In all honesty, it was a very touching experience which left us all speechless and wary of



the sufferings of all the people. Among the pictures we even saw a picture of a Bosnian girl lying on a stretcher during the war in our country. Unfortunately, as we were taking pictures and movies, each one of our cameras ran out of battery power since they were incompletely charged. The reason behind it is that once the main light is switched off in the dorm rooms, the electrical power is also shut down. It was a pretty frustrating thing for us to realize, but the most important memories will remain in our hearts.



One rather unexpected encounter took place in front of the Memorial Museum where we had the chance to meet a curious group of Japanese school children in search of English speaking companions. We took a picture with them and still await their postcard they promised to send to us.

After the visit to the museum we rushed back to the station and boarded our last shinkansen ride back home to Tokyo and reached TBIC by dinner time.

We were happy to be back in our rooms and among our friends, chatting and talking about our study trip and the historical landmarks we had the opportunity to see. At night we got in touch with our families with the help of Skype and MSN Messenger since we did not have that chance during our rather busy and hectic study trip schedule.

### **1.2.3 Hokkaido**

On Sunday, July 1, 2006 after having lunch and meeting with Prof. MIYAKAWA-san in TBIC, we took a JICA bus ride to Hitachino Ushiku station for the Sapporo study trip. There we took a train ride to Ueno station, changed trains and monorail to Haneda airport, where we met JICA trainees from Tunisia, our friends, and their supervisor.



The flight was very comfortable and interesting for us, and it lasted about 1½ hours. Nadia-san was very lucky; she had a window seat in the empty part of the plane, so she used three seats for sleeping. Anton-san found two problems regarding SUDOKU puzzle in ANA's magazines, which he, together with Prof. MIYAKAWA-san, solved quickly. Our plane landed at the New Chitose Sapporo airport from which we took a rapid train ride to Sapporo Aspen Hotel.



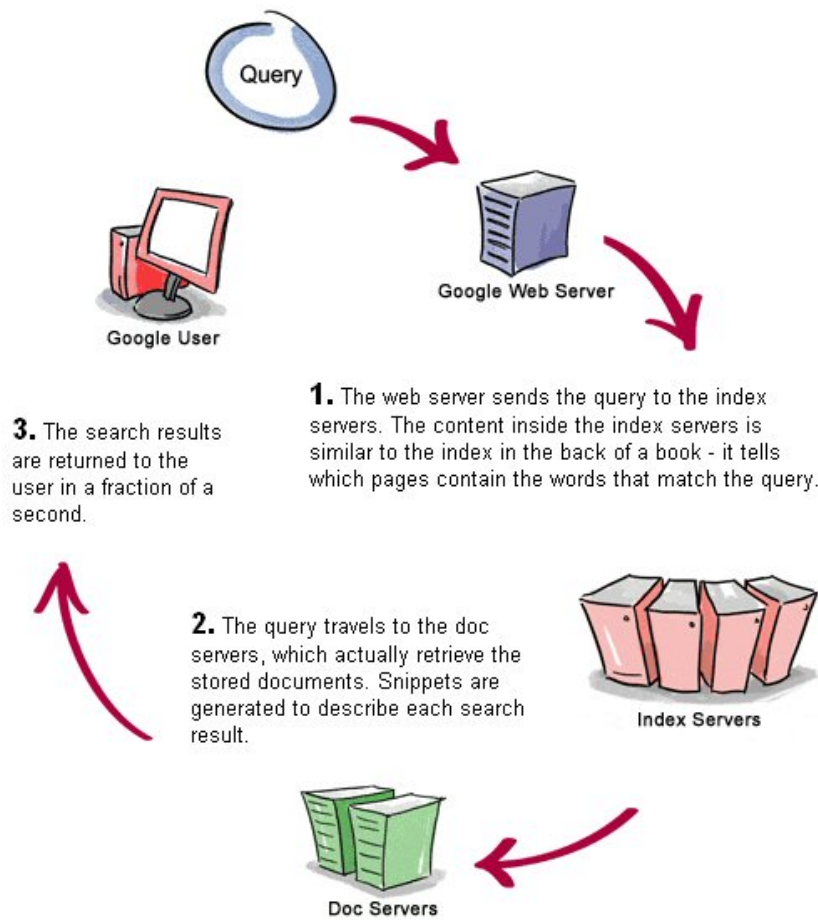
After arriving at the hotel, and taking a short break, we went to the center of the city, where we took dinner. Then we wandered along the center, and in next two hours we visited Odori Park – pleasant Public Park. It is the broad median of Odori ("large street") in the center of Sapporo, separating the city into North and South. TV Tower with its observation deck offering nice views of Sapporo is situated at the eastern end of Odori Park.



On Monday, July 2, 2006 we attended the Conference on "*Web Intelligence and Interaction*" at the Sapporo Convention Center. Conference started at 9:30 AM, and lasted till 17:00 PM. All presentations at the Conference were very interesting for us, and also very informative. The most interesting presentation was "*A Method for Finding Search Keywords Associated with Topics using Global Web Access Logs and Web Communities*" about the new attainment and performance in web search engines, like Google, and their mission to organize world's information and make it universally accessible and useful. The biggest part of this presentation was about four features: speed, accuracy, objectivity and ease of use. In cyberspace, users search for the desired information through search engines. With the improvement of searching accuracy due to the advancements in technologies, it has become possible for users to obtain kinds of information by inputting just search words representing the topics which they are interested in. At the same time, it has become possible to grasp the needs, trends and fashions of the world by analyzing the search keywords used by users. We are aware that the software behind web engine's search technology conducts a series of simultaneous calculations requiring only a fraction of a second, and that searches can be narrowed to a specific domain/sub domain or a specific language.

A more graphic display of the mentioned process is given below:





The conference room was well equipped, which helped all the presenters to have better presentations, and also all attendees to better understand presenter's work. Wireless network was accessible in the conference room, which we used during the lunch break to check our e-mails on Prof. MIYAKAWA-san's laptop. Every presentation was followed by a discussion session, and at the end of the conference a final discussion was held. It was a very fruitful and enjoyable conference for obtaining new ideas and attainments in this very specific and important field for us.



became Hokkaido University. The red stars in front of the building were a symbol of the Hokkaido Development Commission.



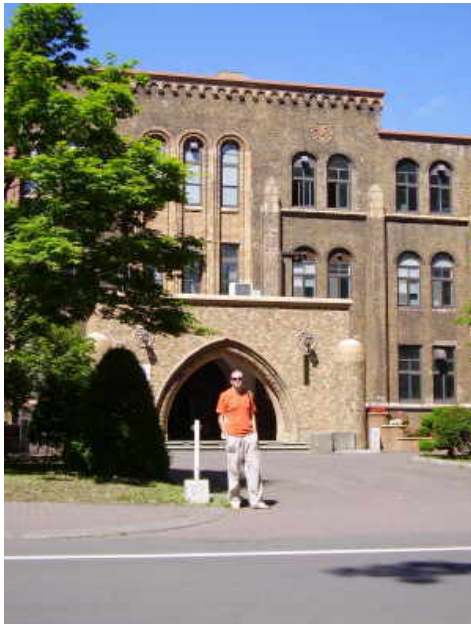
After finishing the conference, we met our colleagues in our hotel and together we took a relaxing walk. On our way we visited several attractions. First attraction was the Clock Tower (Tokeidai) which is the symbol of Sapporo. The building was constructed in 1878 as a drill hall of the Sapporo Agricultural College, which later

Next attraction was The Former Hokkaido Government Building. This Important Cultural Property was built as headquarters of the Hokkaido government in 1888. It is built in an American neo-Baroque style. Its rooms contain the Archives for Hokkaido and are open to the public for viewing during the day.



After a long but enjoyable walk we took dinner in one Italian restaurant. The choice was reasonable, because Italian food is the most miscellaneous, and it can be eaten by almost all.

On Tuesday, July 3, 2006 after having breakfast we went to the Hokkaido University. This prestigious national university was founded in 1876 as Sapporo Agricultural College, with the help of Dr. W.S. Clark of the Massachusetts Agricultural College. Today this multi-disciplinary university has everything from Law and Letters to Medicine and Agricultural Science. There are currently over 11,000 undergraduate students and 6,700 graduate students as well as research associates and faculty. Most buildings on campus are accessible to students and staff only, but the grove of poplars planted by forest science students and known as Poplar Avenue are a popular tourist attraction.



Exactly at 9:30 we entered Prof. SUDA-san's office. He is working on mathematics education at Hokkaido University. He held a two hour lecture for us regarding ICT in education. First of all, Prof. SUDA-san distinguished that he is feeling like a student of the famous Jan Amos Komenský (Latinized Comenius) who was a Czech teacher, scientist, educator and writer, known as the teacher of nations and father of modern education. Later he explained to us his vision of using ICT in education, but from Comenius's point of view. Lecture was very interesting and we enjoyed it while sipping ice cold tea prepared just for us.

After finishing the lecture, we decided to split up, Nadia-san and Olja-san went shopping, while Prof. MIYAKAWA-san and Anton-san went to the Sapporo Beer Museum. We did not have a lot of time for these attractions, because we decided to visit Hokkaido Historic Village in the afternoon, together with our Tunisian colleagues.



The Historic Village of Hokkaido (kaitaku no mura) is an open air museum in the suburbs of Sapporo. It exhibits about 60 typical buildings from all over Hokkaido, dating from the Meiji and Taisho Periods (1868 to 1926), the era when Hokkaido's development was carried out on a large scale. The open air museum is divided into a town, fishing village, farm village and mountain village section. After spending three hours there, we came to a conclusion that the Historic Village of Hokkaido really does document the history of Hokkaido's development.



After the visit to the Historical Village we returned to our hotel, and after a short break we went to dinner. This time Anton-san decided to try Sapporo's favorite dish Dzingiskan. He took his dinner in a popular restaurant at the Sapporo's Beer Factory.

Wednesday, July 4, 2006 was our last day in Sapporo, but without activities. After breakfast we took a rapid train to Chitose Sapporo airport from which we had a flight to Haneda airport. Then the same orbit to TBIC followed, where we came by dinner time. We were happy to be back in our rooms and among our friends, chatting and talking about our study trip and the culture-historic landmarks we had the opportunity to see. At night we got in touch with our families with the help of Messengers since we did not have that chance during our rather busy and hectic study trip schedule.

### **1.3 Diplomatic visits**

During our training course here in Tsukuba, we had the pleasure of visiting our Embassy in Tokyo on several occasions.

First time, on December 14, 2005, we went to Tokyo with OKAMURA-san, to Bosnia and Herzegovina Embassy where we met with all the staff, had traditional Bosnian coffee, enjoyed a very pleasant conversation, received some promotional materials about our country and finally, met Shigehiko Nishihama who works for Foreign Investment Promotion Agency of Bosnia and Herzegovina.

During the 3<sup>rd</sup> International Forum on Basic Education Development in Developing Countries held in March 2006, our ambassador payed us a visit at the University of Tsukuba. We also paid a visit to the vice president of University of Tsukuba and opened diplomatic relations.

Our last visit was done as a part of the 2<sup>nd</sup> B&H seminar in July 2006. Prof. ISODA, Prof.CHINO and Prof.YAHARA accompanied us. Our ambassador concluded his agreement to support the ongoing project for next generations to come.



## **2. Development and implementation of e-learning contents and environment in mathematics and informatics**

In this chapter contents individually developed in the third stage of the course will be described. Each participant developed 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).

### **2.1 *Mathematics contents for elementary school level*<sup>1</sup>**

In developing contents of Mathematics of this paper Macromedia Flash MX was used as the main tool for interactivity.

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 a good feature like 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 the development of contents, limitations of Flash are, for example:

- Flash developers must manually build support for features such as back buttons and book markings, which are otherwise unavailable for users;
- Flash does not use browser settings for font size so text may appear tiny for some users.

However, good characteristics of Flash software prevailed for the development of planned mathematical contents.

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<sup>1</sup> Nadia Bouz-Asal, Faculty of Natural Sciences, Sarajevo

### 2.1.1. Background and Purpose of mathematics contents for elementary school level

The concept of angles is everywhere in today's world.

Angular measurement is the most important tool in all applied sciences. It is the fundamental measurement in studying celestial bodies and their configurations, geography, navigation, topography, optics, civic and mechanical engineering. Even, when a space shuttle wants to enter the earth's atmosphere, we determine its path based on the angle it forms with the atmosphere.

Teaching the topic of angles in school causes many problems, especially at the point where measurement is introduced. Students clearly have difficulties in applying the definition of an angle to its examples.

It is therefore that children later have difficulties in applying the angle knowledge in problem solving.

For the above mentioned reasons, I have decided to cover the topic of angles in my individual project.

### 2.1.2. *The structure of contents*

Considering the fact that elementary schools in Bosnia and Herzegovina are organized in two levels – lower grades (1- 4) where one teacher teaches all the subjects and upper grades (5 - 8) where each subject is taught by a different teacher I ended up partly developing contents for both mentioned levels so as to promote ICT education among all teachers.

Development of contents for my project is based on the idea that angles are better understood if visualized. The aim of these contents is to give students the opportunity to exercise the definition of angles.

Each exercise is given with clear instructions for students. Beside that students are given encouraging comments upon successful completion of an exercise.

Students can approach exercises either at home to practice angles alone or in school where their work can be checked by teachers.

Teachers can also use these exercises in classes to show examples to students, to ask students to solve examples step by step.

If it is possible the exercises will be made in printable form.

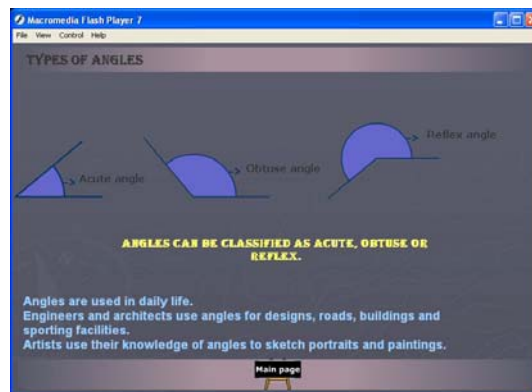
Contents are developed in the form of:

- Lessons
- Exercises
- Quizzes
- Games.

### 2.1.3. Contents developed for lower level of elementary school

- Types of angles
- Right angle
- Rearranging different angle types

As an example, let's demonstrate how the lesson "Types of angles" in the below figure looks like.

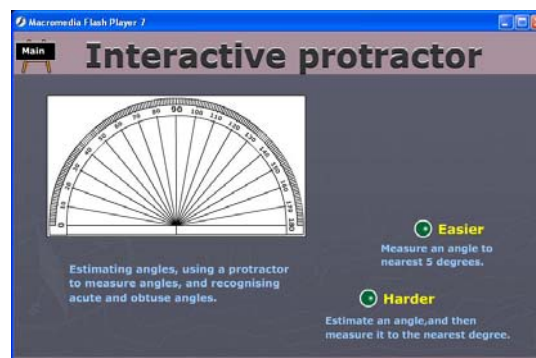


### 2.1.4. Contents developed for upper level of elementary school

- Protractor
- Measuring angles with a protractor
- Interactive protractor
- Rotating minute hand

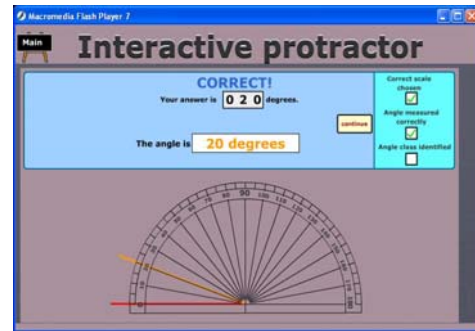
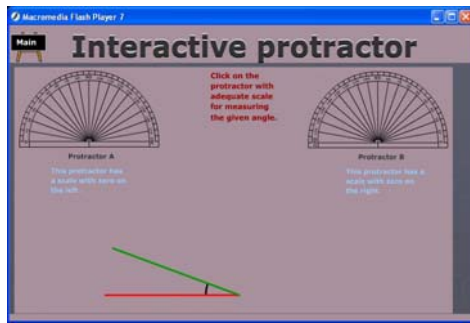
An interesting exercise "Interactive Protractor" can be useful for students and the teacher to test students' knowledge of:

1. Identifying the adequate protractor scale for a given angle
2. Reading the angle measure on the protractor
3. Identifying the type of the measured angle.



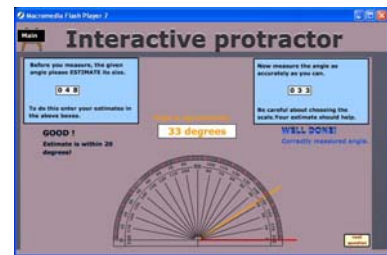
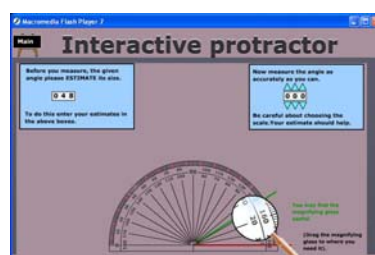
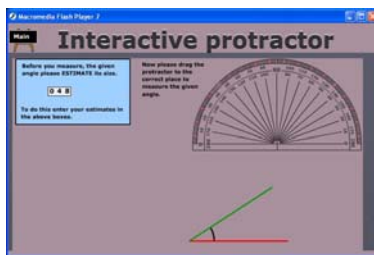
Two groups of exercises are covered to intrigue children's knowledge, easier level and harder level exercises.

Easier level exercise includes three stages. In the first stage, for the given angle, children are asked to choose the correct protractor scale, then measure the angle using the chosen protractor and finally, identify if the angle is acute or obtuse.



Harder level exercise includes two stages. In the first stage, children are asked to estimate the measure of the given angle and save their answer. In the second stage, they are provided with a loop which they can use to read the measure of the angle on the protractor scale.

In both levels of the exercise, easier and harder, once the children enter their answer of the angle measure they can visually watch how the pointer moves on the protractor scale which stops when the correct angle measure is reached.

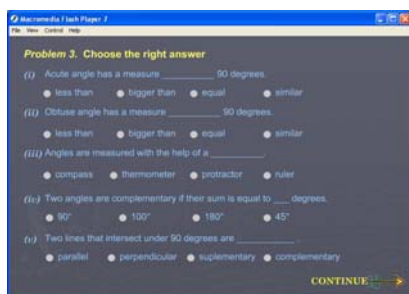
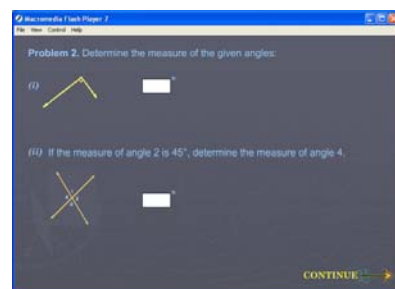
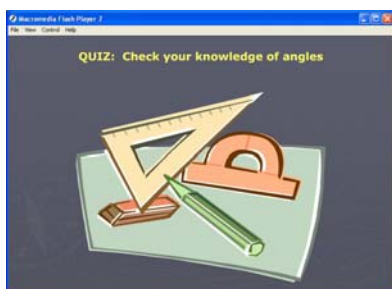


## - Quiz

In the below pictures, an interesting test “**Quiz**” can be useful for students to check their knowledge and get results straight away.

The quiz questions consist of:

1. Answering multiple questions
2. Calculating the measure of an angle



### 2.1.5. Experiment with classroom in Bosnia and Herzegovina

Mathematics contents for elementary school level were developed and carried out in practice in June 2006.

The teaching experiment in cooperation with Karmen-san was organized at the elementary school „**Nafija Sarajlić**” in Sarajevo.

Karmen-san found a teacher, *Daliborka Vilić*, teacher of mathematics and informatics that was able to organize and conduct a class with online FLASH MX developed contents. The target group was a fifth grade class of students.

The main objective of the experiment was to check how pupils would accept new methods of learning mathematics, verifying if „**Angles**“ contents developed by FLASH MX could improve their understanding of the idea and definitions of angles presented. Seeing the potential of e-learning contents in a real Bosnian classroom is of great importance, especially for children at such a young age and stage.

**GRADE:** 5<sup>th</sup> year of elementary school at Sarajevo's *Nafija Sarajlić*  
**TEACHER:** Ms. Daliborka Vilić  
**CLASS:** V-1, group of 13 pupils  
**DOMAIN:** Angles  
**DATE:** 2<sup>nd</sup> period on 6<sup>th</sup> of June 2006, one class  
**OBJECTIVES:** - Reviewing, revising and consolidating the knowledge of angle types, measuring with a protractor.  
- Applying the consolidated knowledge to solving quiz questions regarding angle magnitudes and types.  
**MATERIALS:** Computers for pupils, internet connection

**OBSERVATIONS:** Elementary schools in Bosnia and Herzegovina are rarely equipped with computer rooms, which present an obstacle for interactive mathematics classes using e-learning developed contents.

Much has to be done to change this trend and familiarize children with computer literacy at an early stage.

The number of computers was one of the limiting factors of this teaching experiment too. There were only 13 computers available in the school's computer room, so only a group of 13 pupils was able to participate in the experiment.

The idea of the lesson was for pupils to access and complete 5 examples of the easier level questions followed by the same number of harder level questions of the „*Interactive Protractor*“ followed by the „*Quiz*“.

During experimentation, in the first 10 minutes of the lesson the teacher and her pupils struggled to obtain an internet connection. Once the connection was established, 10 students accessed the contents of the „*Interactive Protractor*“ without any difficulty, while 3 pupils were unable to. This is why the 3 mentioned pupils were instructed to answer quiz questions first.

So, 10 pupils first attempted the easier level questions of the „*Interactive Protractor*“ and they did not face any difficulties in regard to mathematical contents. They asked for technical support like where to write in their result and how to move the cursor. The teacher, as well as Karmen-san noticed that they did not read the instructions on the screen carefully and thoroughly. This could have been because of their excitement and enthusiasm or because they are used to the fact that they can rely upon the teacher's help and guidance.

However, it was sufficient to demonstrate the procedure on one example for pupils to catch up.

While attempting to answer harder level questions of the „*Interactive Protractor*“, pupils did not face any technically related problems, but their success was limited. They simultaneously worked on the computer and wrote answers on prepared sheets of paper.

They were asked to note down their estimates of angles before actually measuring them along with the correct answer.

Three pupils were 100% successful, one of them was 80% successful, four had 60% of successful answers while one pupil failed to correctly complete questions. Unfortunately, one pupil did not write his answers down on the prepared sheet of paper.

And finally, here are the quiz scores of the tested group of pupils. Only 11 pupils accessed the „*Quiz*“, 3 of them did not access „*Interactive Protractor*“ because of the mentioned computer problem and 8 pupils who previously completed questions of the „*Interactive Protractor*“.

Therefore, only 2 pupils were unable to access quiz questions.

Number of pupils	Number of obtained points
3	7
3	5
2	4
1	1
2	0
2	Haven't attempted

As we can see, none of the pupils achieved maximum number of points.

Here is a more detailed look at the pupils' responses to different quiz questions.

Question	1	2	3	4	5	6	7	8	9	10	11	12	13
1. i)	-	+	+	-	-	+	-			-		+	+
ii)	-	-	-	-	-	-	-			-		-	
iii)	-	-	-	+	-	+	-			-			-
2. i)		+	+			+				+	+	+	+
ii)		+	+							+		-	-
3. i)		+	+		+	+				+	+	+	+
ii)		+	+		+	+				+	+	+	+
iii)		+	+							+	+	+	+
iv)		-	-		+					-			+
v)		+	+		+							-	+
<b>Total</b>	0	7	7	1	4	5	0			5	4	5	7



**CONCLUSION:** The teacher experiment was well organized by Ms. Daliborka Vilić with the help of Karmen-san. She actively guided her pupils throughout the lesson and helped with any misunderstandings encountered among them.

Pupils were able to accept „*Angles*“ contents very well and were enthusiastic throughout the lesson. They were particularly delighted with the interactive game/exercise „*Interactive Protractor*“. They eagerly inquired the teacher on how to access the same contents done in class at home as well. They appreciated a different, untraditional approach to mathematics.

Noticeable difference of students' activity was observed as they were encouraged to actively participate during the lesson.

The teacher concluded that these kinds of contents properly combined with traditional methods of teaching and student learning could improve pupils' interest in mathematics, as well as their understanding of different mathematical concepts.

I hope that we will be able to continue and enhance these activities in other elementary schools all over Bosnia and Herzegovina getting a more helpful feedback with the same contents and in this way, try to change the ongoing teachers' fear of using computers for classroom activities.

## **2.2 Mathematics contents for secondary school level<sup>2</sup>**

In the development of the web-page are used Macromedia applications: Dreamweaver as the main tool for building up the page, Macromedia Fireworks, Macromedia Flash MX 2004 and Macromedia FLASH Professional 8 for all graphical applications. In developing mathematics contents we tried to do as different programming as possible and through individual learning from the textbook and internet sites improve our 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 we learned more advanced topics in using Dreamweaver for building the web page which was beneficial investigation and discovery process connected to the development that we will be able to use in our future work with the students.

### **2.2.1 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

### **2.2.2 Mathematics content of the web-page**

In two years we developed contents regarding trigonometry and complex numbers. Tina-san described in details about her contents and main structure of web-page in report from

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<sup>2</sup> Anton VRDOLJAK, Faculty of Civil Engineering, University of Mostar, Bosnia and Herzegovina  
Valentina MINDOLJEVIĆ, Gimnazija Mostar, Bosnia and Herzegovina

last year, so in next pages Tony-san will write in detail about his contents regarding complex numbers. The contents regarding complex numbers are based on the Mathematics curriculum of Bosnia and Herzegovina. Students are introduced to complex numbers in the second grade of secondary school for the first time. Topics for that grade include set of complex numbers based on expanded set of real numbers. Students learn the definition of imaginary and complex numbers, standard form of a complex number, equality of complex numbers, arithmetic operations with complex numbers, absolute value of complex numbers and Gaussian (complex) plane.

In the fourth grade, term of complex numbers is broadened on the polar form of a complex number and definitions are based on trigonometric functions.

So, my online mathematics contents of complex numbers for secondary level will incorporate all these topics in the second and fourth grade of secondary school.

### 2.2.3 The structure of the mathematics 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

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.

**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.

Until august 2006, or writing this final report, these lectures are developed:

- Imaginary Unit;
- Imaginary Numbers;
- The Arithmetic of Complex Numbers
  - Multiplication of Complex Numbers;
  - Division of Complex Numbers.

In future work I will develop these lectures:

- Complex Numbers and the Complex Plane;
- Standard Form of a Complex Numbers;
- Equality of Complex Numbers;
- Conjugates of Complex Numbers;
- The Modulus of a Complex Numbers;
- The Arithmetic of Complex Numbers
  - Addition of Complex Numbers;
  - Subtraction of Complex Numbers;
- The Polar Form of a Complex Numbers;
- Geometric Interpretations;
- De' Moivres Theorem.

The main reason why I did not finish with developing of all contents regarding complex numbers is that we were on our training course only 9 months, but our program is planed for 11 months. Unfortunately we had some paperology problem and we came in Japan late. So in my future work and activities I will try finish all contents regarding complex numbers.

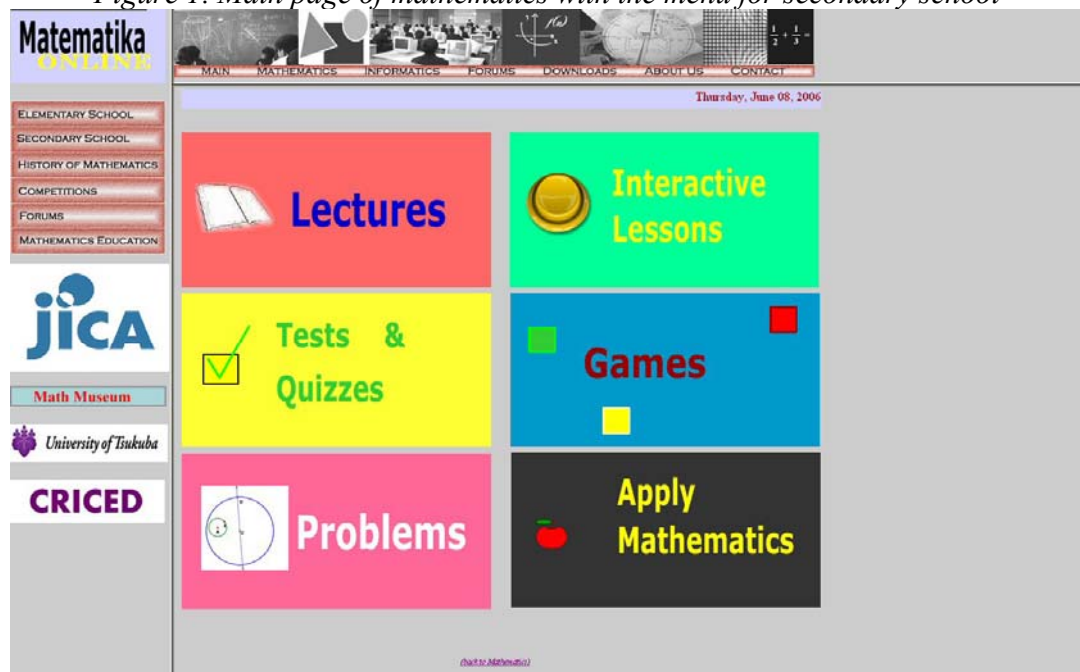
In domain interactive lessons situation is a little bit better, because I developed a lot of materials. Until august 2006 these lessons are developed:

- Adding two complex numbers;
- Multiplication of two complex numbers (3 lessons);
- Endless worksheets for multiplaying two complex numbers;
- Properties of complex multiplication;
- Multiplication with real number;

- Multiplication with  $i$ ;
- Finding the square root of a complex number;
- Geometric interpretations – triangle inequality.

I am developed one test regarding multiplication of complex numbers, but no any games or problems, again the main reason is the same.

*Figure 1. Main page of mathematics with the menu for secondary school*



## 2.2.4 Contents of Complex Numbers

The contents of complex numbers are based on the Mathematics curriculum of Bosnia and Herzegovina. Already I described when students are introduced complex numbers in the secondary school, now I will give official curriculum contents and later I will describe one my lecture, interactive lessons and test attached to this lecture in details.

### 2.2.4.1. Curriculum Contents

- Imaginary unit and imaginary numbers;
- Set of complex numbers;
- Complex numbers and the Gaussian (complex) plane;
- Standard form of a complex number;
- Equality of complex numbers;
- Conjugates of complex numbers;

- The modulus of a complex number;
- The arithmetic of complex numbers;
  - Addition of complex numbers;
  - Subtraction of complex numbers;
  - Multiplication of complex numbers;
  - Division of complex numbers;
- The polar form of a complex number;
- Geometric interpretations;
- De Moivre's theorem.

#### 2.2.4.2. *The Arithmetic of Complex Numbers: Multiplication of complex numbers*

**Why complex numbers? Why do we need new numbers?** The hardest thing about working with complex numbers is understanding why you might want to. Before introducing this lecture, let's backup and look at simpler examples of the need to deal with new numbers.

If you are like most people, initially number meant whole number, 0, 1, 2, 3,... Whole numbers make sense. They provide a way to answer questions of the form "How many ... ?" You also learned about the operations of addition and subtraction, and you found that while subtraction is a perfectly good operation, some subtraction problems, like  $3 - 5$ , don't have answers if we only work with whole numbers. Then you find that if you are willing to work with integers, ..., -2, -1, 0, 1, 2, ..., then all subtraction problems do have answers! Furthermore, by considering examples such as temperature scales, you see that negative numbers often make sense.

Now we have fixed subtraction we will deal with division. Some, in fact most, division problems do not have answers that are integers. For example,  $3 \div 2$  is not an integer. We need new numbers! Now we have rational numbers (fractions).

There is more to this story. There are problems with square roots and other operations, but we will not get into that here. The point is that you have had to expand your idea of number on several occasions, and now we are going to do that again.

The "problem" that leads to complex numbers concerns solutions of equations. In mathematics, we do a lot of solving of polynomial equations, which amounts to finding a root of a polynomial. For example, the solutions to the equations  $x^2 = 1$  are the same as the solutions of  $x^2 - 1 = 0$ , that is, they are the roots of the polynomial  $x^2 - 1$ . These roots are  $x = 1$  and  $x = -1$ . However, some polynomial equations have no real number solutions: for example, the equation

$$x^2 + 1 = 0$$

has no real number solutions, because  $x^2 + 1 \geq 1$  if  $x$  is a real number.

The complex numbers were invented to provide solutions to polynomial equations. For example if we substitute  $i$  for  $x$  in the equation above, we get a solution:

$$i^2 + 1 = -1 + 1 = 0.$$

In the early days, the boldness of simply defining a new number  $i$  as a solution was considered suspicious (hence the term “imaginary part”), just as the existence of  $\pi$  was a matter of religious controversy for the ancient Greeks. Complex numbers are useful abstract quantities that can be used in calculations and result in physically meaningful solutions. Today, the complex number system is so deeply rooted in physical theory (e.g. quantum mechanics) that one could argue the complex number system is a more “real” description of the world than the real number system. (The famous physicist Roger Penrose wrote an essay to this effect, “Nature is complex”.) However, recognition of this fact is one that took a long time for mathematicians to accept. At any rate, students of today are expected to transcend in a blink the worries of past geniuses. It is pretty easy (from the quadratic formula) to see that with complex numbers, we can find roots for any quadratic polynomial.

**Aim of the lecture:** After this lecture the user should be able to define one of the basic arithmetic operations of complex numbers – multiplication, know the main properties and some special cases of this operation and apply it in problem solving exercises.

**Lecture** should contain the definition of multiplication and should explain the technique for multiplying two complex numbers. Because the complex multiplication is a more difficult operation to understand than either an algebraic or geometric one, we will do it algebraically first. The user will be later introduced to some special cases of multiplication, for example, multiplying a complex number by a real number, multiplying a complex number by  $i$ , multiplication and absolute value, and the main properties of this operation, for example commutation. At the end of the lecture, user is led to **the interactive lessons** to discover techniques for multiplying two complex numbers, some special cases of multiplication, main properties of this operation, and finding square roots of a complex number. In addition, the user will later be able to use few bottomless worksheets of multiplying complex numbers.

**Interactive lesson** start with an example, in which the user should enter two complex numbers, and later be able to see techniques for multiplying these two complex numbers, or submit and check his answer. This example also contains a bottomless worksheet, worksheet number 1.

*Figure 2. First Interactive lesson*



## Multiplication of two complex numbers



Enter two complex numbers below and then see the resultant of step-by-step multiplication. Then practice properties of this operation.

$$(\text{ } 0 + \text{ } 0 i) \cdot (\text{ } 0 + \text{ } 0 i)$$

Enter your answer here:  $\text{ } ? + \text{ } ? i$

Reset

Submit

Multiply

[Mathematics](#) – [Lessons menu](#) – [Next example](#) – [Worksheet 1](#)

Second example is similar to previous, but this time user should determine real and imaginary parts in a product of two random complex numbers. So, in this example he should additionally use knowledge about equality of complex numbers. This example also contains a bottomless worksheet, worksheet number 2.

*Figure 3. Second Interactive lesson*

### Multiplication of two complex numbers



- Find a real and an imaginary part in the product of these complex numbers:

$$z_1 \cdot z_2 = (\boxed{0} + \boxed{-17}i) \cdot (\boxed{-4} + \boxed{7}i)$$

Real part is: , Imaginary part is:

Reset

Submit

Show

[Mathematics](#) — [Lessons menu](#) — [Previous example](#) — [Next example](#) — [Worksheet 2](#)

Third example is again similar to previous two examples, but in this example user should determine such real numbers  $a$  and  $b$ , or complex number  $a + ib$ , so that this complex number is equal to the product of the two random complex numbers earlier obtained. Again, this example contains a bottomless worksheet, worksheet number 3.

The **aim** of these three examples is that a user by using dynamic techniques discovers a technique for multiplying two complex numbers, and its use in various situations. **Approach** is based on the self discovery through observation of dynamic techniques and conclusions based on the new lecture as well as on the previous knowledge of complex numbers, for example, equality of complex numbers.

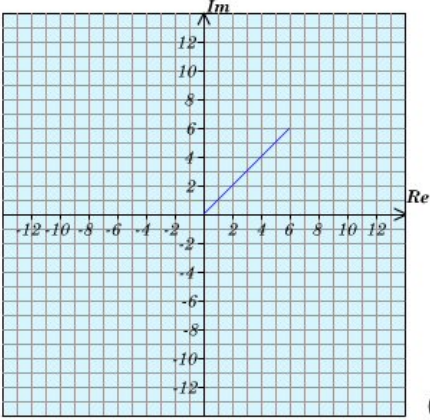
Fourth example first introduces special case of multiplication, multiplying a complex number by a real number, and later another special case, multiplication and absolute value. This example contains a simple **questionnaire** for the observation data.

Fifth example introduces second special case of multiplication, multiplying a complex number by  $i$ , and later, again, another special case, multiplication and absolute value. Also, this example contains a simple **questionnaire** for the observation data. Questionnaire is divided into few parts. In the first part, user uses dynamic multiplying by  $i$  to realize that multiplying a random complex number  $z$  by  $i$ , leads to a counter clockwise rotation of the point  $z$  by  $90^\circ$  around the origin to a new point  $zi$ . Later, the

user will be asked to determine the effect of multiplying a complex number by  $i$  and again by  $i$ , effect of multiplying complex number by  $-i$ , and effect of multiplying by  $i^3$ . In this part, user uses dynamic multiplying by  $i$  and again by  $i$  to realize that multiplying a random complex number  $z$  by  $i$  and again by  $i$  leads to a counter clockwise rotation of the point  $z$  by  $180^\circ$  around the origin to a new point  $zi^2 = -z$ , in other words, user should realize that this multiplying leads to the opposite number of number  $z$ . Effects of multiplying complex numbers by  $-i$  and by  $i^3$  will be explained in details. At the end of the questionnaire user is led to discover that points  $z$ ,  $zi$ ,  $-z$ ,  $zi^3$  lie on the same circumference.

Figure 4. Fifth Interactive lesson

### Multiplication by $i$



Look at the complex number below, then multiply by  $i$ . Type in the answer then click submit to check if your right.

+   $i$

Multiply
Submit
Reset

☒ Effect of multiplying a complex number by  $i$  is a rotation of the point on the Gauss-plane through °.

Check

[Mathematics - Lessons menu](#) - [Previous example](#)

The **aim** of these two examples is that a user by using dynamic multiplying by a real number, dynamic multiplying by  $i$  and dynamic multiplying by  $i$  and again by  $i$ , discovers that these multiplications lead to scaling and rotation. Also, a user should discover a relationship between multiplication and absolute value. **Approach** is based on the self discovery through observation of graphical data and conclusions based on the new lecture as well as on the previous knowledge of complex numbers.

Sixth example, also the last example, should help the user in understanding of finding the square roots of complex numbers. This is the most complex example, and includes use of system of equalities solving previously obtained and equality of complex numbers.

**Test** includes application of learned contents both from the lecture and interactive lessons. It should contain exercises with multiplication of two complex numbers, determining of real and imaginary parts of complex numbers, opposite numbers, comparing and determining modulus of some special complex numbers, and finding the square roots of a complex number. In this part user shouldn't use dynamic technique or dynamic multiplying as it is a test of knowledge.

## **2.3 Implementation of E-learning Environment in Informatics in Schools in Bosnia and Herzegovina**

### **Background and Purpose**

Informatics is a relatively new subject in schools in Bosnia and Herzegovina. Because of reform processes ongoing in Bosnia and Herzegovina the curriculum is changing, therefore it is very hard to choose topics for E-Learning contents. In this case I selected two topics: *Microsoft PowerPoint Basics* and *Microsoft Access Basics*. The main reason is that there are already developed contents about *Microsoft Word Basics* and *Microsoft Excel Basics* which are most common in all curriculums of informatics in Bosnia and Herzegovina in the first grade, but those two topics are contained in most of curriculums of informatics in higher grades. Another reason, ECDL certification is increasingly in demand in Bosnia and Herzegovina as standard for education and evaluation of computer's skills. As we know ECDL consist of 7 modules, including those four modules (topics) mentioned above.

### **Contents Structure**

Informatics contents are, as it is already mentioned, divided in two main topics: *Microsoft PowerPoint Basics* and *Microsoft Access Basics*, which are divided into lessons. I developed contents about *Microsoft PowerPoint Basics* which consists of twenty six topics divided into ten lessons, but *Microsoft Access Basics* contents are not developed yet because of lack of time. As we already know this year course is shorter 2 months comparing with project planned program so I didn't have enough time to realize my plan. Lessons are translated in both, Bosnian and English language. Each lesson has three types of contents:

- Static – HTML text organized like textbook
- Demonstrative lessons – describe processes in static part.
- Interactive lessons – described processes in static part and demonstrated in demonstrative part – student has to practice how to accomplish tasks described and demonstrated in previous parts, or
- Assignments – exercise which contains PowerPoint file and PDF file or AVI file with final layout of presentation, so student has to format PowerPoint file as it shown in those two mentioned files.

*Microsoft PowerPoint Basics* lessons are shown below:

1. Lesson One: Introduction in Microsoft PowerPoint (Getting started, PowerPoint window, Saving presentation)
2. Lesson Two: Types of Presentations Techniques (AutoContent Wizard, Design Template)
3. Lesson Three: Creating New Empty Presentation (Choose type of slide, Adding and Deleting Slides)
4. Lesson Four: Formatting Text on Slides (Add text, Format Font, Alignment and Line Spacing)

5. Lesson Five: Working with Hierarchical Lists (Bullets and Numbering)
6. Lesson Six: Inserting Object on Slide (Insert Picture from ClipArt and from File, Insert Chart from Excel)
7. Lesson Seven: Inserting Object on Slide (Insert Table, Organization Chart, Drawing and Working with Graphical Objects)
8. Lesson Eight: Working with Slides (Copy and Paste Slides, Formatting Slide Background)
9. Lesson Nine: Creating Multimedia Presentation (Applying Animation effects and transition)
10. Lesson Ten: Setup Presentation (Setup Slide Show, Printing Presentation, Editing Slide Master)

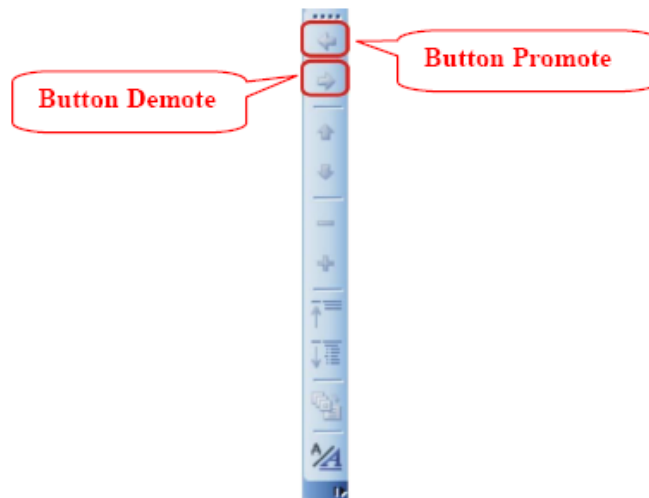
Lessons are designed for absolute computer beginners and are described step-by-step for work in PowerPoint.

Example of static – HTML lesson eight – **Working with Bulleted and Numbered lists** is shown on the picture below.

#### **Working with Bulleted lists**

When we want to create slide with bulleted list, then we should choose slide type with bulleted list, and after that we can add items to the list.

If we go to the next row by clicking **Enter** we will take bullet to the next row.



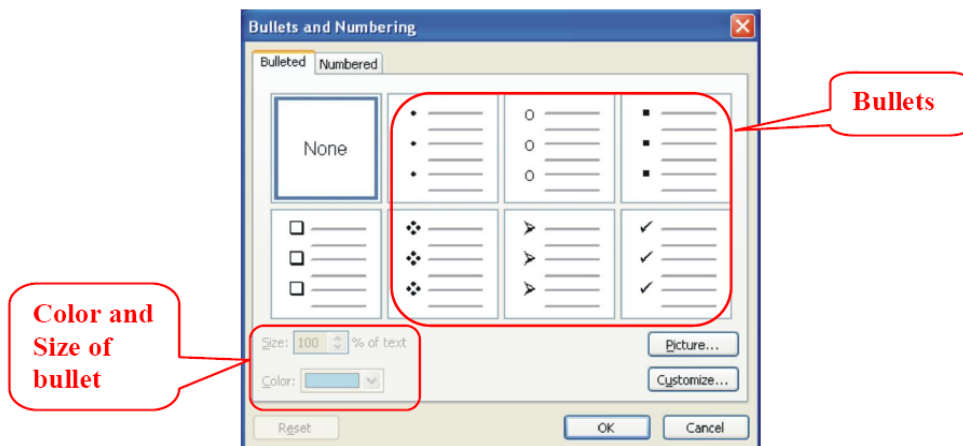
*Picture1. Outlining Toolbar*

If we want to add subitems into the list, to make hierarchical structure of the list we should use button ⇨**Demote** ➦ on **Outlining Toolbar** which will appear on the left side of the window. If we click to the button ⇨**Demote** ➦ row will indent to the right, and bullet in that row will be changed. Bullet will be transposed to the next row every time when we move to the next row by clicking **Enter**. If we want to go back to the main items on the list we should click to the button ⇨**Promote** ➦ on **Outlining Toolbar**.

*Picture 1. Working with Bulleted and Numbered lists*

If you look at picture above, you can see that it describes step-by-step how to work with *Bulleted and Numbered lists* in presentation. If users follow these steps they can easily do it.

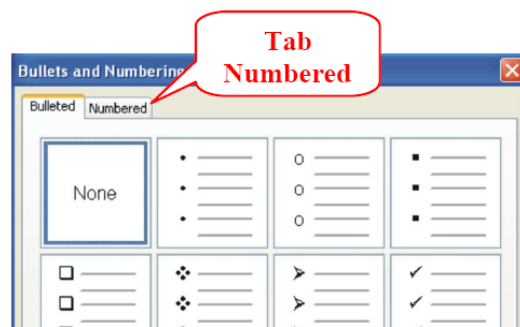
Next figure shows how to Change color and size of bullets.



Picture2. Dialog Box Bullet and Numbering

Then we should choose the other bullet from dialog box and click to the button ⇨ **OK**.

To change size or color of the bullet options **Color** i **Size** can be used. Also, if we want to change bulleted list to the Numbered list we should choose tab **Numbered** from the dialog box *Bullets and Numbering* and then click to button ⇨ **OK**.



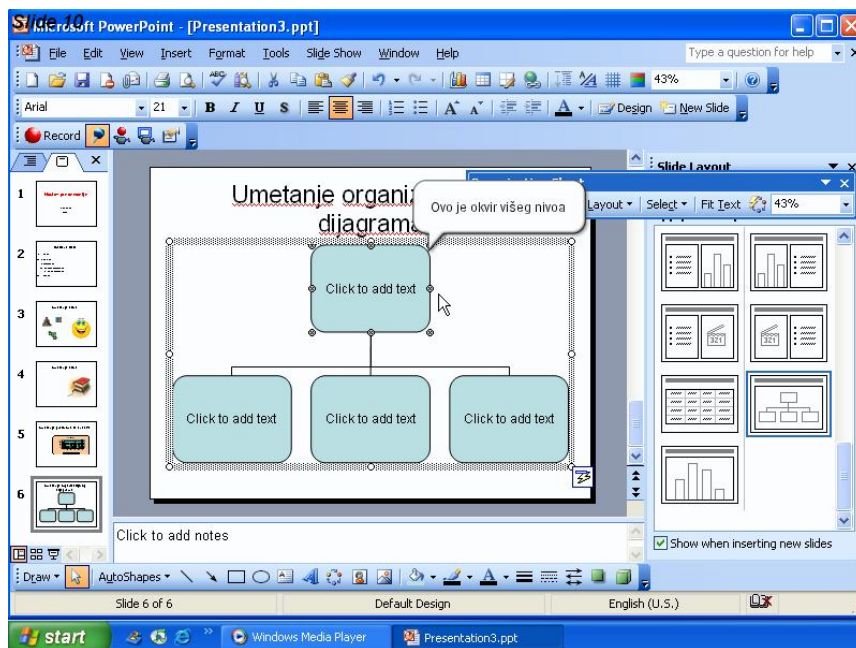
Picture 3. Tab Numbered

Picture 2. Formatting Bullets



Most interesting are dynamic demonstrative – animated lessons of processes described in static part, made by using software ViewletBuilder. The Picture 3. is showing one frame from dynamic demonstrative lesson - how to Work with Bulleted and Numbered lists. Animation of process is additionally described with tips written in yellow clouds like on the picture above.

Interactive lesson is similar, but there student is asked to click on proper place so the process could be accomplished. If student clicks properly, he will be informed that it is correct and next slide will automatically be displayed. In case if he clicked wrong, he will be asked to repeat the action.



*Picture 3. One frame of dynamic demonstrative lesson*

Assignments are totally different from other types of lessons. Student can download from Moodle site, which will be described later in this chapter, unformatted PowerPoint presentation and PDF or AVI file, depend is it animated or static presentation, which show how presentation has to look like at the end. After student finish with formatting, presentation should be uploaded to the Moodle server, following very easy procedure, so teacher can grade student work.

As you can see students can use the TextBook - lessons in HTML format or Dynamic Demonstrative – Animated lessons to learn about subject and then after that check their knowledge by Dynamic Interactive – Animated lessons and also by accessing to quiz, made in Moodle. The most important advantage of Moodle system is good support for developing and conducting quizzes.

## ACCESSING INFORMATICS CONTENTS

Described informatics contents can be accessed through developed web site currently located at <http://bosnia.criced.tsukuba.ac.jp/moodle/>. Each person requires only one account for the whole server.

Beside that student need good internet connection to access the contents as fast as it possible. Let us describe some technicalities about website and contents. Today, almost everyone in Japan 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. 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 600Kb. Comparing to 10Mb which would be needed for ordinary animation file it is quite difference and contents can be accessed quite faster.

## USED SOFTWARE: VIEWLETBUILDER AND MOODLE

In developing my contents I used ViewletBuilder as a main tool to create compelling, animated online presentations, demonstrations and software tutorials. The reason that I chose this software is because it is easy to create and visually compile animated flash demos which are perfect for online software training.

Developed contents were published through *Moodle* system. *Moodle* is a learning management system (LMS) - a free, Open Source software package designed to help educators create effective online learning communities. It is the most popular learning management system on the web nowadays and it has a large and diverse user community with 12,165 registered sites in 155 countries with 4,021,531 users in 376,565 courses (as of May 30, 2006)<sup>3</sup>. Each person requires only one account for the whole server. Each account can have different accesses such as *Student*, *Teacher with or without Editing Permissions*, *Course Creator* and *Administrator*. Students can access a *Moodle* course using almost any browser, including Internet Explorer, *Mozilla*, *Firefox* and *Safari* for the *Macintosh*.

The reason I chose *Moodle* to publish my contents is that *Moodle* has a simple, efficient, low-tech browser interface and it is suitable for 100% online classes as well as supplementing face-to-face learning.

*Moodle* features make it very appropriate environment for publishing distance learning contents. According to that, *Moodle* was used to conduct experiment with Bosnia and Herzegovina students. Students were access to contents through the *Moodle*.

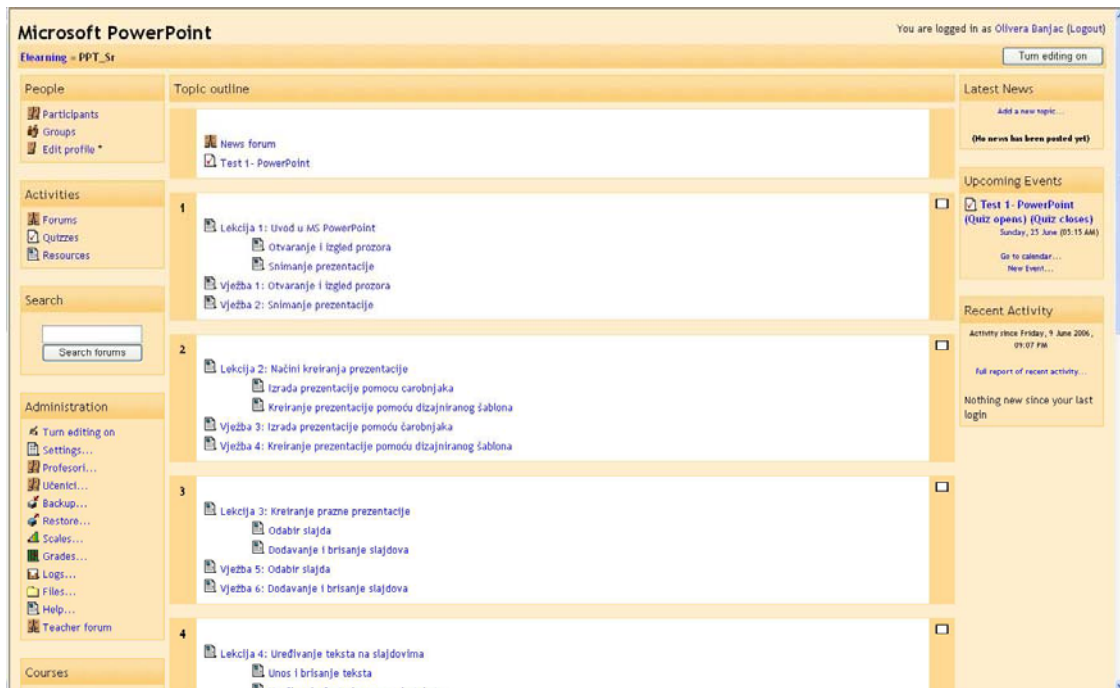
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<sup>3</sup> <http://www.moodle.org>

## TEACHING EXPERIMENT

The important point of this project was testing the contents and e-learning environment in a real school. The schools which were used for experiment were Electrotechnical High School in Prijedor and Gymnasium in Mostar, Bosnia and Herzegovina.

Informatics contents about MS PowerPoint were developed during last period and published through Moodle learning management system to the server. Moodle web site used for the experiment with mentioned schools is shown in the picture below.



Picture 4. Moodle web site used for experiment with Electrotechnical High School in Prijedor

The teaching experiment in cooperation with last year project participant Ljubo-san was organized at Electrotechnical High School in Prijedor, Bosnia and Herzegovina. Target group was the third grade students in the mentioned school. Ljubo-san is a teacher of informatics in mentioned school and because of that time, by curriculum, his students were learning about Microsoft PowerPoint he was able to organize and conduct a class with online developed contents.

In fact, because during that time it was the last week of school year for the third grade students, Ljubo-san decided to test his students' knowledge about MS PowerPoint using a quiz which was developed as a part of MS PowerPoint contents.

The teaching experiment in cooperation with last year project participant Tina – san and his college Vlado – san was organized at Gymnasium in Mostar.



Target group was the second grade students in the mentioned school. Vlado – san is a teacher of informatics in mentioned school and because of that time, by curriculum, his students were learning about Microsoft PowerPoint he was able to organize and conduct a class with online developed contents. Picture shows a part from teaching experiment in Gymnasium in Mostar.

In fact, because during that time it was the end of school year, they decided to test Vlado's students' knowledge about MS PowerPoint using a quiz which was developed as a part of MS PowerPoint contents.

Experiment in Electrotechnical School in Prijedor was conducted on the 30<sup>th</sup> of May 2006 and on the 10<sup>th</sup> of June in Gymnasium in Mostar.

The main objective of the experiment was:

- to check how students would accept new methods of learning informatics
- to enable students to solve quiz questions regarding MS PowerPoint and multimedia technology using Moodle management system
- to develop their ability and motivation to use online learning for practical purposes.

### **ANALISYS OF EXPERIMENTAL CLASS**

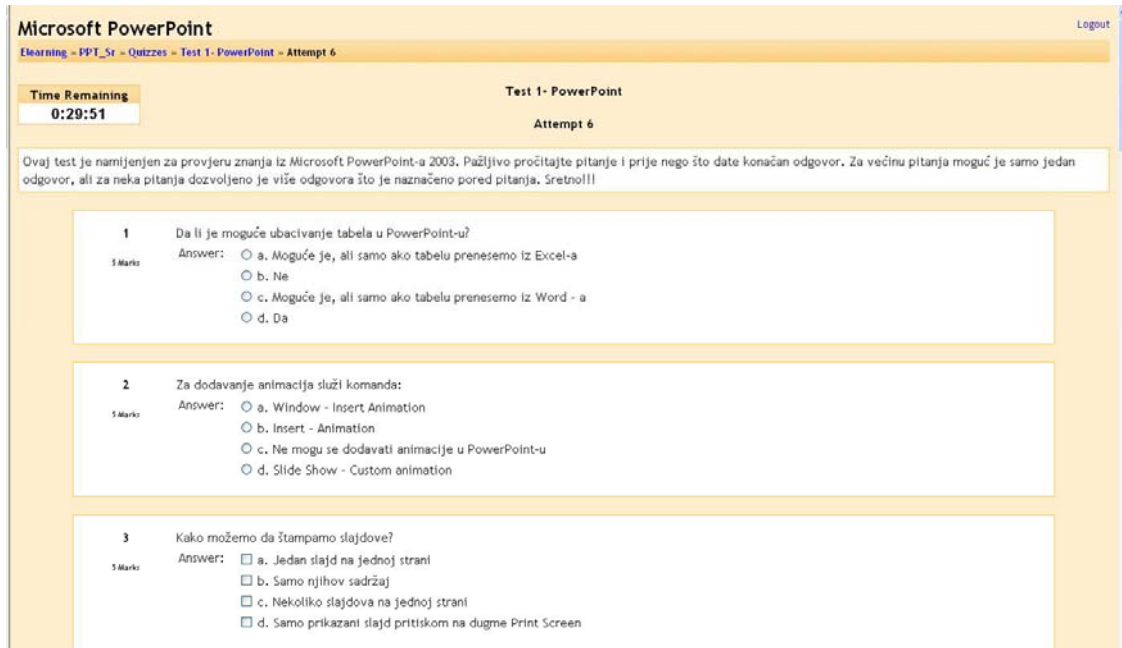
Electrotechnical High School in Prijedor has two computer rooms. Each room is equipped with 15 computers, but one has very old computers and has no internet connection. The other one has internet connection but not very well. Two computers were not connected at that time because of network problem.



Because of that Ljubo-san choose one group of 13 students to attend the Moodle quiz regarding MS PowerPoint. Students were accidentally chosen with different level of knowledge. The idea of this class was to test students with different level of knowledge.

*Picture 5. Informatics classroom in ETS Prijedor*

Each student from the group attempted the quiz using their username and password which I provided them with before the experiment. Grades they got in this quiz were included in the 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 1<sup>st</sup> to 20<sup>th</sup>, Moodle chooses one from the library of 5-10 questions. That way we increasingly reduce cheating chances. Quiz has time limit 30 minutes. Moodle quiz used for experiment with Electrotechnical High School in Prijedor is shown on the picture below.



*Picture 6. Moodle quiz*

## OBSERVATIONS

Using Moodle learning management system gives us a good feedback of how each student accesses the contents and statistics of attempted quiz. That means that each student was identified through his/her account. Overview of student's results is shown on the picture below.



	Milan Gajić	<input type="checkbox"/> 3.4	30 May 2006, 02:27 PM (5 mins 17 secs)	3.4
	Bojan Đurić	<input type="checkbox"/> 2.6	30 May 2006, 02:27 PM (7 mins 33 secs)	2.6
		<input type="checkbox"/> 2.4	30 May 2006, 02:36 PM (2 mins 54 secs)	
	Milenko Knežević	<input type="checkbox"/> 3.1	30 May 2006, 02:28 PM (7 mins 22 secs)	3.1
	Aleksandar Radaković	<input type="checkbox"/> 2.5	30 May 2006, 02:28 PM (8 mins 5 secs)	2.5
	Armin Alagić	<input type="checkbox"/> 3.9	30 May 2006, 02:24 PM (13 mins 14 secs)	3.9
	Jovana Đukić	<input type="checkbox"/> 2.6	30 May 2006, 02:27 PM (9 mins 32 secs)	2.6
	Marinko Rokić	<input type="checkbox"/> 3.4	30 May 2006, 02:26 PM (11 mins 43 secs)	3.4
	Bojan Došen	<input type="checkbox"/> 3.0	30 May 2006, 02:28 PM (9 mins 35 secs)	3.0
	Zoran Vučkovic	<input type="checkbox"/> 3.2	30 May 2006, 02:27 PM (11 mins 20 secs)	3.2
	Jelena Vukojević	<input type="checkbox"/> 2.2	30 May 2006, 02:28 PM (11 mins 2 secs)	2.2
	Dragan Stanic	<input type="checkbox"/> 2.2	30 May 2006, 02:27 PM (11 mins 27 secs)	2.2
	Zorka Stakić	<input type="checkbox"/> 1.6	30 May 2006, 02:29 PM (10 mins 45 secs)	1.6
	Danijel Kotur	<input type="checkbox"/> 2.7	30 May 2006, 02:27 PM (12 mins 18 secs)	2.7

*Picture 7. Quiz statistics*

On the picture above we can see student's grades and how long each student has been doing the quiz.

One of the students made a mistake and accidentally clicked to finish the quiz before he answered all question, so the teacher allowed him to restart the quiz. In this case Moodle takes highest grade, as a final grade as we can see for student in second row on picture above. Even students got instructions from their teacher how to do quiz this kind of mistakes can happen because students are not used to do such kind of activities on the computer.

Also statistics showed that students did this quiz very quickly. They spent from 5 to 13 minutes to complete the quiz. They were very surprised because, usually they need a whole class to complete such kind of quizzes without computers.

Most of students were satisfied with their grades because it was in accordance with their usual grades, but some of them got worst grades than usual.

Maximum grade was 3.9, but minimum grade was 1.6. Maximum mark is 5 and there were no negative marks for students who didn't answer correctly.

Picture below shows simple statistic of student's answers on each question.

Test 1- PowerPoint	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Jovana Đukić	5	5	0	5	5	5	0	5	0	5	2.5	0	5	5	0	0	5	0	0	0
Bojan Đurić	5	5	0	5	5	5	0	0	0	5	0	0	0	5	5	5	5	0	2	0
Armin Alagić	5	0	5	5	5	0	5	0	5	5	2.5	5	5	5	5	5	5	5	0	5
Bojan Dolen	5	5	0	5	5	0	5	0	5	5	0	5	5	0	0	5	5	0	1	5
Milan Gajić	5	5	0	5	5	5	0	0	2.5	5	2.5	5	5	0	5	5	5	0	2	5
Milenko Knežević	5	5	5	5	5	5	0	0	0	5	0	5	0	5	5	0	5	0	2	5
Danijel Kotur	5	5	0	5	5	0	0	0	0	5	2.5	5	0	0	5	5	5	0	1	5
Aleksandar Radaković	5	5	0	5	5	5	0	0	0	5	2.5	5	0	0	0	0	5	0	2	5
Marinko Rokić	5	5	0	5	5	5	5	0	2.5	5	2.5	5	5	0	5	0	5	0	2	5
Zorka Stakić	5	5	0	5	0	0	0	0	0	5	0	5	0	0	5	0	0	0	2	0
Dragan Stanic	5	0	0	0	5	0	5	0	0	5	2.5	5	0	0	5	5	0	5	2	0
Zoran Vučkovic	5	5	5	5	5	0	0	5	2.5	0	0	5	5	0	5	5	0	5	2	5
Jelena Vukojević	5	0	0	5	5	5	0	0	5	0	2.5	5	5	5	0	0	0	0	1	0
	5	3.9	1.2	4.6	4.6	2.7	1.5	0.8	1.7	4.2	1.5	4.2	2.7	1.9	3.5	2.7	3.5	1.2	1.5	3.1
%	5.00	3.85	1.15	4.62	4.62	2.69	1.54	0.77	1.73	4.23	1.54	4.23	2.69	1.92	3.46	2.69	3.46	1.15	1.46	3.08

Picture 8. Simple statistic of student's answers

Students used contents for 1 class (45 minutes) with assistance of their teacher for studying about Microsoft PowerPoint.

During this experimentation there were not problems with network connection.

## CONCLUSION

With my developed contents I hoped to bring about a modern and refreshing approach to informatics teaching for B&H's students. These kinds of contents properly combined with traditional methods of teaching and student learning could improve students' interest in informatics and software knowledge. Therefore, the advantages include **self-pacing** because students have a chance to speed up or slow down as necessary and **interactivity** engages students, pushing them rather than pulling them through training.

In this way, students are encouraged to actively participate during the lesson and they get them into the habit of accessing such educational contents from home too.

In the future I have planned to develop contents about MS Access using Viewlet Builder and to publish it using Moodle.

### 3. 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 were invited here.
- Continue to make contents and finish contents in complex numbers according to the curriculum given above
- Continue to work on administrating the web-page “Matematika Online” and upload contents
- Introduction of e-learning in curriculum of Mathematic Teaching Methodology on Faculty of Natural Science and Mathematics, University of Mostar
- Continuing development of e-learning contents with interested students on Faculty of Natural Science and Mathematics, University of Mostar

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 conducted through seminars which we will participate. We have to rely 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.



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## 5. Appendix