Report by JICA Trainees from Bosnia and Herzegovina
No.3

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

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APPRECIATION

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INTRODUCTION

When taking a look at any industry, science or economy, the improvements done in the last hundred years are more than evident. But taking a look at educational system and comparing it to the one that existed one hundred years ago, it becomes clear that the changes are happening slowly and only in the last decade have some improvements been introduced. These improvements are related to the fact that society is shifting from industry to information based state. Every aspect of human existence is affected by this change and consequently the same thing is gradually starting to happen to educational system as well. Education and learning have always been key components in developing a firm and stable society so it is important to make this component of society as stronger as possible. This goal is achievable by applying ICT (Information and Communication Technology) to educational system. This type of learning is known as ICT Education.

ICT Education is implying a use of Information and Communication Technologies in the educational process. It is including a wide range of activities such as utilization of:

- over head projector for presenting a lesson
- Internet resources for teaching and learning
- educational forums where students can exchange ideas and help each other with tasks
- interactive educational software
- interactive digital books
- touch screen software
- online courses for distance learning
- virtual reality environment

All of these and many more activities can be categorized as deployment of ICT in education.

When talking of the different ways how ICT can be used in education, there are many situations:

- teacher can use ICT benefits for planning and preparing the materials for teaching
- student can use it individually from home
- teacher can use it to teach the whole class as a group
- students can work in groups during the class

Benefits of introducing ICT in education are clearly visible:

- the process of making the teaching materials, storing them and exchanging them with other teachers is available and easy
- tasks are more interesting for students making them more motivated for the lessons and learning
- the technology is allowing the placement of focus on the real problem of lesson, eliminating all the pre-calculations that students would have to do by hand thus making it hard to for them to notice what the lesson is about

- interactivity of the approach is allowing the view of the problem form different angles with ability of changing different parameters with just one click and providing students with more examples to examine
- students can exchange their ideas or homework assignments through different forums and educational portals
- students have many resources available if they need to do additional studying on the lesson that wasn't clear to them

Governments around the world are recognizing the need for introducing ICT in education and all the positive effect coming out of that process. Bosnia and Herzegovina suffered many losses in infrastructure and in qualified teaching workforce. Today, the infrastructure and the computer equipment level are getting better, but the factor still missing is related to human resources. Almost all of the teachers still resort to traditional *chalk and talk* way of teaching and the present ICT equipment is not utilized. Teachers need help in making a transition. They need to learn how to properly utilize ICT: how to create interactive environment, use the existing resources that are already available and create interactive learning materials by themselves. In order to help this process of reform in Bosnia and Herzegovina, a three year project *The Promotion of Information and Communication Technology (ICT) in Mathematics and Informatics Education and Developing Environment for E-Learning* has been organized.

This project has been held in cooperation with JICA (Japanese International Cooperation Agency), CRICED (Center for Research on International Cooperation in Educational Development) and Government of Bosnia and Herzegovina. The main goal is to provide training to the new generation of Mathematics and Informatics teachers who will introduce new methods to the homeland and help create e-learning environment for the promotion and implementation of I CT learning in Bosnia and Herzegovina.
Special objectives of this training are:

- getting to know Japanese education and its theory in Japan, and curriculum reform movement in the world, research on teaching and teacher education for developing school curriculum
- increasing knowledge of Information and Communication Technology in classroom practice in Mathematics and Informatics
- developing teaching skills by utilizing ICT methods based on Japanese approach of lesson study
- acquiring skills for developing web-sites with the collaboration between programmers, Mathematics and Informatics teachers

This report will present all the activities and results that we, three trainees, have conducted during our ten month stay in Japan. The first part of the report is explaining about all the lesson studies, seminars, workshops, conferences and study trips we have been and attended to. The second part is demonstrating developed content available online. The third part is consisted of our final remarks.

Content developed this year is published at following URLs:
Mathematics Online:

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

Informatics Online:

http://elearningbih.criced.tsukuba.ac.jp/informatics/flowcharts.swf

E-learning with MOODLE:

http://bosnia.criced.tsukuba.ac.jp/moodle/

These websites can also be found at the following URL on the CRICED web site:

http://math-info.criced.tsukuba.ac.jp/bih/

1. Activities

1.1. Training program

<table>
<tr><th>Term</th><th>Subject</th><th>Contents (Group)</th><th>(Individual)</th></tr>
<tr><td rowspan="2"><u>1st stage</u>
Basic techniques and development plan of contents (2 months)

Depending on skills already have, contents of curriculum may change</td><td>Introduction and experience of Japanese Education
(2 weeks)</td><td>Knowing Japanese education and its theory in Japan, and curriculum reform movement in the world, research on teaching and teacher education for developing:
School curriculum
School subject
ICT
Mathematics education
Informatics education</td><td rowspan="3">Each participant is supported by academic advisors. At the same time, participants work as a team with collaboration of previous participants.

Each participant makes his/her plan for contents on website with advisors.

Each participant chooses the main subject of internet skills depending on their majors and roles</td></tr>
<tr><td>Over view of e-learning environment and various applications.
(1 week)</td><td>e-learning environment, Internet environment and information education.
Basic multimedia technique:
EXCEL, VISAL BASIC
LEGO Mindstorm
Geometric Construction Tool, Graphing Tool, Computer Algebra System
Adobe Photoshop, Premier for VTR</td></tr>
<tr><td>Developing skills of internet application
(5 weeks)
with textbooks.</td><td>HTML, Java, Java Script
Macromedia Flash, ActionScript
Server management with Linux
Learning Management System (Moodle)</td></tr>
<tr><td rowspan="2"><u>2nd stage</u>
Environment and contents development with applying acquired techniques
(6 months)</td><td>Developing skills depending on each content
(2 months)</td><td>Continuing the development of necessary skills</td><td rowspan="3">Each participant collaborates with people in Bosnia and Herzegovina, and implements experiment on his/her site to confirm how it works</td></tr>
<tr><td>To create e-learning environment and contents development
(4 months)</td><td>to create e-learning contents development through the basic technique in three languages in Bosnia and Herzegovina, and English
Experiment of distance education between Bosnia and Herzegovina, and Japan using the environment</td></tr>
<tr><td><u>3rd stage</u>
Integrating the results and evaluation
(2 months)</td><td>Integrating the results on web site and evaluation</td><td>Presentation of final report
Presentation at academic meeting, college seminar etc.
Evaluating meeting</td></tr>
</table>

The table above is just presenting an outline of activities.
All of the software that we have learned are not mention is this table. Also, big part of our training have been other specific activities such as attending lesson study, conferences, seminars, workshops etc. All of these elements will be explained in detail in the further text.

1.2. Acquired knowledge of different software

During the training, various softwares have been introduced to us, at passive or more active level.

- Macromedia Dreamweaver – in the first stage of the course we were trained how to use this software and accordingly, we developed a personal web-site. This software was introduced to us because we needed to acquire some expertise regarding HTML and web-sites in general.
- Macromedia Flash MX/8 – after learning about Dreamweaver, we started learning about Macromedia Flash. We had a very comprehensive and exhausting approach in learning this software because of our future work was based on it. After two months of learning how to operate in Flash, we started creating our online content in this software. From that point all through our training we were actively using Flash.
- Cabri 2D – during 3 months in the second semester (of Japanese school year), we attended classes at Tsukuba Gakuin University held by professor Kakihana. During this time we were learning about Cabri 2D and the best ways to utilize it
- Cabri 3D – we had demonstrative lessons from one of CRICED staff, Kimiho Chino about Cabri 3D. We learned about some most used features
- Grapes – Grapes is a Function Graphing Software which was developed in Japan by Katsuhisa Tomoda. We had demonstrative lessons about Grapes couple of times by CRICED stuff and we also had the opportunity to meet the developer of the software himself and get a close insight about the software: how to use it, useful ways of utilization, secrets about creation process etc.
- Geometry Inventor – Professor Arcavi from Israel gave us a lecture in March, 2007 and he presented to us Geometry Inventor. We found this software to be very good and easy to use
- Viewlet Builder – for creation of some of our lessons we needed to acquire help from another software: Viewlet Builder a multimedia authoring tool. This software is valuable for creating animated, interactive tutorials and demonstrations quickly and easily
- Moodle – MOODLE is a Modular Object Oriented Dynamic Learning Environment, an open source software which is appropriate for publishing content and it's allowing a monitoring of all the students and their progress through the lessons. We learned about Moodle and we published our content using it.

1.3. Lesson study

Lesson study is a concept originating from Japan and making its way to the other parts of the world. It's a practice of actively monitoring a class held by one teacher and later discuss about it in order to improve it and make teaching more efficient. Throughout our training we had many opportunities to attend different lesson studies and to learn more about good sides of Japanese teaching.

Lesson studies we attended are listed as following:

- November 11, 2006. Tsukuba University Attached Junior High School at Otsuka, Tokyo
- November 17, 2006. Mase Municipal Elementary School at Tsukuba
- November 24, 2006. Tsukuba University Attached Junior and Senior High school Komaba, Tokyo
- December 2, 2006. APEC Conference, Tsukuba University Attached Junior Elementary School at Otsuka, Tokyo
- December 5, 2006. APEC Conference, Hokuto Elementary School, Sapporo
- December 6, 2006. APEC Conference, Maruyama Elementary School, Sapporo
- February 15, 2006. Tsukuba University Attached Junior Elementary School at Otsuka, Tokyo
- May 28, 2006. Kita-Sakado Elementary School, Sakado, Saitama Prefecture
- June 14, 2006. Tsukuba University Attached Junior Elementary School at Otsuka, Tokyo

Some of them will be closely described in the further text.

1.3.1. Lesson study at Tsukuba University Attached Junior High School at Otsuka, Tokyo

On November 11, 2006, we visited Junior High School at Otsuka in eastern part of Tokyo. We arrived in front of the school at 11 AM with our JICA coordinator Okada san who was our guide and interpreter for the day. We registered and got our study materials at the registration desk in the entrance hall of the school. We proceeded to the school gymnasium where we met with professor Isoda and professor Yahara.
Our schedule consisted of two open lessons: a mathematics class and informatics class followed by lesson study and discussion.

This was our first encounter with this way of teaching and this way of thinking about teaching so we had to make an effort to understand the essence and main principles of this approach. The other goal was to try and find the differences between Japanese teaching and the teaching in our country – Bosnia and Herzegovina. The third goal was to comprehend the more the possible so we could implement some elements into our own country's education development.

Mathematics class

Mathematics class was scheduled from 11:20 to 12:10 AM under the guidance of the teacher Naoto Mizutani in the 1st grade of junior high school. The part of the curriculum was proportion and inverse proportion with the topic of applying mathematics to phenomenon in daily life. The teacher presented cylinder shaped test tube and asked the students to imagine it being filled with water to the top and to draw the graph representing that action. The students didn't find this task to be difficult and they completed it successfully in a short time. Then the teacher showed them more complicated object looking like a pool with three steps inside and again asked them to draw a graph representing the filling with water. On our great surprise, the students also finished this task efficiently. One of the students explained to the others the properties of the graph and the whole process in detail. After that, the teacher introduced more complex figure and asked for another graph.

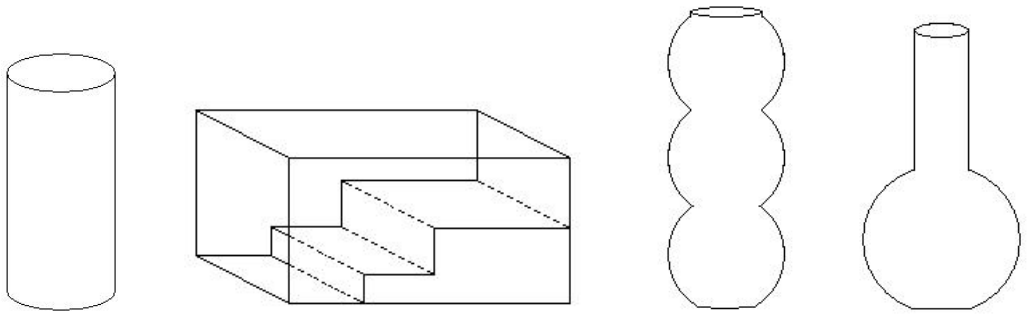

Image 1.3.1.: Tubes and shapes presented to students for thinking about the task

Because this was somewhat more challenging assignment the students were divided into the groups of 3 and were given A3 sheets with coordinate system drown on it to use it for representing their graph. Students had about 10 minutes to consult and agree about the solution. The teacher analyzed the solutions and found out that all of them were in two variants so he drew those two alternatives on the blackboard and asked the students to think again which one is the accurate one. The discussion was developed and while the teacher was slightly leading them in the right direction the students recognized the correct solution. The discussion continued because some students had another approaches to solving the problem and they all involved in reviewing them. At the end, the teacher gave them their homework – drawing a graph for an object, combination of two objects already elaborated.

Informatics class

Informatics class started at 13:10 and finished at 14:00 PM under the guidance of the teacher Jun Samata and he was teaching the 3rd grade students. The topic was 3D referencing in MS Excel. All of the students had their own personal computer in front of them and the professor's computer was connected to the projector so he had the opportunity of demonstrating some actions. The students tried to solve the problem of scoring teams at the school sport event that took place few months ago. The teacher handed out the sheets containing two tables: one with points for each event distributed by the teams and the other one with deduction points for each team through events. The students were supposed to enter the data in two tables on two sheets and then to create a new table containing the final points for each team by using MS Excel's 3D referencing feature. While the students were entering the data and formatting the tables, teacher went around the classroom and gave instructions and offered some help to each student individually. This approach is different then the one we observed in the mathematics class where the teacher addressed the class in whole. This is understandable because in informatics class the students are in front of their computer and have unique pace of work. Because the tables contained a lot of data, some of the students didn't finish their assignment, but all of them saved their file onto the USB memory flash stick and will continue their work in the next class.

Image 1.3.2.: Students discussing about the problem

Discussion

After the classes we joined the lesson study of mathematics class. The discussion was about teacher Mizutani's and teacher Masahiko Sakamoto's class of mathematics held that day. The coordinator of the discussion was Yasushi Suzuki with Professor Masami Isoda as the adviser. About 30 people were present and they all discussed about the above mentioned classes. The issues brought up concerned the conditions of choosing a concrete topic for one class along as what factors to take into consideration when deciding how complicated and difficult the task should be and what example should be the most appropriate according to the given topic and the age of the students. The discussion was pretty detailed going down to the depth of analyzing why did the teacher choose a specific shape and why were the problems introduced in that order. They also explained what their specific goal was for that class, what they were trying to achieve in students thinking and actions. Both of the teachers were giving detailed answers and explained their process of preparing for the class and thinking about their lesson. After that professor Yutaka Oneda talked about government curriculum in junior high school. Professor Masami Isoda continued and gave presentations dealing with the topic of problems with curriculum through the example of geometry class, the existing gap between the teachers and the students and the possible ways of fixing that problem.

Conclusion

The first visit to lesson study was very interesting. Before this, we didn't know anything about lesson study, but after this event, we got a clear image about the whole concept. We understood some basic principles and understood how important is for the teacher to prepare the class very thoroughly and also how important is for him to interact with students the whole time. It is also a necessity for teachers to discuss among themselves about the class and to see the positive effects, but also to acknowledge the negative features and to try to correct them.

When comparing this class to the one in Bosnia and Herzegovina, the first obvious thing that is different is the existence of an equipped classroom. In our country, mathematics classroom doesn't have a computer with projector and it also doesn't have other tools (big poster papers, magnets, little models for children to use etc.) that Japanese teachers are using regularly. Japanese teachers also give more attention to the introduction to the problem, while professors in our country go straight to the problem.

Observing lesson study gave us motivation to introduce some changes in classrooms back home: to use more helping tools while explaining the problem, to give students more time to think about the problem, to discuss with other teachers about the class and the ways to improve it.

1.3.2. Lesson study during APEC Conference at Tsukuba University Attached Junior Elementary School at Otsuka, Tokyo

Two open lessons where organized on December 2, 2006 within APEC Conference.

The task for the teachers was to explain, through different problems, how we can use mathematical thinking and previous knowledge for solving problems. Before class, teachers gave brief explanation which consisted of explaining topic for that day, goals of

the class, their expectations anticipated responses from the pupils. They had to make a detail plan of that lesson including procedures how to actualize all that. The classes were planned for 2nd and 5th grade pupils.
The 2nd grade pupils were guided by Mr. Takao Seiyama. The topic was *Placing Plate* (Unit: *triangles and quadrilaterals*) and his research theme was: *Thinking about lesson that helps faster students' mathematical thinking by connecting numbers and geometry.* Teacher gave to pupils many small triangles (with two and six candies on it) and quadratic (with five candies) shapes. He drew a big hexagon on the blackboard. The task for the pupils was to fit together small shapes and make a shape that matches the large one on the blackboard using as much candies as they can. Pupils had different solutions which they presented in front of the class on the blackboard in the end. The aim was to calculate how many candies they have used by applying multiplication rules they have learned before. The pupils figured out the situation really quickly and had various solutions to the given problem.

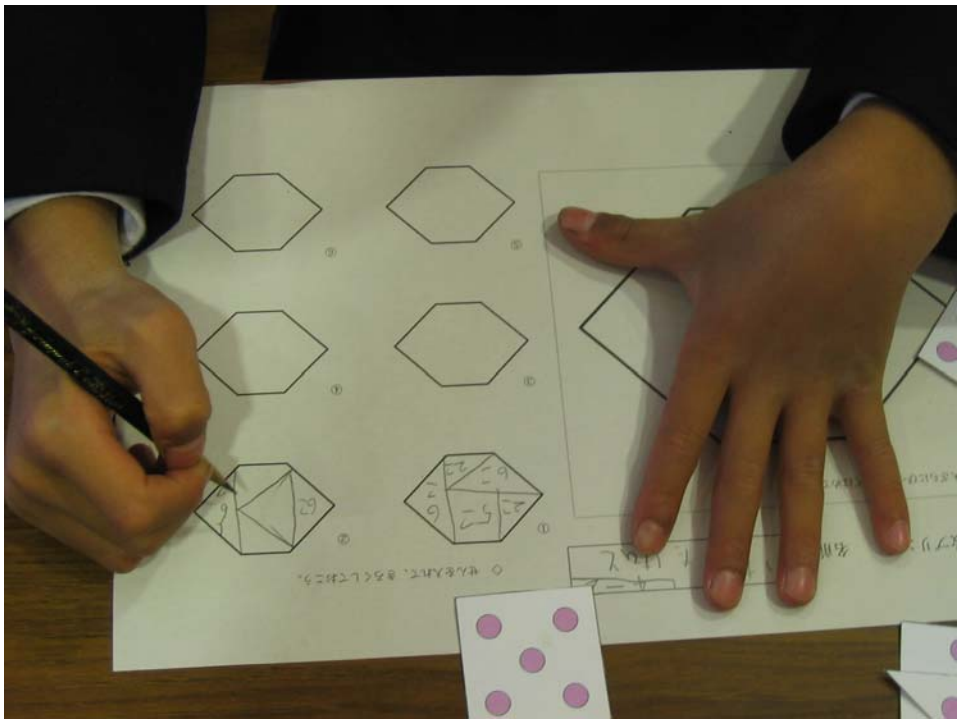

Image 1.3.3.: A student trying to solve the given task

The 5th grade pupils were guided by Mr. Yasuhiro Hosomizu. Topic of this class was *Area of the circle* and his research theme was: *How to develop lessons designed to foster students' secure academic ability through relishing the joy of thinking*. The teacher wanted pupils to find an area of a circle by dividing the circle into sectors and arrange them in to parallelogram or triangle. In this way they could use their previous knowledge to find a formula. The whole class was managed through discussion and it was quite dynamic. Pupils were interested in the problem and they were exchanging ideas between

themselves. At the end they got a formula from by deriving it from formulas of already learned shapes.

Image 1.3.4.: The "full" blackboard after the class

There was a panel discussion about the class at the end of each open class. The panelists were teacher and four members. At the beginning teacher briefly said what he thought about his class and his opinion if he had succeeded in his attentions. After that other members said their opinion and asked teacher some questions like what was the purpose of some examples and generally what did he think how we can use it in our daily life and what are the ways of developing mathematical thinking with that lesson.

1.3.3. Lesson study at Kita-Sakado Elementary School Sakado, Saitama Prefecture

On May 28, 2007, we visited Kita-Sakado Elementary School at Saitama prefecture. The school is situated in a very nice neighborhood at Sakado city. It is quite large facility with big area of sports fields around it and a swimming pool.

The class

At this lesson study we observed third grade students of elementary school. The class was consisted of 25 students and they were under the guidance of the teacher Nabuhiro Ozaki. Study theme was "Thinking about the differences between measurement division

situations and partitive division situations" under the teaching unit of *Division*. The teacher's aim was to introduce the difference between partitive and measurement division. This difference is often very hard for children to comprehend and to notice. He decided to use software called S*chool Presenter*. This is very useful interactive software which is also operated through touch screen so children can be actively involved in the process of problem solving.

The introduction itself of the problem was very interesting. The children saw a big bag on the screen and had to guess how many candies were inside. After process of guessing they got an opportunity to extract the candies (in digital form on the screen) from the bag using *School Presenter*. The teacher explained problem slowly and carefully making sure that all children fully understand. The problem was: We have 12 candies and we're supposed to distribute them to friends so that every friend gets 3 candies.

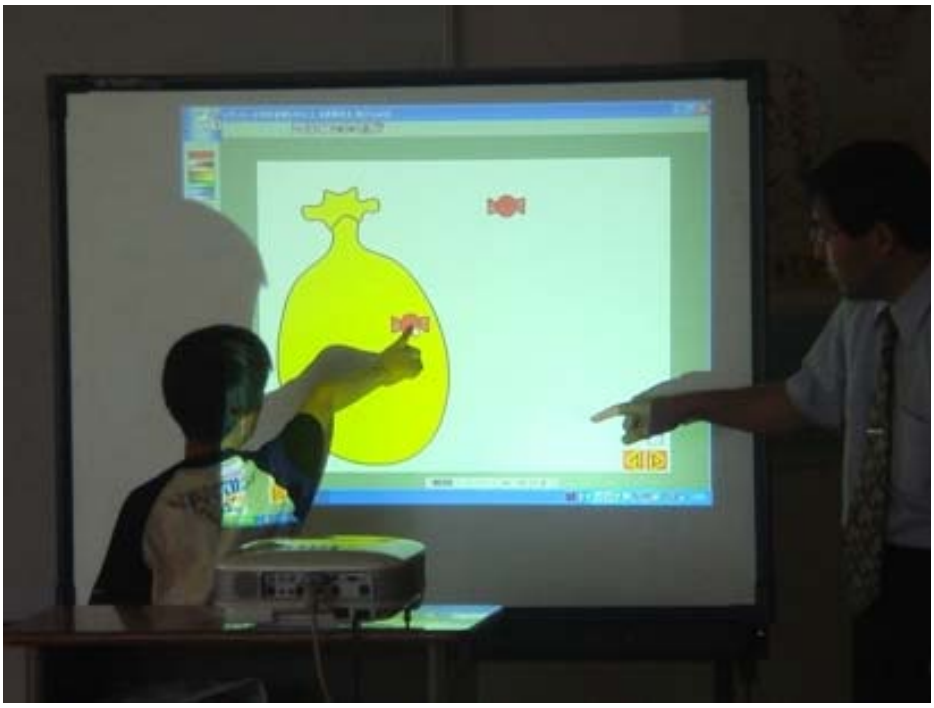

Image 1.3.5.: A student using interactive software School Presenter

All students also got small plastic pieces representing candies and solve the problem by themselves at their classes. After that, 4 students came up to the screen and presented the solution in a digital way so it was very clear to them all that the solution was 4. They needed 4 plates to put all the candies in groups of 3.

They did this solution by taking candies 3 by 3. This was a demonstration of a *measurement division*. After that the teacher rephrased the question: If we have 12 candies and we have to evenly distribute them to 4 people, how many candies would each person get? At the first sight, this seems like the identical example, but it's not. In this example candies are distributed one by one to each person until we finally reach the solution 3. This was a demonstration of *partitive division*.

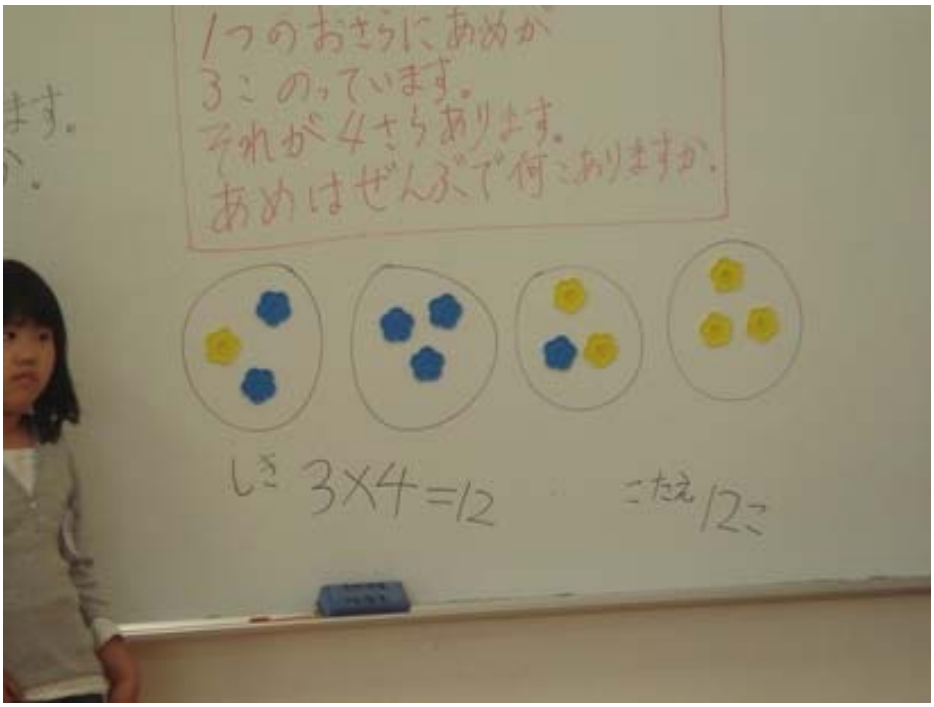

Image 1.3.6.: Student volunteering for solving a task

In these two very simple examples teacher managed to display two types of division and district difference between them.

Discussion

After the class discussion was started. Ten participants around the table talked and discussed with teacher Mr. Nabuhiro Ozaki. He answered the questions in a good manner and gave everyone very robust explanations about the given subject and the class observed.

Image 1.3.7.: Teacher explaining his approach

Followed after, some what more then hour of, questions and answers part, was a small break and then professor Isoda gave a long comment.
Some of point he made were:

- children solved the problem using the things they had already learned and through this example they gained some new knowledge which will be useful for them in the future
- it is very important to perceive the difference between two types of division because both of them have a good usage in other problems (division with remainders Euclidean algorithm etc)
- there are 3 major targets of numbers and calculations
    - meaning of calculation
    - considering the way how to calculate
    - acquiring better and fluent skills

and at the observed class, the first target was achieved and it would have been even better if the second target was achieved as well

- it is very laudable that the teacher used software such as *School Presenter* because in that way even those students that are not so talkative and that are not so good at saying their opinion could express themselves by showing the solution on the screen (precondition is that they how to operate the software).

1.3.4. Concluding observations about lesson study

Our encounters with this philosophy of teaching generated some very positive effects. It was delighting to see teachers and students work on such interactive level. The one thing that lesson study implies is the existence of an equipped classroom. The mathematics classrooms are usually equipped with one computer with projector and with different objects which helped the teacher to introduce the problem in a visual way and, in that way, motivate the students to think about the problem. Informatics classrooms are usually equipped with one computer per student. This part concerning equipped classroom would be very hard to achieve in our country but the thing teachers can do is the part coming after – the lesson study itself. This activity requires no equipment and it's just up to the teachers to use the existing equipment and get actively involved in the process and try discussing their methods. In this way, every teacher can improve the class and also can get useful comments and remarks about the class and the way of teaching.
We learned a lot about Japanese teaching methods and we're planning on introducing them to our country in order to improve the teaching process.

1.4. Seminars, conferences and workshops

In order to learn as much as possible and to collect as many useful information as we can, we attended various conferences, seminars, special lectures, workshops etc. All of them were very instructive and illuminating in their own way and offered us new viewpoints and helped us broaden our horizons.

Our involvement and participation is listed as following:

- December 2, 2006 — Symposium to promote outstanding student
- December 2-7, 2006 — APEC Conference, Tokyo and Sapporo
- January 16, 2007 — International Symposium, Tokyo
- February 15, 2007 — Professor Tomoda's seminar, Osaka
- March , 2007 — Professor Arcavi's seminar, Tsukuba
- March, 2007 — 3rd Bosnia and Herzegovina Workshop in Mathematics and Informatics Education
- June 21, 2007 — Bosnia and Herzegovina Seminar in Informatics Curriculum
- June 30-July 4, 2007 — 5th Bosnia and Herzegovina Seminar in Mathematics and Informatics Education
- August 15-19, 2007 — Annual Meeting of JSSE, Sapporo

1.4.1. Symposium

On December 2, 2006, we attended the Symposium to promote outstanding student. After official opening, we heard some information and interesting details about educational systems in Bulgaria, Vietnam and China. It's worth mentioning that Bulgaria is one of top countries when considering mathematical achievements in education. After the presentations the discussion was developed with an aim of trying to determine the best way of raising students with talent in mathematics. Different strategies were revised and some suggestions of what to improve were presented. Everybody agreed that it's not just the problem between teachers and students, it's also a government problem. Government has to understand teachers and pupils, their feelings and position and it ought to give them support. On the other hand the teachers should give answer why mathematics is so important in our life and how we can use it in our daily life.

Image 1.4.1.: Jelena and Jovana with Okada san, the interpreter

1.4.2. APEC Conference

On our great pleasure, the opportunity of attending "APEC TSUKUBA International Conference - Innovative Teaching Mathematics Through Lesson Study II" was given to us. This conference is the part of a bigger, four year long project. The project and the meetings are all in the duty of improving APEC economies' welfare. This particular event was organized by CRICED with focusing on mathematical thinking, the theme for this year. It took place in Tokyo (two days) and Sapporo (4 days) from December 2 to December 7. The conference included symposiums, open lessons, lesson studies, lectures and presentations and it was attended by lecturers, specialist and observers from different

countries: Japan, China, Hong Kong, Korea, Thailand, UK, USA, Australia, Indonesia, Malaysia, Philippines, Singapore, Brunei, Taiwan, Vietnam and Mexico. This event gave us the chance to hear various experiences from different educational systems and to comprehend and understand some modern mathematical ideas and up to date reflections about mathematical thinking.
On the first day, two open lessons where planned. There was a panel discussion about the class at the end of each open class.
On the second day of International Conference we attended lectures and presentation part. The ceremony was opened by Yutaka Takenaka - Vise president of the University of Tsukuba, Japan. After that, we heard some greeting lines from Yukitsuku Ono – Deputy Director, International Affairs Division, Minister's Secretariat, Ministry of Education, Culture, Sports, Science and Technology, Japan, Shinichi Ishihara – Team Reader on Basic Education in human Development, SICA, Japan and Shizumi Shimizu – Vice President of Japan Society of Mathematics Education, Japan. All of them were introduced by Professor Masami Isoda, Center for Research on International Cooperation in Educational Development, University of Tsukuba, Japan.

Image 1.4.2.: Presentation part of the conference

Lectures and presentation part followed after the opening ceremony. Chairman of the first session was Marcela Santilian, National Pedagogical University of Mexico, Mexico who greeted the participants and introduced the first keynote speaker Kaye Stacey, Faculty of Education – Science and Mathematics Education, University of Melbourne, Australia. She held the presentation on the subject *What is mathematical thinking and why is it important?* The second session was monitored by chairman Shangzi Wang, Capital

Normal University, China and the second keynote speaker was David Tall, University of Warwick, UK. Subject of his presentation was *Encouraging Mathematical Thinking with Power & Simplicity*. The third session was guided by Suladda Loipha, Dean, Faculty of Education, Khon Kaen University, Thailand who introduced third keynote lecture Fou-Lai Lin from National Taiwan Normal University, Department of Mathematics, Taiwan and his subject was *Designing Mathematics Conjecturing Activities to Foster Thinking and Constructing Actively*. After the lunch break other lectures continued with their presentations. The presentations were followed by open discussion with Patsy Wang-Iverson from Gabriella and Paul Rosenbaum Foundation, USA at chair. The panelists were lecturers from that day although all of the audience got included and everybody shared their opinions. The official part of the conference for that day was closed by taking the picture of all of the specialists.

On the third day, the conference was moved to Sapporo on Hokkaido, the north island of Japan so the schedule for that day was brief. Sapporo open symposium was opened by the chairman Mr. Kazuyoshi Okubo from Hokkaido University of Education. The audience was also greeted by Mr. Takashi Tanaka, Deputy Director of JICA Sapporo. The key speaker for that day was Professor Shigeo Katagiri, Emeritus President, Society of Elementary Mathematics Education, Japan. The topic for that lecture was *Mathematical Thinking and How to Teach it*.

Our fourth day started with a brief presentation from Ben-Har Yeap explaining about APEC Lesson Study Project. He explained about the vision of the project, target for year one and what the specialists are expected to do by the next meeting. The participants and observants were divided into four groups and all groups were suppose to discuss and try to give answers on 4 questions related to mathematical thinking. Each group had to make a presentation of answers that they concluded. The group discussion lasted until lunch. That was only the first part of group work which is to be continued the next day. After lunch, all of the participants, including us, went to the Sapporo City Hokuto Elementary School.

Image 1.4.3.: Jelena Brkic in her work group

Image 1.4.4.: Jovana Stojcic in her work group

On fifth day the group work was continued. Every group tried to give answers to the four questions from the day before and make a brief presentation (about 5 minutes) with conclusions. Questions were hard so neither group answered on all of the questions.

Some of the groups were discussing mainly about one or two questions, some gave their opinion through example and some gave generally statements. Every group presented their work and all of those conclusions made a nice and rounded picture of topics discussed during the conference. After presentations we visited Sapporo City Maruyama Elementary School.
December 7 was the last day of the APEC conference. The schedule only included some work before noon because the travel back to Tokyo was planned in the afternoon. Some explanations were offered about the next meeting of the specialists. Professor Masami Isoda gave the final speech thanking everyone and wishing them lot of success in future work until the next meeting.
This whole conference has been one overwhelming experience. It was first time for both of us to get actively involved in the conference program and we liked it very much. Although we already had a chance to observe open class and lesson study, this was the first time we could discuss with others about it.
All of the lectures gave us a new insight to the definition of mathematical thinking, new understanding of class of mathematics and the refreshing view on mathematics altogether. Many reflections will stay in our minds and hopefully we'll be able to introduce some of these ideas to our country too.

Image 1.4.5.: All participants of the conference

1.4.3. International symposium Tokyo

International Cooperation Project towards the Endegenous Development of Mathematics Education – International Cooperation in Education Symposium 2007 was held on January 14th, 2007 at JICA Institute for International Cooperation (IFIC), Tokyo. The symposium was organized by CRICED (Center for Research on International Cooperation in Educational Development) - University of Tsukuba, IDEC (International Development and Cooperation) – University of Hiroshima and Graduate School of Education from University of Hiroshima. The project was also supported by JICA (Japanese International Cooperation Agency) and MEXT (Ministry of Education, Culture, Sports, Science and Technology).
Professor Masami Isoda (CRICED) was the chairperson and he opened the symposium. He welcomed the participants and the observers and introduced the organizations that were involved in this project. He also explained that this is the presentation of a project that had been going on for three years.

Image 1.4.6.: Three participants at the Symposium

Keynote speaker Prof. Norma Presmeg (Illinois State University) was introduced by Takuya Baba. She was speaking how culture and society are connected, she gave some definitions of mathematics and she was also speaking about was ethnomathematics.
The second part of the symposium was consisted of presentations of Country Reports. The chairperson was Mr. Satoshi Nakamura (Hiroshima University) who greeted the audience and presented Mr. Takuya Baba who explained the framework of the research that has been going on and that this symposium is product of. The research included 6 countries: Philippines, China, Thailand, Bangladesh, Ghana and Zambia. The goal was and still is to establish a professional and long term relationship among the participating countries in the filed of mathematics education.

After all of the presentations, it was time for the panel dicussion.
The final part of the symposium was the activity report of international cooperation from each university.

1.4.4. Professor Tomoda's seminar, Osaka

During our stay in Osaka, on February 20, we had the opportunity to go to Ikeda Senior High School Attached to Osaka Kyoiku University and meet high school teacher Katsuhisa Tomoda. We already knew him by his name because he is a developer of Grapes - Function Graphing Software. We met with him and with the vise principal of the school. We had an introductory session where we heard some information about the school and its activities. We also got some promotional material about the school and about Grapes. Then we moved to informatics classroom where the software was presented to us by the creator himself. He demonstrated us some useful examples, some examples that are related to everyday problems and hence, are easier for children to understand. We got the opportunity to ask questions about the flow of development of the software, how did the idea involve and other interesting questions. We found Grapes to be software with great potential and a good candidate for utilization in the classroom in our country also.

Image 1.4.7.: Teacher Tomoda demonstrating his software

1.4.5. Professor Arcavi's seminar

On March 20, we were given a big opportunity to receive a lecture from Professor Abraham Arcavi from Israel. He is a mathematics professor at Weizmann Institute of Science in Israel. With him, we discussed about potentials of using computers while teaching mathematics. He showed us some very convincing cases how computers improve the teaching process. He also demonstrated some interesting examples in the form of playing with numbers. Professor demonstrated a software he likes to use: Geometry Inventor. It's a "very easy to use" geometric software which can really assist the teacher to present the lesson as better as possible. This lecture we received was very helpful to us. It helped us with considering some new views on modern mathematics teaching.

1.4.6. 3rd B&H Workshop in Mathematics and Informatics Education

The participants from the last year's course: Olivera Banjac, Nadia Bouz-Asal and Anton Vrdoljak came to visit in March. They were here for five days and during that time we had many obligations to fulfill:

- to present our content and to get suggestions and ideas from last year's participants
- to see their progress after Japan
- to discuss how to promote our content in Bosnia and Herzegovina
- to find a way to continue this project in our country and to spread the positive effects of our training

On March 22 we all went to visit Bosnia and Herzegovina embassy in Tokyo. It was very nice to meet the ambassador and his deputy and to discuss about our work as well about our homeland.

On March 23 we had a whole day workshop titled *3rd Bosnia and Herzegovina Workshop in Mathematics and Informatics Education*. First the last year's participants presented their work and progress after leaving Japan. After them, we presented our content. They were positively surprised to see how much we have created. All of this was organized in the presence of professors Masami Isoda, Kyoko Kakihana and other CRICED staff.

Image 1.4.8.: Trainees from two generations

On March 24 we had a cultural trip and we all went to Kamakura to see a Great Buddha statue. We try to, on every occasion we get, to broaden our knowledge of Japanese culture and history so this trip to Kamakura, important historical place with many temples and shrines, was a big bonus for us.
During all of this time we discussed about continuation of the project and our joint work. We decided to ask JICA for help, but in any case we decided to continue our collaboration in Bosnia and Herzegovina and create a network of people who had the benefit of living and learning in Japan.

Image 1.4.9.: All participants of the workshop

1.4.7. 4th Bosnia and Herzegovina Seminar in Informatics Curriculum

On June 20, we had another group of visitors from Bosnia and Herzegovina that are involved in another JICA project. Their project is related to reforms in Informatics curriculum for High Schools in B&H, currently focused on one school in town of Mostar. Because our areas of interest are entwined, we decided to have a one day seminar to discuss a possible collaboration.
There were more objectives to this seminar:

- to reflect improvement of the Informatics curriculum in Mostar based on organizing its tasks.
- to propose a plan of training of (in-service) informatics teachers in B&H except as teachers in "Gimnazija Mostar".
- to forge a framework of cooperation in B&H regarding Informatics curriculum through discussion on the support system to this project.

The schedule of the seminar:

9:20- 9:50 Question & Discussion the status of Informatics Education in B&H

9:50-12:00 Workshop on Learning Management System "*Moodle*"
Workshop
Main lecturer：Hiroki Yahara

12:00-13:30 Lunch (The University hall)
13:30-14:00 The e-learning Contents with ICT in Informatics
Presenter：Ms. Jelena BRKIC (in Croatian Language)
14:00-16:10 Lecture & Discussion on training of (in-service) teachers in Japan
Lecture：Kyoko Kakihana

16:10-16:40 Discussion on mutual assistance and cooperation

In the first part, everybody introduced themselves and their current working positions and experience.
During the workshop Professor Yahara demonstrated Moodle to them. They were nicely surprised because they haven't encountered this kind of management system before. We all worked together and created some online test just to get a feeling how Moodle operates.

Image 1.4.10.: Professor Yahara explaining about Moodle

In the second part Jelena Brkic demonstrated created online content from Informatics. They were not aware of existence of this content so they were delighted with it and they have promised that they will try to promote it in our country.

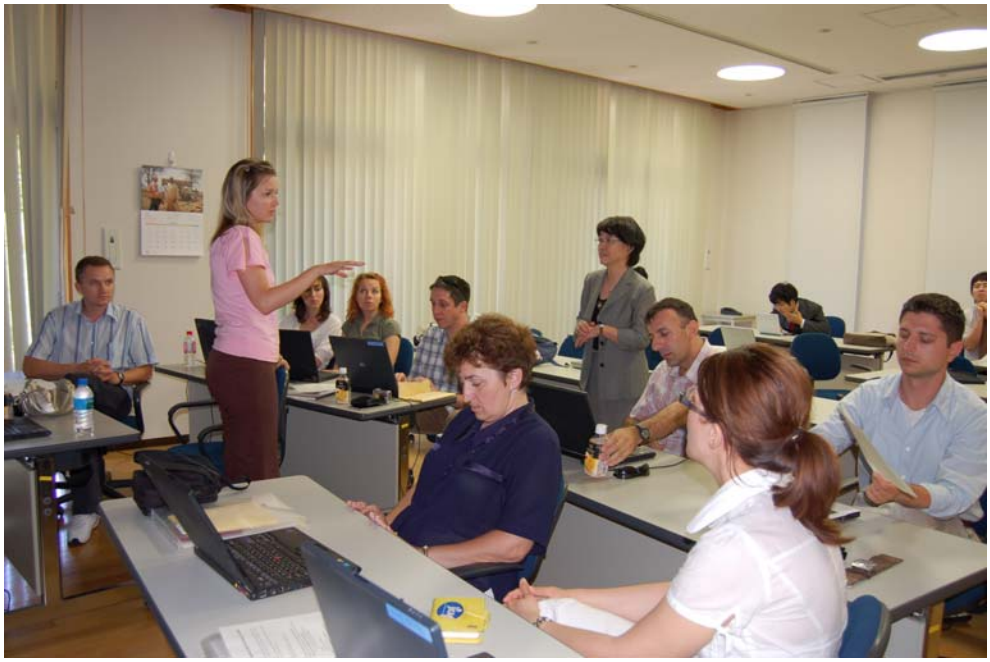

Image 1.4.11.: Jelena Brkic giving presentation about Informatics content

After that Professor Kakihana gave a lecture about training of teachers in Japan and what are the obligations and responsibilities of every teacher.

Image 1.4.12. Professor Kakihana giving presentation

In the last part, we sat down as one big work group and tried to find some way of collaboration and some way to introduce our created online content into classrooms of Bosnia and Herzegovina. We also discussed about some greater educational problems that exist in our country and the ways to improve the current situation. The problems that we are facing are mainly related to the existence of three different curriculums which is producing whole new specter of problems: problems in harmonizing them, problems in which language to use, dispersed control over system due to the presence of many pedagogical institutes, ministries of education etc. The other issue is bad economical situation in our country which is resulting in low income for teachers thus making them less motivated for improvement of their teaching. Bureaucracy procedure is also causing many problems because anyone trying to introduce some change is encountered with them. These problems are discouraging and making most of the people just to give up from trying. We are aware of the fact that as individuals we cannot make much progress, but if join our forces, we can start making some reforms in education.

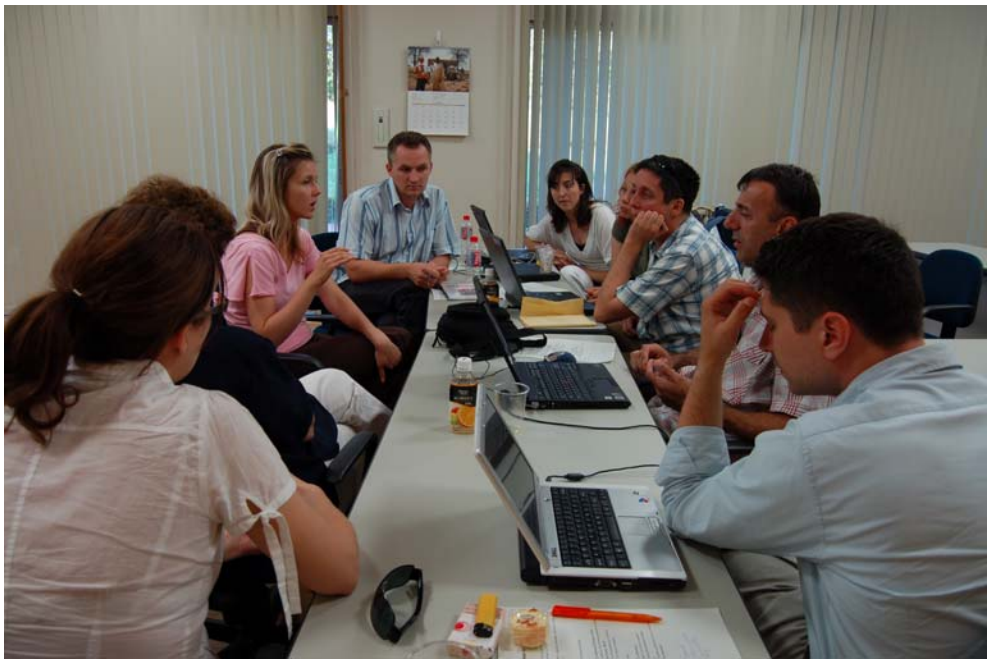

Image 1.4.13.: Discussion part

1.4.8. 5th Bosnia and Herzegovina Seminar in Mathematics and Informatics Education

In order to discuss academic collaboration between two countries, professors from Bosnia and Herzegovina universities came to Japan. Four professors came: two from Mostar University: Brano Markic and Drazena Tomic, one from Sarajevo University: Mirjana

Vukovic and one from Banja Luka University: Vladimir Jovanovic. They stayed from June 28 to July 4.
During this time, we had one day workshop where professors introduced their universities and current status of mathematics and informatics education in Bosnia and Herzegovina. We introduced our work in Japan, all of our activities, acquired knowledge and created content. The professors didn't have the chance to see our content before so they were positively surprised.
Professors also spent some time discussing with Tsukuba University Professor Masami Isoda about future collaboration between universities. Banja Luka University already has a contract with Tsukuba University so the discussion was aimed at two other universities and their willingness for cooperation.

Image 1.4.14.: Professor Isoda in discussion with Bosnia and Herzegovina professors

We had a meeting in CRICED office in Tokyo where we all met Professor Kakihana who was unable to meet us in Tsukuba. All of us also discussed about possible cooperation and ideas for the continuation of the project.
All of us also paid visit to Bosnia and Herzegovina embassy in Tokyo. The professors were introduced to the ambassador and we all discussed about current project and the ambassador expressed his support for any kind of help we need with the project.
In the end, it is worth mentioning that CRICED stuff organized a welcome party in a traditional Japanese restaurant which was a delighting experience for professors, but also for us.

Image 1.4.15.: Japanese and Bosnia and Herzegovina professors

1.4.9. JSSE Annual Meeting

Another conference we're going to attend is JSSE (Japanese Society for Science Education) Annual Meeting in Sapporo from August 17 to August 19. Title of this meeting is *Turning Point of Science Education*. This time we are not going just as observers, we are going as authors and presenters of papers. All three of us, current trainees, wrote the papers in collaboration with other CRICED staff members. These papers are available in the appendix part of this report.

1.5. Study trips

We had three study trips during our training:

- December 2006 — Tokyo, Sapporo
- February 2007 — Osaka, Kyoto, Nara, Kobe
- August 2007 — Sapporo

1.5.1. Study trip to Tokyo and Sapporo

This study trip has been organized in order for us to participate in APEC International Conference. During this study trip we attended lessons studies, presentation meetings, work groups etc. Our activities during the conference have already been described in previous chapters.
By this time, the third participant, Mirjana Milijevic, hadn't arrived yet so it was just Jelena Brkic and Jovana Stojcic going to Sapporo. In Sapporo we saw our first and last snow in Japan. We took advantage of the nice winter weather as much as we could.

Image 1.5.1.: In the Sapporo snow

We also had the opportunity to go to the famous Sapporo Beer Factory one evening and to enjoy with other participants from the conference.

Image 1.5.2.: In the Sapporo Beer Factory

We were also very thrilled because we visited another great historical site. Professor Isoda took us and Professor Kaye Stacey to the spot for ski jumps where the Olympic Games took place in 1972.

Image 1.5.3.: At the Olympic site with Professor Isoda and Professor Stacey

1.5.2. Study trip to Osaka, Kyoto, Nara and Kobe

This study trip lasted from February 19 to February 25.
On the first day, we took a shinkansen to get to Osaka where our accommodation was. This was our first time to ride in this high tech product of Japan. The ride itself was very comfortable and enjoyable. We spent almost the whole day traveling so when we finally got to Osaka we just had time to settle in our rooms.
On the second day we visited Ikeda Senior High School attached to Osaka Kyoiku University. This visit has already been explained in the previous chapter.
On the third day we went to Tenri to visit a Sharp Laboratory. Especially interesting for us were the Memorial hall, where we could see the development of Sharp products, and Technology Hall, where we observed the highest achievements today. It is always a great experience for us to visit this kind of facilities because we get to see the best of Japan and to see all the modern achievements that we can only read about. After visiting this laboratory, we arranged a cultural trip to Nara, a great historical site.

Image 1.5.4.: Exploring Memorial Hall of Sharp Laboratory

On the fourth day we stayed in Osaka and visited a Panasonic Center which is quite overwhelming with all the new Panasonic products which are free for visitors to try out or test.

Image 1.5.5.: Mirjana Milijevic in front of the Panasonic Center in Osaka

After that we went to Kyoto and visited many shrines. Of course, the one that made the biggest impression is Golden Pavilion.

Image 1.5.6.: Three trainees in front of Golden Pavilion

On the fifth day, we had the opportunity to visit NTT Science and Core Technology Laboratory Group. The Laboratory employees gave us two lectures explaining their work and the newest achievements. They explained the mission of their group and how they are trying to use computers to process natural languages. They also did a presentation about cryptography and what are they doing to protect the information. They also did a demonstration of one method of cryptography and they used us for it. It was very interesting to understand something like this on a simple example.

Image 1.5.7.: Three trainees actively involved in demonstration by NTT Science Laboratory employees

On the sixth day, a cultural trip to Kobe was organized. The main purpose was to visit an earthquake museum and to understand what this city has suffered. This museum was built after the great earthquake in 1995 and it's showing all the facts about that event in a realistic manner.
On the final day it was time to pack and leave this beautiful part of Japan. We took another shinkansen ride (and our last) and headed back to Tsukuba. On our way back, as we were riding, we had our first sighting of Mt. Fuji.

1.5.3. Study trip to Hokkaido

From August 16 to 19 we will have another opportunity to visit north island of Japan. This time we are attending JSSE conference in Sapporo which is explained in the chapter about conferences. We hope to meet many prominent people from Japanese science circles and to make some good contacts. The other papers should be a good insight for us to see the current flows in Japanese science. We also hope we'll manage to go on some cultural trips to visit this beautiful city's sites because on our last trip Mirjana Milijevic wasn't with us and it would be very nice for her to discover the beauties of Sapporo.

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

In the 2nd stage of the training course, the participants started creating e-learning environment. E-learning is a concept that carries a lot of potential, but only if it's implemented in an efficient way. It should be more than just another way of delivering information to students with inserting a couple of simple animations. It should be environment developed in highly interactive way allowing students to receive knowledge, develop creative thinking and reasoning skills. For better fulfillment of these conditions and for developing more robust online content, software Macromedia Flash MX was used. This is currently the best choice because this software is considered to be a leader in creating various online elements and it's moving from being just a tool for animations, that are inserted in HTML websites, to a tool for developing complete websites which are modern, interactive, interesting and attract more attention. There are more specific reasons why Macromedia Flash was used:

- diversity – allowing the use of different graphical tools along with applying programming for complex tasks, suitable for all elements from small animations to whole web-sites with high level of dynamics
- presence – flash player has become a necessity for a computer user, approximately 96% of all web browsers have Flash Player installed
- suitable for any bandwidth – Flash player is suitable for any kind of bandwidth because of more than one reason: it uses vector based graphics allowing efficient storage of the images; it has a high-performance compression facility enables Flash files to run quickly; multimedia components are downloaded partially when needed so the bandwidth is not wasted on elements that are not used
- platform independent – Flash files are standalone and they don't have problems with running on any platform
- easiness of usage – the software itself is very easy to use with lots of beneficial features: user-friendly interface, variety of templates (quizzes, presentations, photo slideshows etc.), pre-built components (checkboxes, combo boxes, push buttons, scroll bars etc.)

Three participants developed content from three areas: Mathematics content for elementary school level, Mathematics content for secondary school level and Informatics content for secondary school level. All of these contents are presented in the next three chapters.

2.1 Mathematics contents for elementary school level[1]

The topics below have been developed for elementary schools:

- Operations in the set of numbers 1 – 100,
- Fractions,
- Angles,
- Sets.

The topics have been developed in English language and in Bosnian language.
In this subchapter we will discuss more about sets.
The main goal in developing this topic was to make an interesting educational content different from the content that we can find in the textbooks. The goal was also to connect sets with some topics in mathematics such as geometry, inequalities and number theory. Connection is motivation for the learning.

2.1.1 Background and purpose of sets

Set is one of the basic terms in mathematics and it is the starting point in developing of many mathematical fields. In elementary schools in Bosnia and Herzegovina sets are studied at the beginning of fifth grade or sixth grade depending on the curriculum. Teaching the topic in schools causes many problems, especially when teachers try to explain what is set. In textbooks students can only read that set is a basic term in mathematics which we don't define. Almost all teachers teach mathematical contents as appeared in the textbooks. For students set becomes an abstract concept and they lose interest in the topic.
The topic is adequate for visual representation and explanation through animations in which elements from one set moves to another and in which students can drag elements of the sets or sets, with the mouse. This way of learning is very interesting for the students and interesting educational contents is motivation for learning.

2.1.2 The structure of contents

Contents about sets are consisted of two parts:

- Lessons,
- Interactive lessons.

Lessons

This part of the contents is written in informal way. It begins with the figure on which we have 14 geometrical objects of different colors. Then there is an explanation about how

[1] Mirjana Milijevic, Electrotechnical High School, Prijedor, Bosnia and Herzegovina

we can put those objects into sets according to some property that they have. There is also an explanation about the way of representation of sets (Venn diagrams, by listing of its elements between braces, by writing of some property that all of its elements have), about the elements of sets, subsets of the sets, empty set and about the cardinality of the sets.

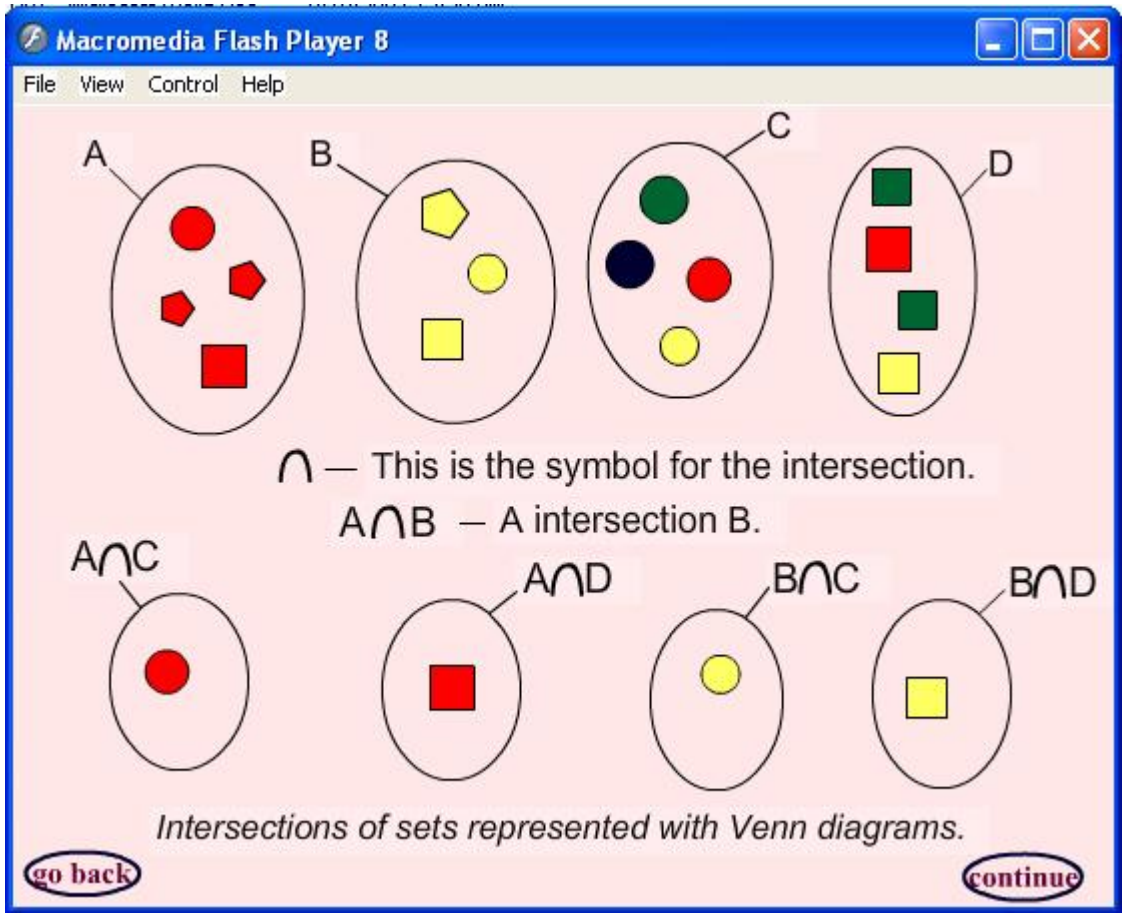

Figure 2.1.1.: Explanation about the intersection of sets

Operations with sets are also explained with 14 geometrical objects, when they are elements of the intersection, union, difference or symmetric difference of the sets. Disjoint sets, complement of the set, power set and Descartesian product of the sets are also explained.

Interactive lessons

In this part four exercises are given. Each exercise is composed of ten tasks.

In the first exercise five sets are given, A is set of books, B is set of green colored books, C is set of red colored books, D is set of books that are on the desk and E is set of books that are in the bag. The task for the students is to write precisely the meaning of the given

expressions such as B∩D, C∩D, D∩E etc. Students should write their answers into the marked fields. After inputting the answer students can check the correctness of their answer by clicking on the given button "Check". If the answer is not correct students should click on the button "See the correct answer" where the correct answer together with animation is provided. If the answer is correct students can continue with the exercise by clicking on the button "Continue" which is provided after inputting of the correct answer. After 6^{th} task in which expression A∩B is given, question "Why in this task we didn't write that A∩B is the set of books and of green colored books?" is given. On this point students can choose options "I know the answer" and "Still thinking". Option "I know the answer" provides an extra exercise in which five possible answers to the question above are given. Students should click on the buttons "Correct" or "Not correct" according to their opinion. After successfully completing the exercise students can pass to the exercise no.2 without solving tasks that are left in the exercise no. 1. Option "Still thinking" returns student to the beginning of the exercise no.1. In this extra exercise students should conclude that B is a subset of the set A, and also learn that there are equivalent conditions to the fact that B is a subset of the set A, such as that A union B equals A, that A intersection B equals B etc. Similar extra exercise is provided after 8^{th} task in which expression "A union D" is given. Here students should conclude that D is a subset of the set A and also learn about equivalent conditions such as that A union D equals A. At the beginning of the exercise no. 1 button "See definitions of union and intersection" is given. By clicking this button students can see the precise definitions of union and intersection together with animations. After completion of ten tasks in the exercise no. 1 students can pass to the exercise no. 2.

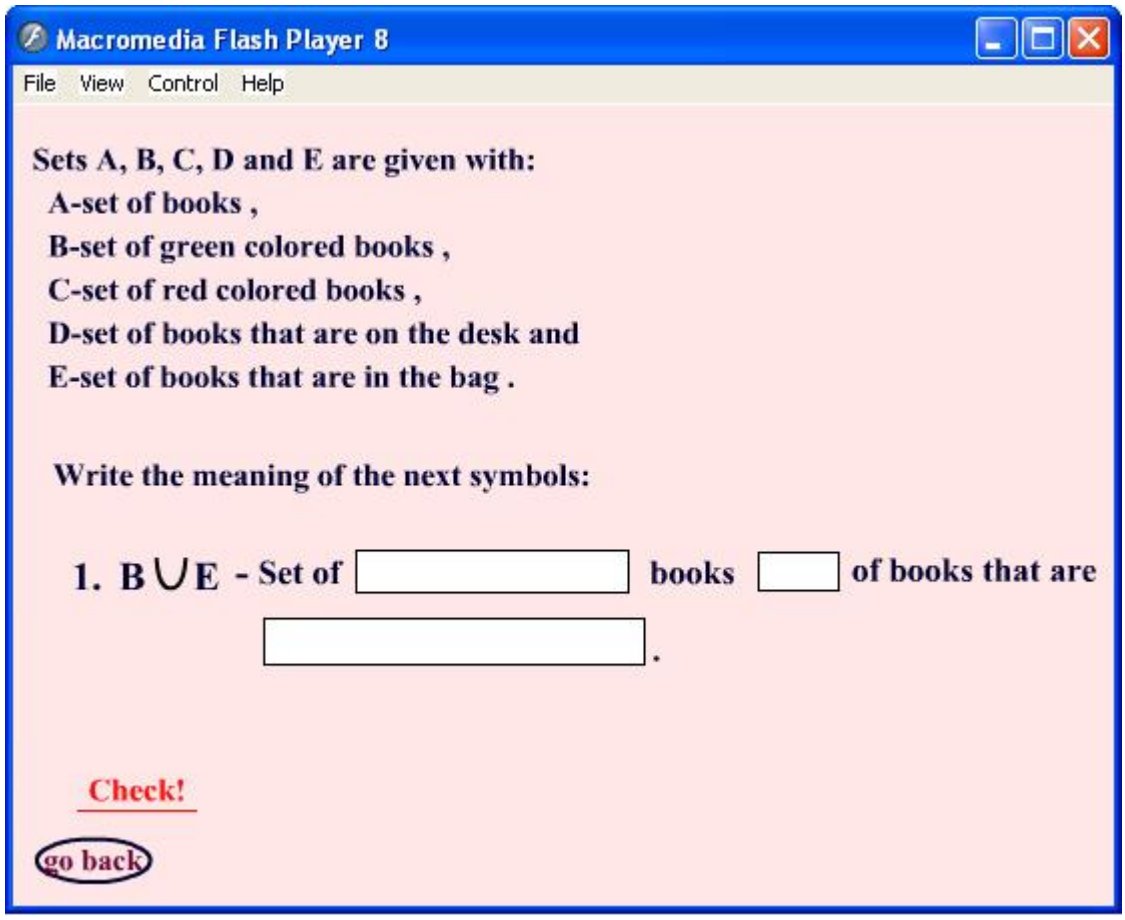

Figure 2.1.2.: Students should write the meaning of the symbol for the union of sets B and E

Goal of this exercise is for the students to realize and learn that there is a connection between logical operations and operations with sets: union is equivalent to logical "or", intersection is equivalent to logical "and" etc.

In the second exercise the task is for the students to associate given Venn diagrams with adequate algebraic expressions. Exercise consists of five pages, on each page there are two yellow marked fields and six Venn diagrams. Students should choose only two Venn diagrams and drag them with the mouse into marked fields above which algebraic expressions are given. After putting diagrams into marked fields students can check the correctness of their association by clicking on the given button "Check". If the association was correct the button "Continue" is provided, by clicking on it students can pass to another page of the exercise. If the association wasn't correct, animation which shows the correct association is provided. Also at the beginning of this exercise the button "See definitions of union and intersection" is given. After successfully completed exercise students can pass to the exercise no. 3.

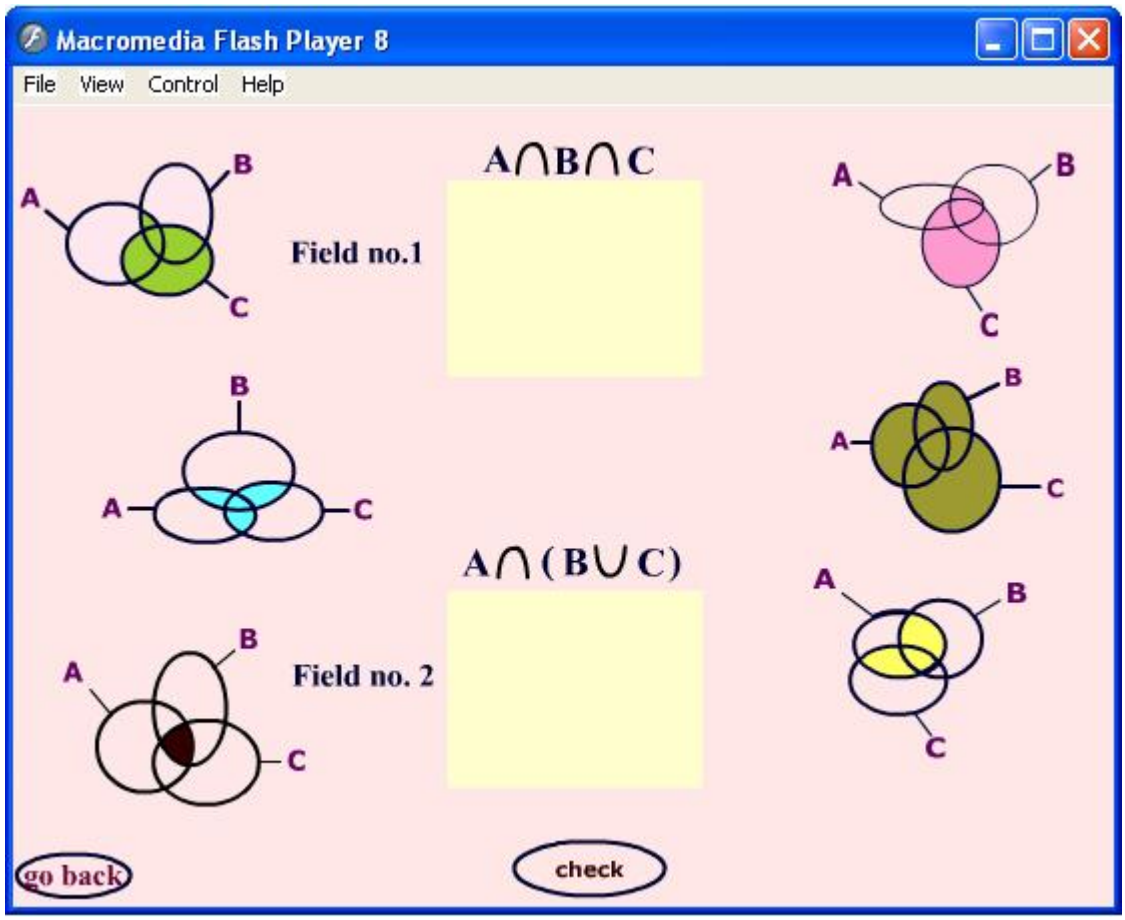

Figure 2.1.3.: Students should find the adequate diagrams and put them into the fields

Goal of the exercise no. 2 is for the students to realize and learn that there is a connection between Venn diagrams and algebraic expressions.
In the third exercise 23 polygons are given, students should put these polygons into the given sets according to some criteria such as number of sides and color. In some examples, figure with three empty sets (A, B, C) is provided and students should put, for example, into the set A concave polygons, into the set B yellow colored polygons and into the set C polygons with five sides. Here students should be careful about which polygons to put into intersection part of these sets. Also in this exercise the button "Check" is given after each example, with provided animation about the correct solution in the case that students didn't put polygons into adequate sets. In this exercise the definition of convex and concave polygons is given.

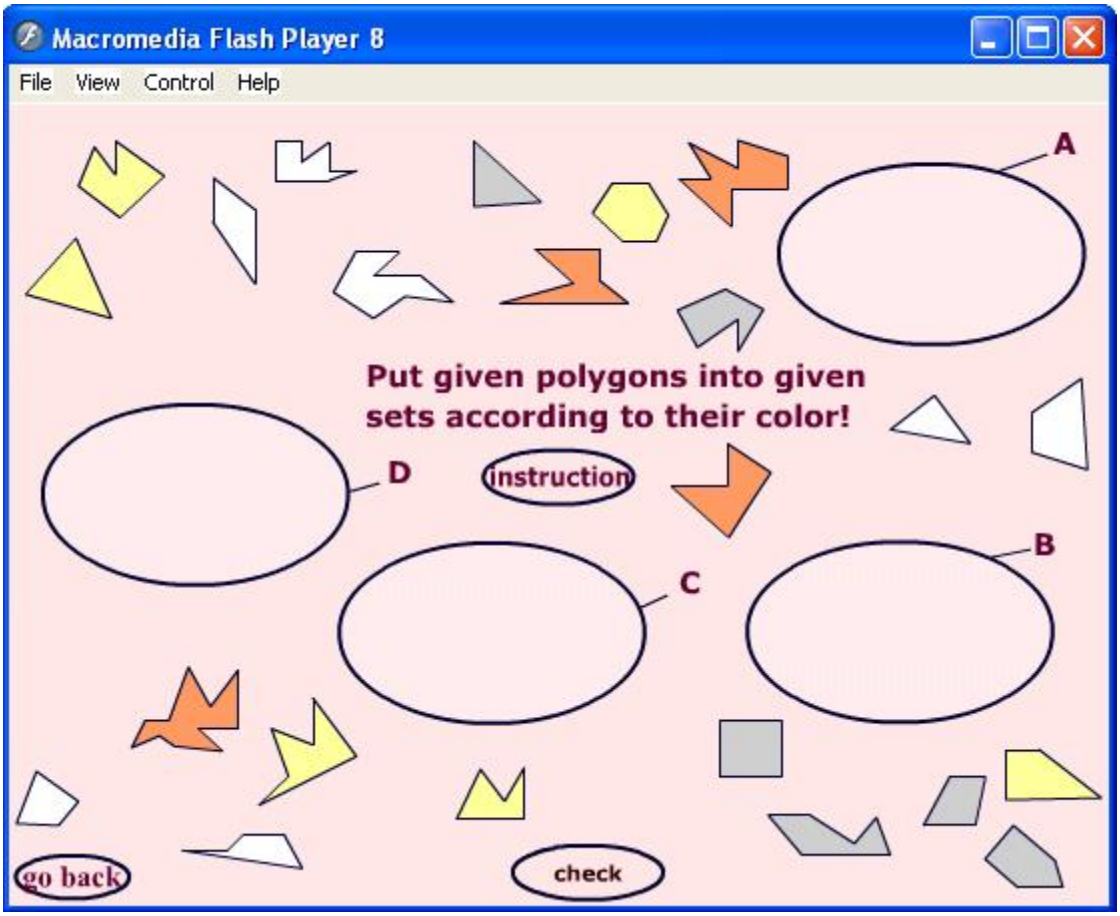

Figure 2.1.4.: Students should put polygons into the given sets according to their color

Goal of the exercise no.3 is for students to realize that the same object can be an element of many sets, depending on chosen criteria and to be capable to conclude what element belongs to difference, union or intersection of two sets.

Examples in the exercise no. 4 are about numbers, representation of set with listing of its elements, representation of set with writing of some property that all elements in that set have and about sets of solutions of inequalities.
In one of the examples sets A={x|x is an integer and -3<x<3}, B={x|x is an integer and -1<x<6}, C={x|x is integer and 1<x<4}, integer numbers from -3 to 6 and Venn diagram (three empty intersecting sets, A, B and C) are given. Students should drag the given numbers into the empty sets.
Also interesting here is example in which sets A={x|x is integer and -3<x<3}, B={x|x is integer and -2<x<5}, C={x|x is natural number and 0<x<5}, number axis and three intervals are given. Students should drag the intervals that represent the given sets and put them on the number axis. After that, they should write the elements of the sets A, B and C into the marked fields.
About sets of solutions one example is given. In that example inequalities A: $2x - 5 < 3$ and B:$2x + 5 > 1$, intervals that represent the set of solutions of the given inequalities and number axis are given. After putting the given intervals onto the number axis students

should write the elements of the sets A and B into the marked fields. One example in this exercise is about geometrics objects that intersect, triangle and square. The task here is to click onto intersection and difference of the objects.

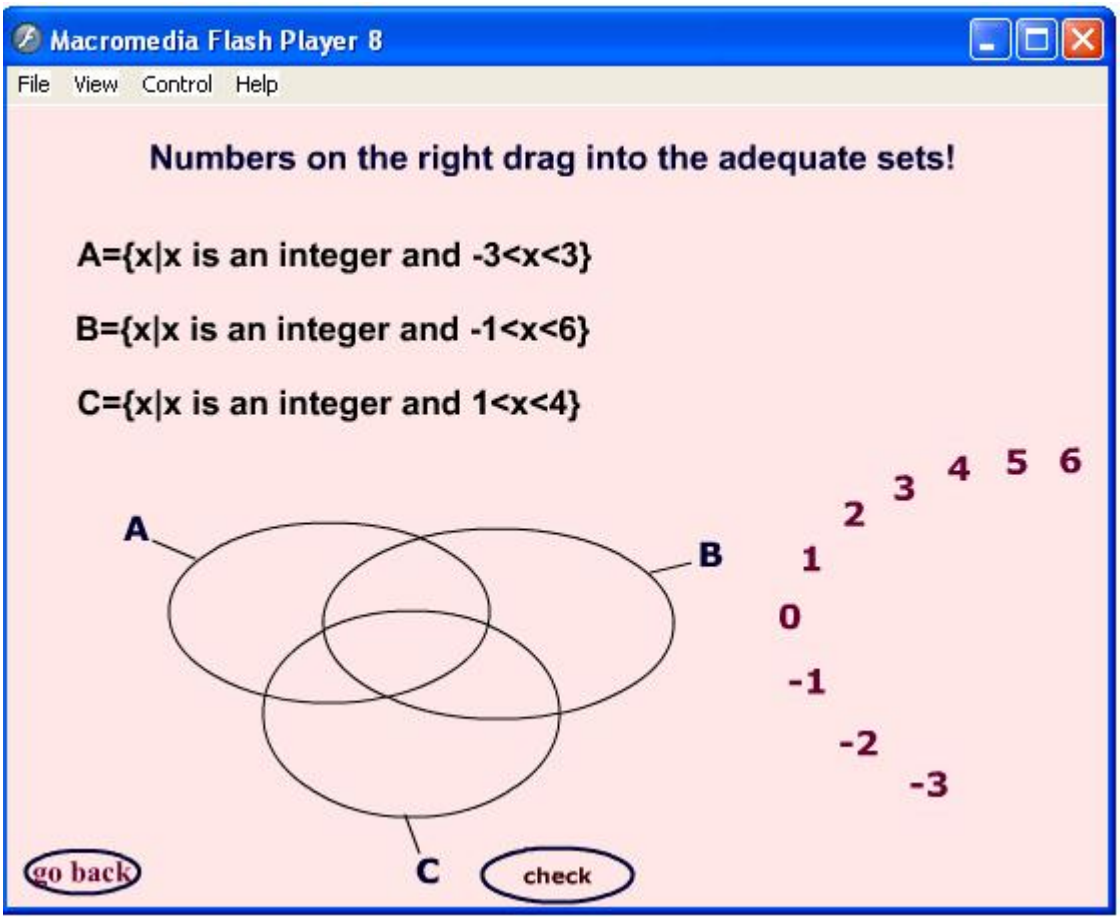

Figure 2.1.5.: Students should put the numbers on the right into the empty sets

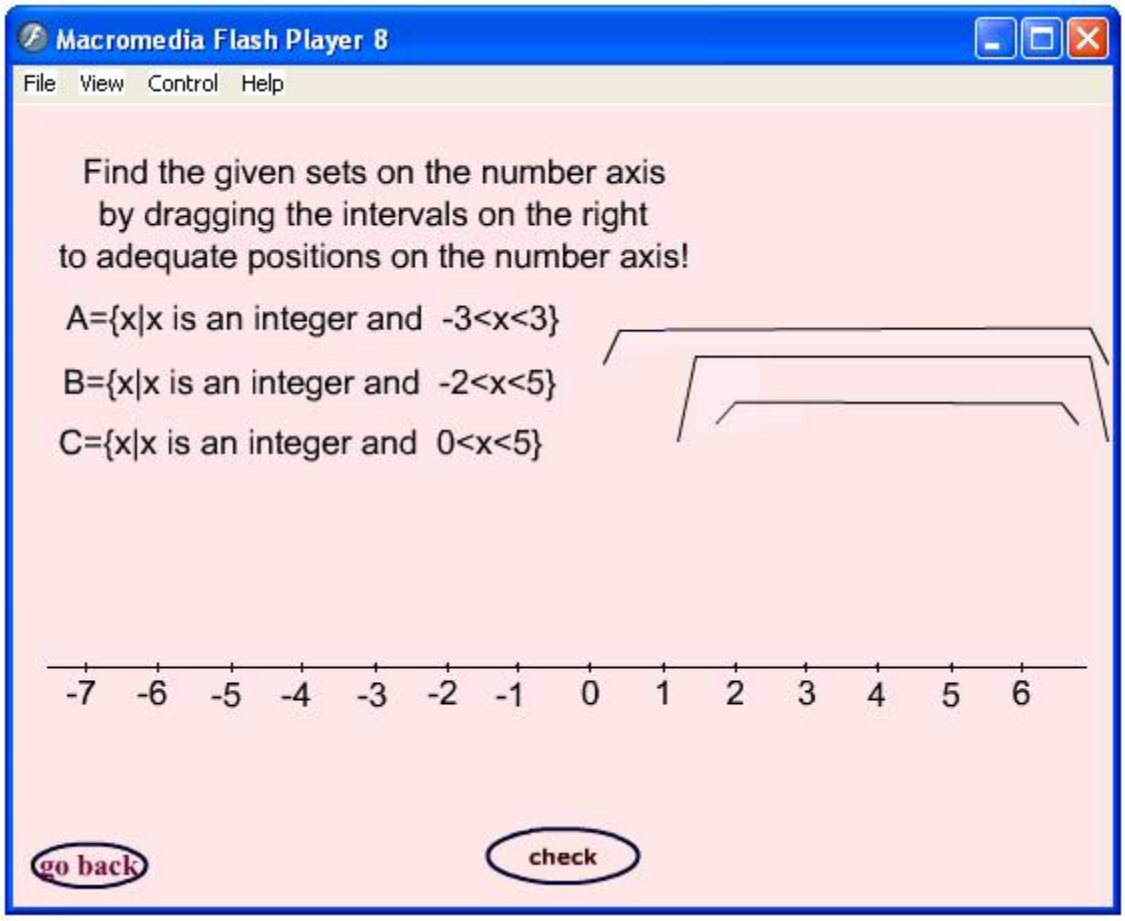

Figure 2.1.6.: Find the given sets on the number axis

Goal of the exercise no. 4 is for the students to realize that sets and operations with sets have applications in many fields in mathematics.

2.1.3 Experiment with classroom in Bosnia and Herzegovina

Teaching experiment was carried out with sixth grade students at "Petar Petrovic Njegos" elementary school in Prijedor on 30th May 2007.
The main objective of the experiment was to check how students would accept new methods of learning mathematics. The idea of the lesson was for students to access and complete three interactive exercises.
Sets are studied at the beginning of the school year so this was a review lesson.

Observation of experiment

Class was carried out with 15 students. They had 45 minutes to complete the exercises. Seven students completed all three exercises, six students completed two exercises and two students completed one exercise.

Teacher's observation of class

Students are active and interested in contents. Combination of traditional way of teaching and e-learning could improve students understanding of abstract mathematical concepts.

Students observation of class

All students said that learning with help of computers is more interesting than traditional way of learning.

My experience

I held eighth classes in second grade of Electro technical school in Prijedor using interactive contents on elearningbih.criced.tsukuba.ac.jp about complex numbers.

Observations

Students were interested in lessons, more active than usual and motivated to learn. Goals of mathematics teaching were accomplished. Teacher has more time for communication with students.

2.1.4 Conclusion

Traditional way of teaching in combination with e-learning could improve students' knowledge and interest in mathematics. Educational contents on http://elearningbih.criced.tsukuba.ac.jp bring interesting and refreshing lessons into classrooms and make easier the teachers' job, who can now communicate more with his students. Developed contents provide more interactivity between students and educational contents. It is possible for the students to have access to the contents, to learn and to test their knowledge from home.

2.2. Mathematics content for secondary school level[2]

2.2.1. Introduction

This is the third year of project for developing web-page for e leaning mathematics and informatics. Content for mathematics is developed for elementary and secondary school level. Content has been enlarging every year. For secondary school, participants from last years already developed contents about trigonometry and complex numbers. Regarding to mathematical curriculum in Bosnia and Herzegovina these contents are mainly for first and second grade of secondary school. The content that I developed is for third grade and it is about sequences. To be more precise it is about special sequences, which are consisted of two topics arithmetic's and geometrics sequence. I also put as an extra topic about Fibonacci numbers. This is not in mathematical curriculum in our country, but I thought in would be interesting for students to learn something about it, because in school is always lack of time for some extra lessons like this one and it is also a special sequence.

2.2.2. Sequences

A sequence is nothing more than numbers written in a specific order. Sometimes we can see connection between those numbers, sometime we cannot. Like for example in number sequence 1,2,3,4,5,6,… we can see that every time we are adding number one, so we can make a formula how to count n^{th} term of this sequence, but for sequence of numbers 3,1,4,1,5,2,… there is no formula for each term. Important point here is that we are treating formulas as functions that only have integers plugged into them. Arithmetic's and Geometrics sequences are special sequences, what means that formula for each term we can treat as a function. Form all this we can see that this topic is important not just to give students information about arithmetic's and geometrics sequences, but also to learn more about functions. Also finding sum of fist n terms of sequences is introduction in infinite series, which are very important in field of ordinary differential equations.
Finding some specific term or sum of n terms require a lot calculus so it is much easier if we can use computer to do all that calculations for us.
Usually students are afraid of mathematics; they say it is hard subject with a lot of difficult problems and lot of calculus. Learning with e-learning, learning and teaching become more interesting for both, students and teachers. Students can learn and practice their knowledge at home also, without repeating things that are already familiar to them, so they can concentrate on what they don't know.
Regarding to all this I have tried to make e-learning content for students and teachers as well. Using a lot of animations and with variety of problems I've made content about Special sequences that covers the whole topic in secondary school about arithmetic's and

[2] Jovana Stojcic, Gimnazija Gradiska, Bosnia and Herzegovina

geometrics sequences. I've also tried to find problems form real world to make this closer to students.
One of things that I was thinking about is what kind of language to use, in a meaning weather be more precise or try to explain as much simpler as I could. Should I use mathematical or daily language making my content? This topic has a lot formulas that students need to remember, so it is hard to escape formal language. At the end I decided to use something between.
To attract students more I have made colorful background. To escape the monotony of the same frame for both sequences (the background for both is TV) I changed the color. For arithmetic's sequence the background color is orange and for geometrics is blue. Also I've made some examples that are similar to both parts. I wanted that students can see some connection between them, what is difference in calculating let's say 5^{th} term of arithmetic sequence and 5^{th} term of geometric. At the time it is nice to solve problems that are in a way familiar to students. But if all problems are repeating (with only difference for arithmetic's or geometrics sequence) monotony is presented. So I tried to make a variety of problems for each topic.

2.2.3. The structure of content

The page for online mathematics is written in English and Bosnian language and in Japanese is under construction. Page is divided in mathematics for elementary and mathematics for secondary school level. Content for mathematics online is consisted of six parts, according to the each topic:

- Lectures
- Interactive lessons
- Games
- Test and quizzes
- Problems
- Apply mathematics

First students choose one of these parts, and then which topic they want. Inside each topic is a big selection of lessons.
So far on page we can choose lecture, interactive lessons, games, test and quizzes, while problems and apply mathematics are under construction.
This web-page and content on it can be use for both learning and teaching.
In lecture part lessons are made similar to lessons in the textbooks. Every lesson is fallowed with solved examples. This is good for students, because they can find formulas and information about things they do in school in one place. And teachers can use this content to make classes a little bit different than in traditional way of teaching, and also it is easier for them, because in this case there is no necessary to write all these facts onto blackboard.
Interactive lessons are following lecture content. In this part students are not just supposed to read lessons, but also to fill in the blanks. These lessons are made like a conversation between students and computer. They go through lesson answering questions. In this way information is not just served to students like in a lecture part, they

have to search for information. They learn about some specific topic giving a correct answer. All problems have button *Check*, where students can see if their solution is correct or not and button *Solution* that shows correct solution with explanation. This part of page teachers can use to take a variety of problems and examples. Also using this way of teaching, there is no difficulty of going further for students that know more and to those who know less. Students can go through page and learn by them selves on level that they are.
Games are very important in a way that they increase students' motivation and competitiveness. Students can find a lot different type of games like puzzles, click and slide, to put numbers into correct order etc. Games that are based on mathematical knowledge are good and interesting to students. They learn about a specific topic through fun. Teachers can use games to motivate students and increase their imagination.
Test and quizzes are made for revising the knowledge from one topic. Here students can see if their solution is correct or not, without any explanation. Teachers can use this part to check the student's knowledge from each topic.

2.2.4. Developed content

Above I shortly explained about lectures, interactive lessons, games, test and quizzes. Here I will explain more about my content.
Special sequences are in part for secondary school mathematics content.
Lectures
In lecture part students choose topic they want to learn: Arithmetic's, Geometrics sequences or Fibonacci numbers. Each of topics is consisted of three lessons and each lesson is fallowed with three solved examples.
Lessons that each topic is separated into are:

- Introduction in arithmetic's / geometrics sequence, characteristics
- Sum of the first n terms of arithmetic's / geometrics sequence
- Interpolation

Lessons are made similar to lectures in the textbooks. What is different here is that students can see not the whole lesson at once. As they go through lesson they have to press some buttons to continue. With this I wanted to make them to think in front about topic.
For example, one of lessons under Geometrics sequence is *Introduction in geometrics sequence, characteristics.* Aim of this lesson is to teach students what geometrics sequence is and how to develop formula for calculating n^{th} term of sequences, actually formula for general term of geometrics sequence. Lesson is given in small parts, which is easier to read and understand for students. After pressing button *Next* they can see the rest of lesson. Part of lesson is examples. At any time they can go on examples.

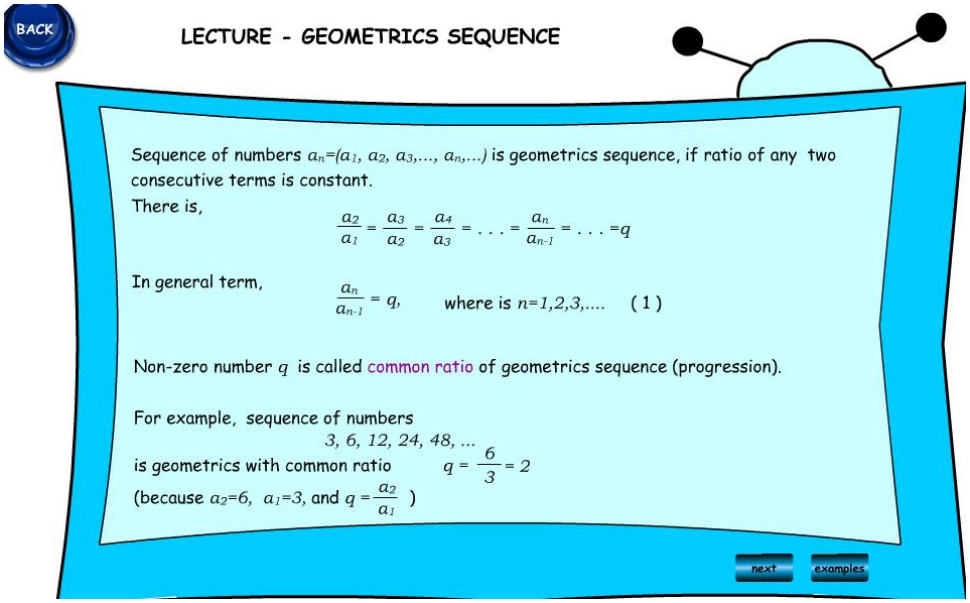

Image 2.2.1.: Lecture-Introduction in geometrics sequence, press next to continue

Examples are given with detailed solution. At the beginning of each example students can see only problem, without solution and after pressing button *Solution* they can see solution of problem, but also in small parts, so they can try to do next step and after that to check and continue. I wanted from students not just to read the solution but also to think and try to do problem by them selves. In this way they are more consecrated on problem and some of them for sure would like to guess what's next, so they will do next part of problem.

One of examples, under mentioned lesson from Geometrics sequence, is: Calculate the sum of 6^{th} and 10^{th} terms of geometrics sequence, which has numer3 as a 1^{st} term and common ratio is 2. At the beginning when students open example's part they can see only problem and Solution. After clicking on solution, it is shown how to find a general term for this sequence, and it's stopped then. So here students can try to calculate 6^{th} and 10^{th} term using what's already done. Clicking on continue students can see solution in the whole.

Students can easily move thought one example to another one.

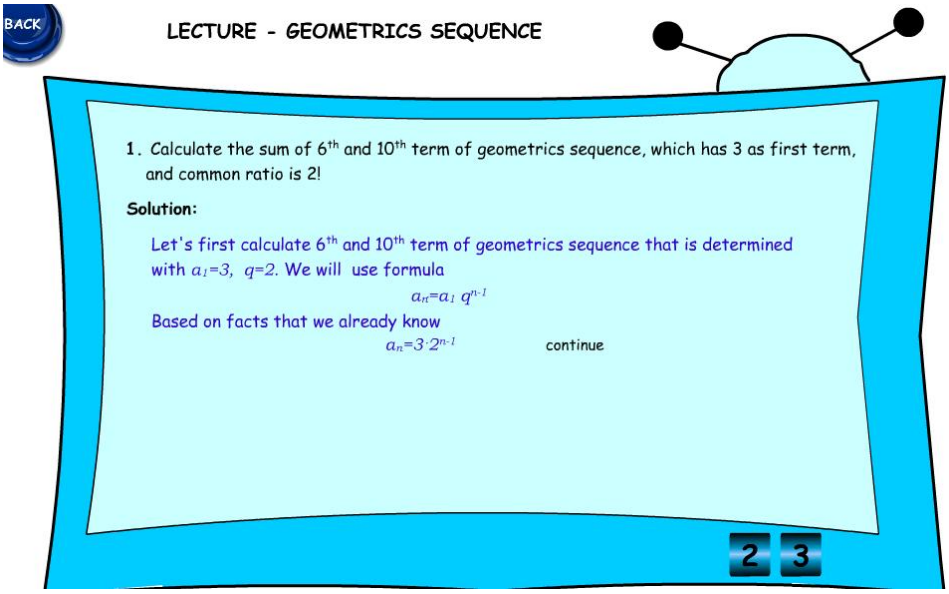

Image 2.2.2.: Lecture-Example: solution is given in sections

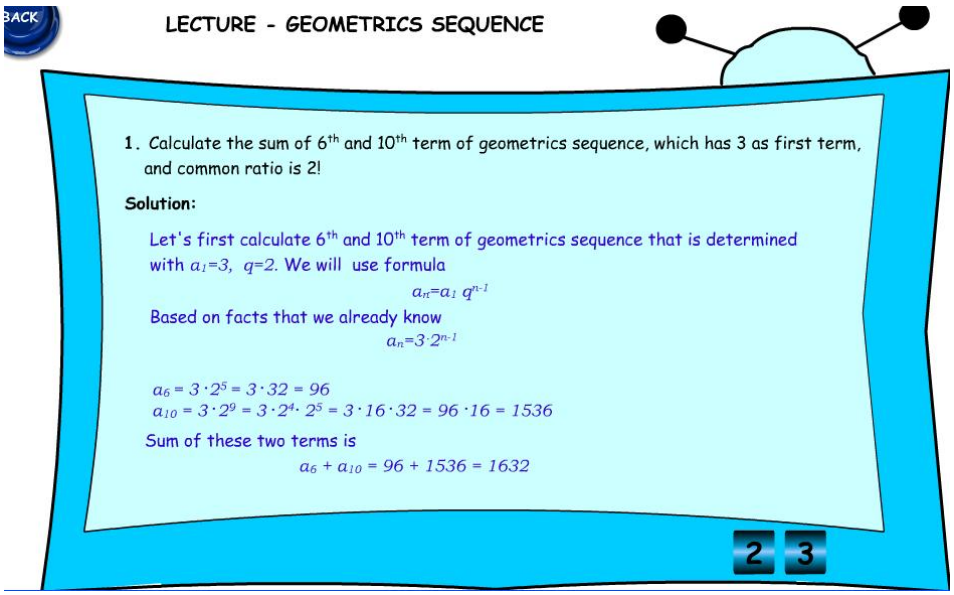

Image 2.2.3.: Lecture-Example: the whole solution

After reading lecture part of each topic students are supposed to know the basic about arithmetic's and geometrics sequences. Also they should be able to solve some easier problems.

Interactive lessons

As it is said these lessons are following the lecture, with difference that students are expected to be more involved in solving problems.

This part is also divided as lecture part:

- Introduction in arithmetic's / geometrics sequence, characteristics

- Sum of the first n terms of arithmetic's / geometrics sequence
- Interpolation

After clicking on each part list of interactive examples is shown.
In part interactive lessons, students can learn more about characteristic of sequences that are presented with lot's of animations. In some examples students are expected to make problem by themselves, self questioning. If they make not good question they can see message, so they can start from the begging. Also for teachers this kind of examples is very useful, because they can make a lot different problems of the same type.
Specially one of the problems in this part about Geometrics sequence, under lesson *Sum of first n terms*, is consisted of more questions in a row. First students are asked to continue the sequence of numbers, after that they should choose which of these sequences are geometrics. In lot of cases students and not only students know to continue the given sequence of numbers without knowing it is about special sequence with a lot of interesting characteristics. In any time they can see solution, or to check their answer or to skip on next question.

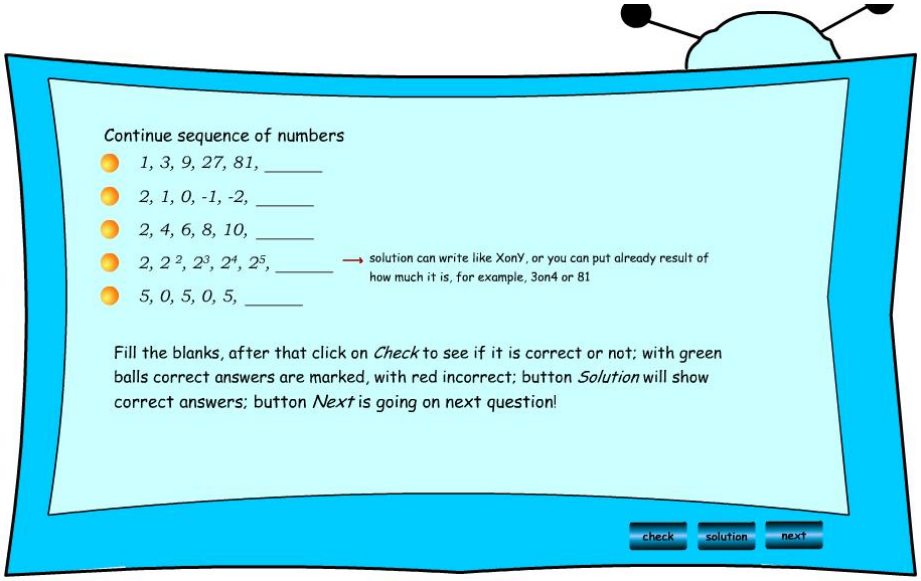

Image 2.2.4.: Interactive lessons-Continue sequence of numbers

After showing which of sequences are geometric, students should calculate general and 10^{th} terms of sequences. As before, pressing button *Solution* the solution is shown, and button *Check* is giving a message if the answer is correct or not. One more question they have in this example, and the question is to find a sum of first 5 terms of each geometrics sequence.

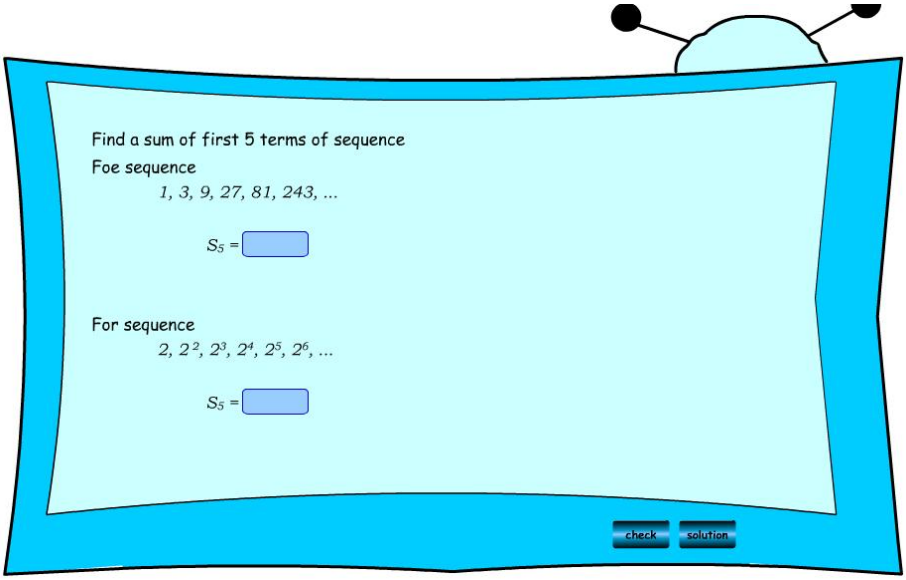

Image 2.2.5.: Interactive lessons-Find a sum of first 5 terms of each sequence

I've put a six first terms of sequences, as a little trick if students just try to calculate all numbers they can see.

With this example, using animation and different type of questions (like fill in the blank, or clicking the correct answer), students can check their knowledge in general about sequences, to see if they are able to recognize the geometrics sequence. Also to learn how to find the n^{th} term and general term of sequence and how to calculate the sum of first n terms of sequence.

Games

People all around the world like to play different games. And all games are based on some knowledge and skills according to different topics.

Aim of games part of this page is learning and revising knowledge thought fun. In this way students are also learning about sequence's characteristics and they have to calculate sum, or nth terms of sequences. And because of different levels all students can play, so all of them are involved into subject.

Games that I will explain here are puzzle and click and slide game. I've made puzzle game for arithmetic's and geometrics sequences. In the following is described the one under Arithmetic's sequence. In this game students can choose between three levels of difficulty. First two levels has two tables and the last one (the hardest level) has only one table. So students can choose one of these tables inside the level. Aim of this game is to move all numbers from right into table so that numbers make arithmetic's sequence by rows and columns. Number stay inside the table only if you put it in correct place, in another case it goes back in previous position.

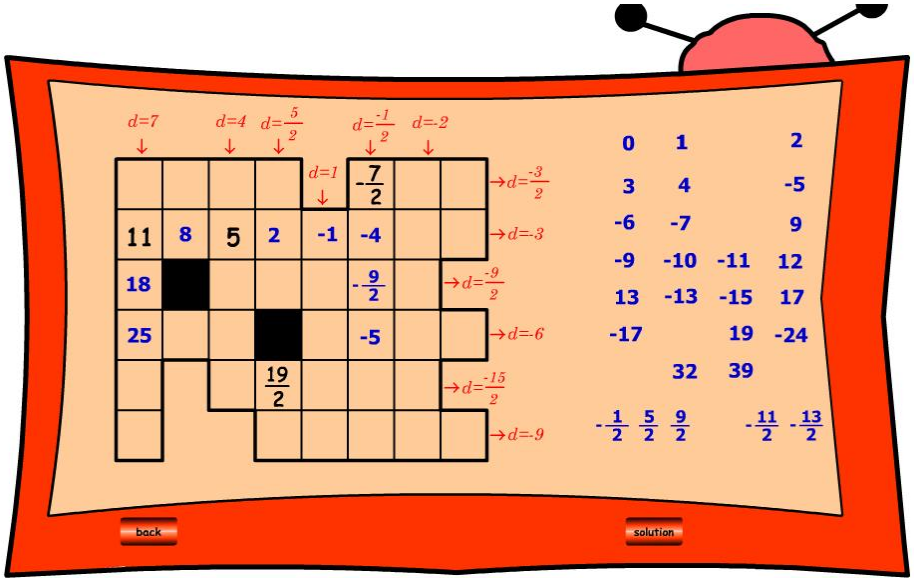

Image 2.2.6.: Puzzle game-Drag the numbers from right into correct position in table

Each level has options *Solution* and *Help*. Pressing *Solution* students can see correct position of numbers in table, and with *Help* button they can see common differences for each row and column.

Another game is under Geometrics sequence and it is also about putting numbers into correct position in table, but in this case not by dragging numbers, it is by clicking numbers. Name of the game is Click&Slide. Clicking number you change the position of number in table, and move it in another possible position.

As in the puzzle game, students can choose between three tables with different numbers and common ratios.

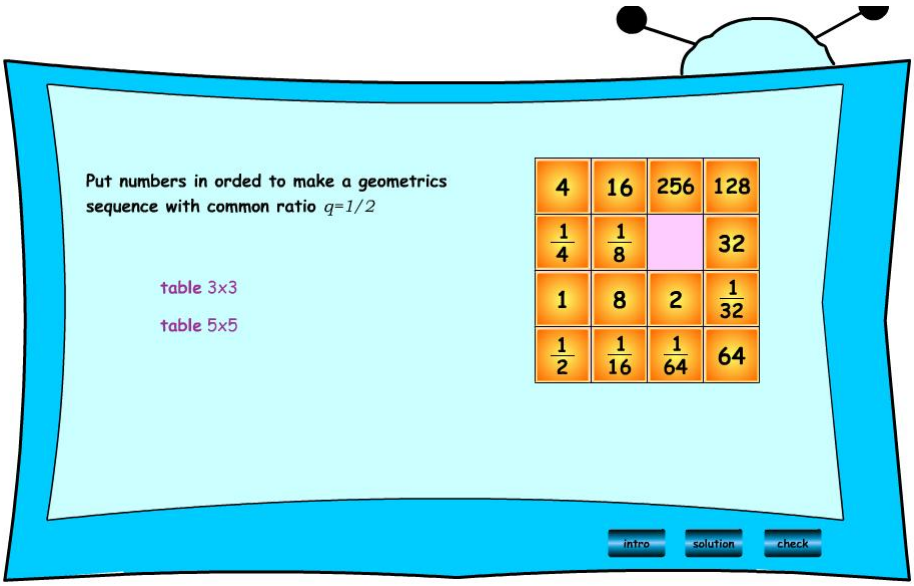

Image 2.2.7.: ClickAndSlide- Clicking numbers put it in correct order

Aim of the game is to organize numbers in table to make a geometrics sequence with given common ration from the top left corner. Clicking the *Solution* button, correct position of numbers is shown, but not the way of moving numbers, because it is not unique. At any time students can move from one level to another.
All games have *Introduction* where is explained what is the aim of the game, and how to play.
Test and quizzes
For test and quizzes I took one of the existing templates from Flash Macromedia. Test is made of different kind of question, like dragging, input correct number, multiple choices, yes/no questions, also with variety of difficultness. Test contains questions from the whole topic. Students have to do question by question and as a feedback information they can see if that their answer in correct or not without any explanation.

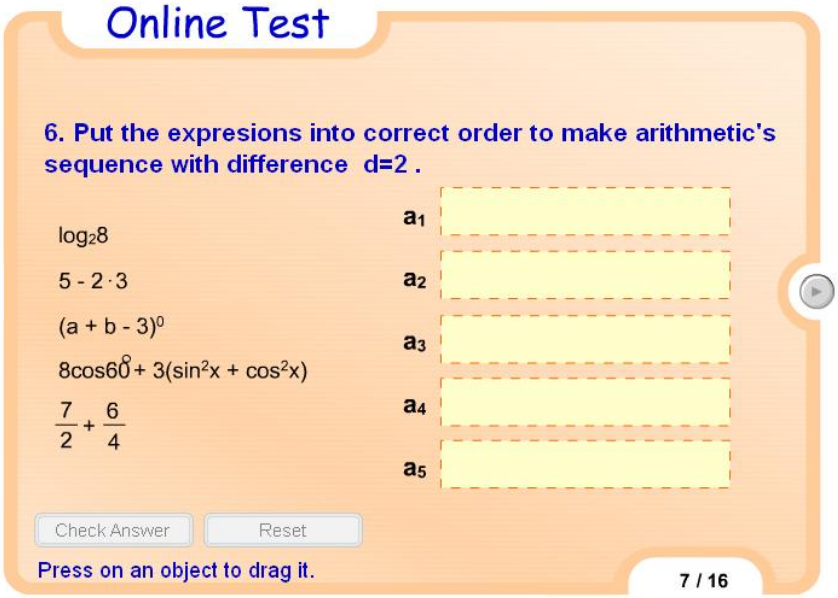

Image 2.2.8.: Test- Check your knowledge about Arithmetic's sequence

The questions are asking from students to use their knowledge not just about arithmetic's sequence, but also knowledge about extension, logarithms, trigonometry, fractions, etc. Because students cannot skip questions, I've put combination of easier and harder problems mixed, which makes students more motivated.
Teachers can use this test as a final test about arithmetic's sequences. And the result at the end can be an indicator of how much students learned about this topic.

2.2.5. Experiment

Part of this project is to test this content in schools. What I wanted to find out are some details to see if I am on a good way or not. I was interested how students can move though page, content's organization, did I choose good examples, is it clear what the problems are about and are solutions detailed enough, what is the impression of students and teachers in general.
Until the May 2007, when the experiment was held I developed lectures for Arithmetic's sequence, without examples, a part of interactive lessons for Arithmetic's and geometrics sequence, games and test for Arithmetic's sequence.
Experiment was organized at secondary school Gimazija in Gradiska, with the 3rd grade students under guidance of teacher Dragana Misimovic. This was the first time to use e-learning content for teaching and learning. The topic was Arithmetic's sequence.
Teacher took double classes (90 minutes, 45 minutes each) in informatics classroom, so students were able to use computers. Teacher organized students in pairs, so every pair of students has a computer. The lesson of that day was to find a sum of n terms of arithmetic's sequence.
At first teacher open page with content. Using projector she explained how to move through page. From part interactive lessons, she took two problems about introducing in arithmetic's sequence and characteristic, just to remind basics about it. After that students opened the page and took a look around the page. They did not have any difficulties moving and finding what they wanted on page. So the first part of first class was about introducing page and revising knowledge. At second part of class, teacher explained lesson about finding sum of the first n terms, again, using the projector. At that time lesson where showing the whole at once, and she said, it was very hard for students to consecrated and follow content. She suggest to make smaller parts so students can follow as she is explaining and they can write in their notebook at the same time, and continue after clicking on some button. On the second class students were solving problems connect with sum of n terms by themselves from part interactive lesson, and playing games.

Image 2.2.9.: Experiment-Motivated students in solving problems about Arithmetic's sequence

Students with more knowledge about this topic could move through lessons and examples much faster than with traditional way of learning, and students with less knowledge could choose easier problems to solve and after that move on a little bit harder.
What students liked the most were games, especially that it was in levels so all students could play.
Even they should do a lot calculus students said this way of learning is more interesting and they feel they can learn about sequences using this content. Almost all students write a page to continue at home.
What teacher said was that she was surprised how much students were involved in solving problems. She said they've spent all 90 minutes finding solutions for problems.
With this kind of teaching students are really motivated, because it is new for them, but not just because for that, also because they can move and do problems that they want, and they don't need to call teacher for explanation. In this they are learning by themselves and all this for them is a like a game.
She gave me some useful technical comments such as to put some instructions in some examples, also some mistakes in writing. Also she told me it would be good to make lessons in small parts. But she said in general students didn't have problems with understanding content.
The whole impression about page and mine content was good. But at the end I can say that I don't have enough feedback information about mine content. To get real mark about content it is necessary to do the whole topic about special sequences, using this content. At the end I don't know if students learned something from this content, because it is impossible to find that out just from one lesson. The problem about it was that May is almost the end of school year in my country and this topic is at the end of school year recording to mathematical curriculum in Bosnia and Herzegovina. So it was not enough time to do more of experiment with my content.

2.2.6. Conclusion

If we make mathematics lesson with adequate combination of traditional way and e-learning we can engender students' interest in mathematics and their better understanding. In our country we are lacking with qualified teachers that know how to make their own content and how to use ICT in classroom. This training helps me a lot in understanding ICT and how I can improve my classes using ICT and e-learning.
Web page that all of us made, can improve out teaching methods as much as learning. Using this kind of teaching (learning) is easy and good thing is that we can use it in any place at any time (home, classroom).
I can say that I gave a small part in improving educational system in Bosnia and Herzegovina with my developed content. With this content I made calculating more interesting and enjoyable. At the same time learning and teaching is more effective (teachers don't need to loose time writing important facts on the board, time that students

need for learning can be expanded or reduced by themselves). Also I wanted to make online tool to help develop students' imagination, creativity and problem solving skills through these examples.

In future I am planning to use this web-page and my content in teaching. In that case I will be able to see how I can expand my content. Also I am planning to use more e-learning with ICT as much as to make more lessons for myself using Macromedia Flash.

2.3. Informatics content for secondary school level[3]

2.3.1. Introduction

Informatics curriculum in Bosnia and Herzegovina is not harmonized on the national level. There are three different curriculums in use and in some parts of the country informatics is taught only in one grade at secondary level, while in the other parts it is taught through all 4 grades. The best approach, when developing online content, is to choose those lessons that are present in every Bosnia and Herzegovina Informatics curriculum. Last year's participants created content for MS Word, MS Excel and MS PowerPoint. With these content most of the curriculum for one grade of teaching informatics is covered. Following this path of development I decided to create content related to Introduction to programming and I decided to put my focus on lesson of Flowcharts. By introducing this topic through highly interactive examples, students will learn basic principles for flowchart creation and develop skills for procedural programming.

2.3.2. Topic of Flowcharts

Lesson of Flowcharts is a part of almost every secondary level informatics curriculum. It is usually taught at the end of 1st grade and (or) throughout the 2nd grade (depending on the curriculum). It's usually very hard for students to comprehend the concept of flowcharts, yet this knowledge is highly needed during the programming process. Students observe flowcharts as something abstract and they cannot relate them to the real world and everyday situations. Also, even though lot of literature is available from various sources (books, manuals, Internet etc.) for different programming languages (Pascal, Fortran, c, c++, java etc.), the resources for the lesson of flowcharts are quite scarce and few. With this content students will be introduced to the world of flowcharts gradually, working their way from the very simple examples, connected to everyday situation they can relate to, all the way to the real and complex programming challenges. All of this would be done at the high level of interactivity so the students can absorb the knowledge and really deeply understand the essence of the topic. These created contents can be used as:

- just an introduction to flowchart – as a first lesson from that topic
- a complement to the classical way of learning flowcharts – mixing couple of examples from the online content to make the learning more interesting
- complete approach for the whole topic of flowcharts – everything explained using the content
  knowledge check up – using the examples from created content as a test for students

[3] Jelena Brkic, Faculty of Economics, University of Mostar, Bosnia and Herzegovina

- home study – allowing and encouraging students to practice the examples by themselves from their homes (e.g. as an homework assignment)

For the purpose of presenting this content a web-site was created. This web-site (LINK) is linked to all of the Informatics and Mathematics content created by 9 trainees through 3 years. It continues all the lessons and examples in English and Bosnia and Herzegovina languages. All of the content is easily reachable and switching the languages can be done at any time for any part of the web-site. The whole web-site is created using Macromedia Flash MX so it's very compact and fast and easy to use, with no problems concerning bandwidth. It also has its HTML equivalent available (LINK).

2.3.3. Structure of the content

Upon accessing a web-site, the user is interfaces with a homepage explaining what the site is about and all the chapters it contains.

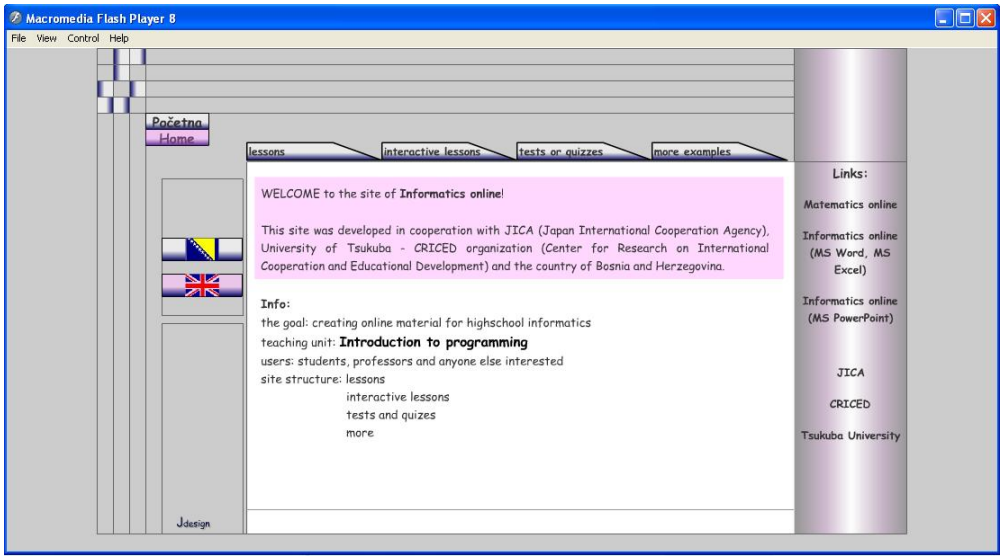

Image 2.3.1.: Informatics home page with introductory text

All of the Flowchart content has been divided into four parts:

- lessons
- interactive lessons
- tests and quizzes
- advances examples

Lessons are small chapters holding theoretical background to the topic. Interactive lessons are practical examples which are following the theoretical part available in the lesson part. Test and quizzes have different test available for assessing students' knowledge. Advances examples are offering more complex examples appropriate for students who want to learn more.

Every part is created to stimulate constructive thinking about the problem and it's leading the student to the correct solution. Interactive lessons have different options of getting student involved: answering multiple choice questions, writing in the correct answers, drag and drop feature to put elements in the correct position etc. There is an extensive explanation after every solved example to assure that students do understand what kinds of operations have been done. Every problem is introduced in an understandable manner and often offering a graphical explanation for a better comprehension of a task.

2.3.4. Developed content

2.3.4.1 Lessons

Lesson part is a good foundation from where the teacher can start his/her lecture. Also, all of the important symbols, formulas and expressions are present in this part. Chapters available in the lesson part are:

1. What is programming
2. Algorithm
3. Control structures
   - 3.1. Sequence
   - 3.2. Selection
   - 3.3. Iteration
4. Arrays
   - 4.1. One-dimensional arrays
   - 4.2. Two-dimensional arrays

Lesson Algorithm will be demonstrated as an example in further text.

Lesson: Algorithm
In this lesson a basic concept of algorithm is introduced. To offer a better understanding of what algorithm actually is and how everything around us can be represented with it, an example of a process of making a phone call was taken. For those who are reading carefully and are very studious in their learning there is a secret assignment available at the end of the text. By clicking on a small button "exercise", a student is given another example of algorithm. On the next page of this lesson, the symbols for creating flowchart (graphical representation of an algorithm) are introduced.

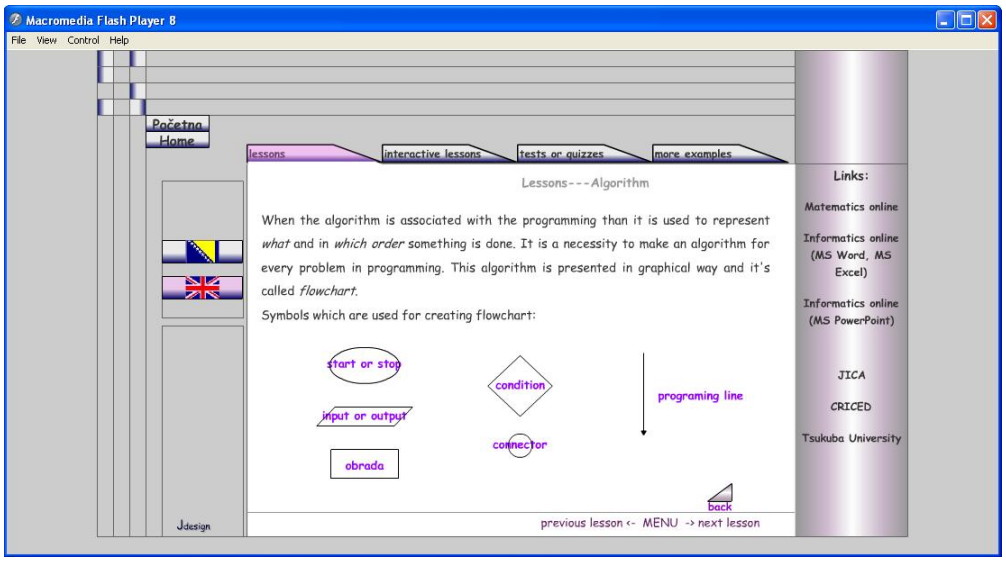

Image 2.3.2.: Lesson: Algorithm

This lesson is just an introduction part which teacher can use to start the topic. Also, it's very useful for a student to refer to in the process of solving some other examples (when some help is needed).

2.3.4.2. Interactive lessons

Interactive lessons are following the material from the lessons part by offering examples for every chapter. The menu itself is a little differently structured:

1. Basics of flowchart creation
2. Sequence
3. Selection
4. Iteration
5. Arrays

Basics of flowchart creation is offering some very simple examples that are used to lead the student to a world of flowcharts. These examples are not formally structured and they are related to everyday situations. Next four chapters are self explanatory, they're demonstrating different programming structures and concepts.
Student can choose between different chapters:

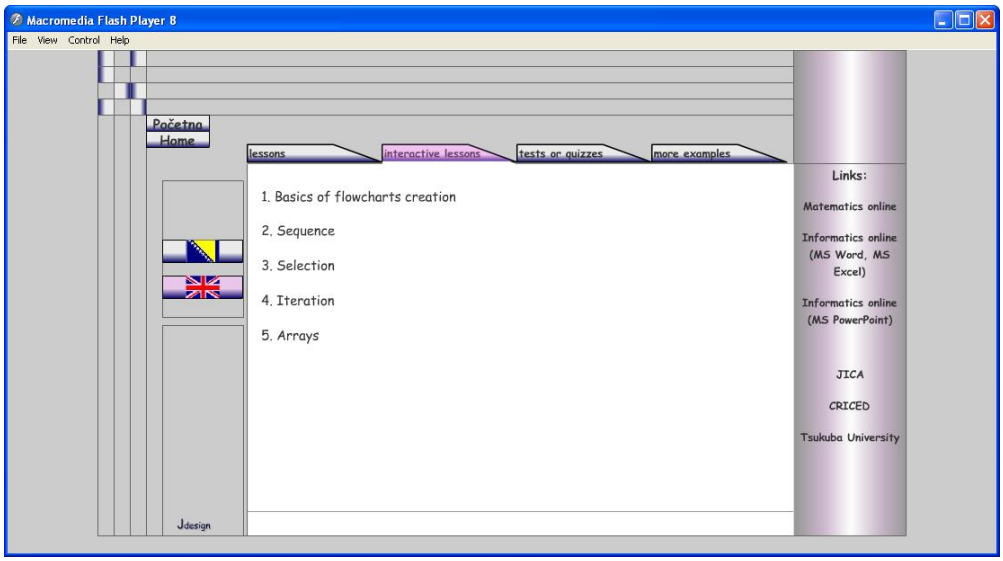

Image 2.3.3.: Main menu for Interactive lessons

Every chapter is offering 5 examples:

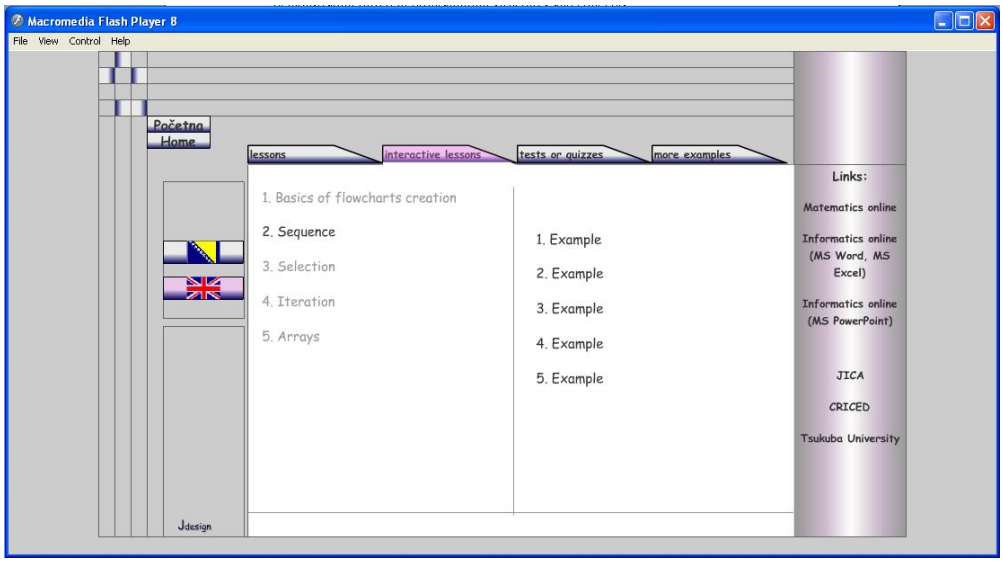

Image 2.3.4.: Submenu for Interactive lessons

Two interactive lessons will be demonstrated in further reading: *Basics of flowchart creation: Example 1 – purchase process* and *Selection: Example – absolute value*.

Interactive lesson: Basics of flowchart creation: Example 1 – purchase process
This is the first interactive lesson that students meet. It's been created for a slow and gradual progress through the problem.

Student is given a problem of looking up the prices of a cd and dvd and calculating the overall price for his friend. First, the student is supposed to drag the offered sentenced in the correct chronological order.

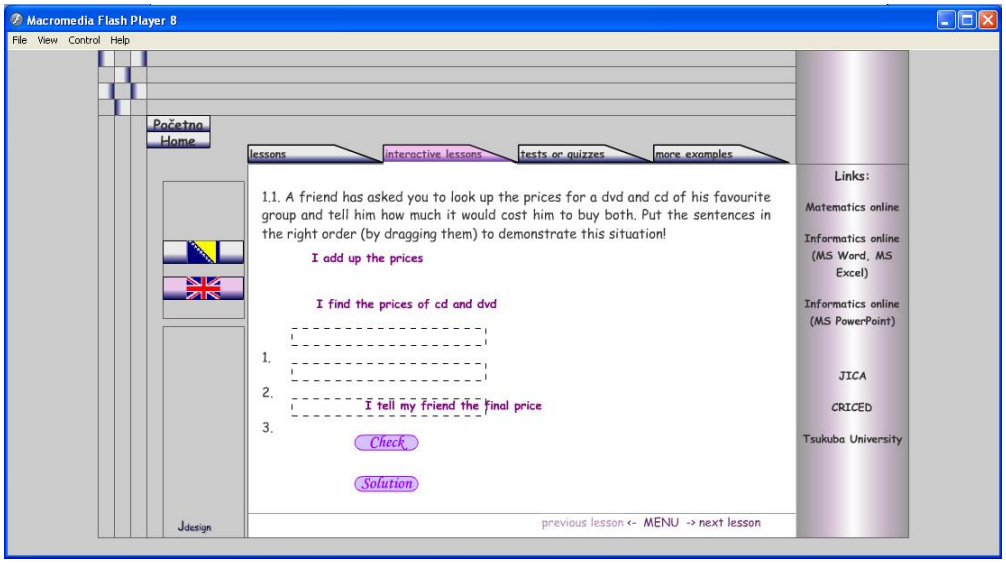

Image 2.3.5.: Drag and drop option in interactive lesson

Then, the student can check his solution or, if he is not sure how to solve it, he can click the button *solution* and move on to the next step. After that, an imitation of a flowchart is created allowing student to observe how given sentences can be put in a flowchart in the same order that they happen in the real life. In this way, a student is making a relation between a flowchart and a real world and realizing that flowcharts are not abstract items. Then, the student is supposed to answer some multiple choice questions and to find the appropriate symbol for each sentence – action.

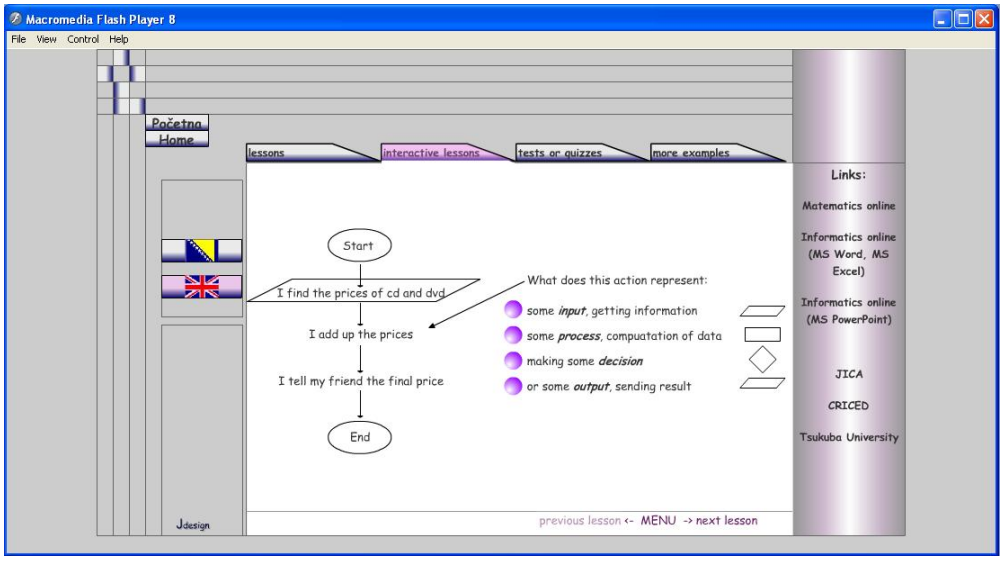

Image 2.3.6.: Multiple choice menu in interactive lesson

In the end a student is offered a final solution and the sentences transform themselves to formal expressions. An explanation is presented to inform the way to the final solution.

Interactive lesson: Selection: Example 2 – absolute value

In this lesson a student is given a task of creating a flowchart for the calculation of absolute value of the number. First, he is given an opportunity to enter absolute value for given numbers and check if the answers are correct.

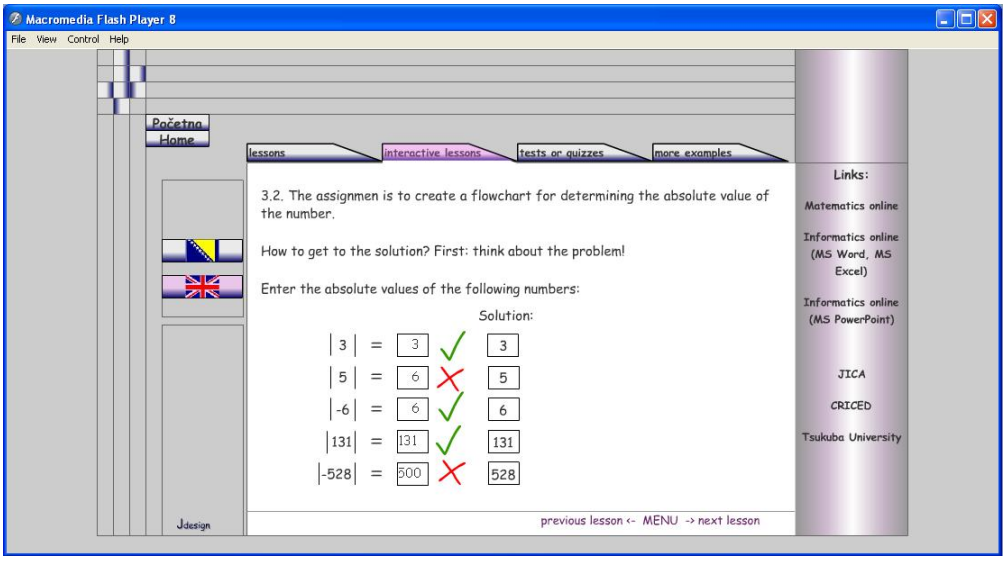

Image 2.3.7.: Introduction to creating a flowchart for absolute value

In this way, a student gets a chance to remind himself the procedure for getting an absolute value which will help him construct the flowchart. After that a student is offered a brief explanation how to calculate the result. Student is then asked to recognize which logical structure is used for this flowchart. After it's concluded that the structure needed is selection, a student is provided a part of a flowchart and it's required from the student to complete the flowchart by himself.

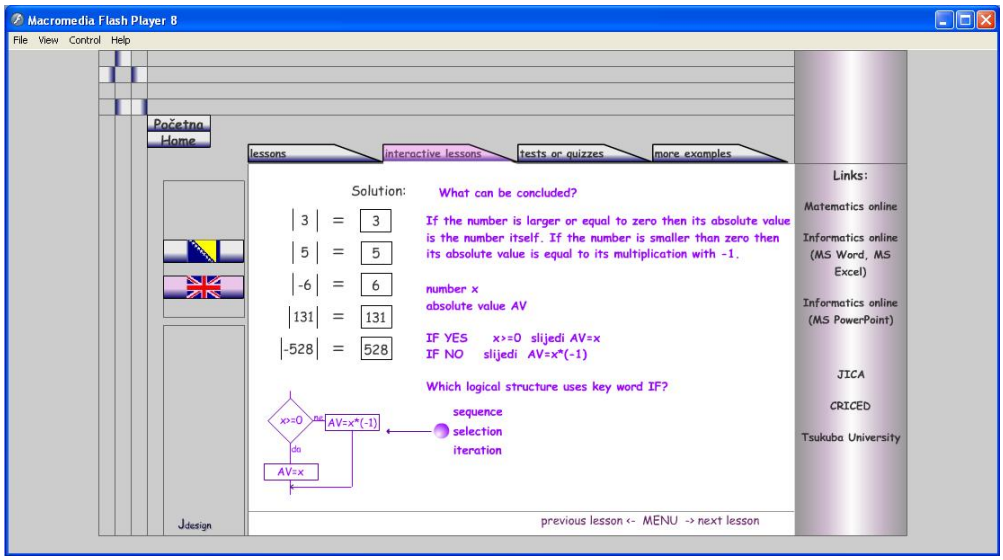

Image 2.3.8.: Process of creating a flowchart for absolute value

It is visible from this example that every lesson is not completely solved. Students are supposed to solve it by themselves using the guidelines provided in the example. This kind of lesson is useful for practicing and for a teacher to establish how much the students understand the topic.

2.3.4.3. Quizzes

For creating quizzes, I have used the Macromedia Flash quiz template. This type is not technically part of a web-site, but it is linked with it so the user is still having the sense of integral environment.

Quizz: Test your knowledge of flowcharts – advanced level
In this Macromedia Flash template a quiz was created for the students who were already taught the topic of flowcharts and it's time for the assessment of their knowledge. The quiz has 10 questions and they are all variations of different types: multiple choice, fill in the blank and drag and drop. Drag and drop option is particularly helpful because it allows student to arrange a disassembled flowchart. The student cannot move to the next question until he/she offers an answer. There is no time limitation on taking the quiz. In

the end the student is provided with a number of correct answers and a percentage of success.

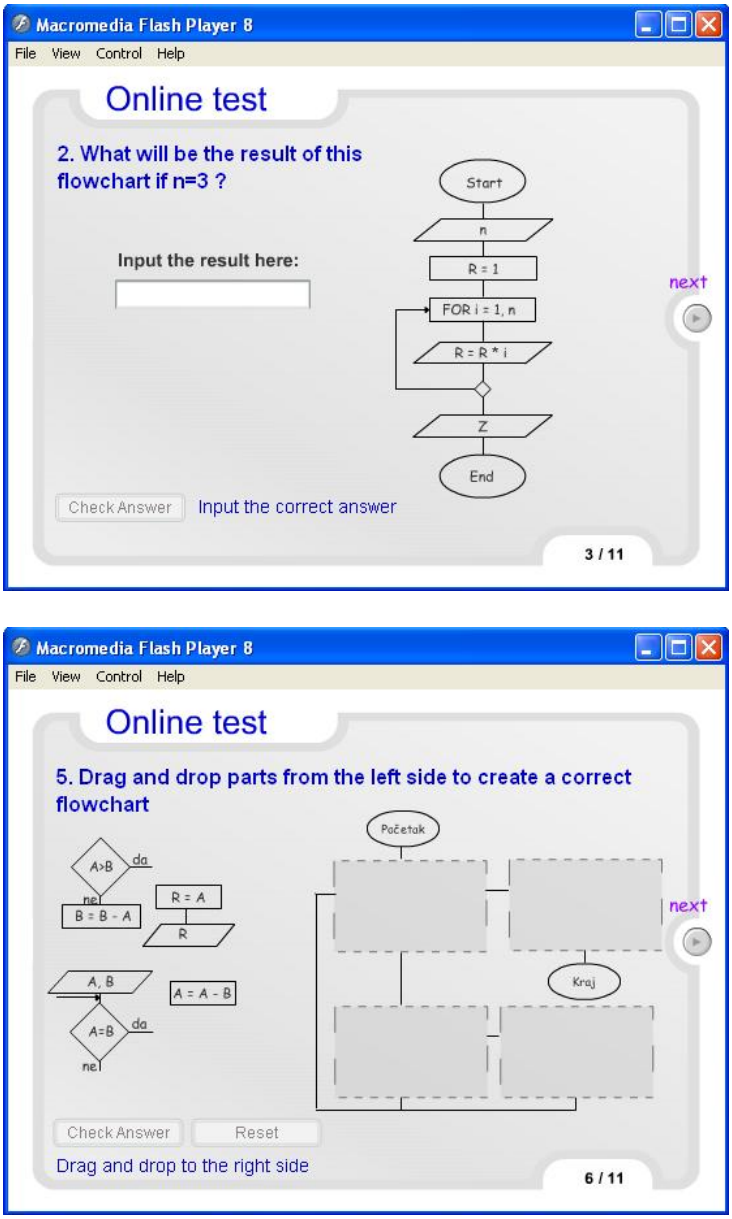

Image 2.3.10.: Interactive quiz

2.3.5. Additional content

Although all of the lessons are nicely settled in the environment of a web-site, I thought it would be also useful to assure more than one way of accessing the content. For this

purpose I decided to use MOODLE. Another reason is that the content from last 2 years is also available from this resource so from this perspective, the content is also integrated. MOODLE stands for Modular Object Oriented Dynamic Learning Environment. It is an open source learning management system which we have used for locating Informatics content. All of created lessons and interactive lessons from this year are available from this resource (LINK). For accessing this content a student is required to register and log in under his/her user name. In this way, a teacher can monitor all of the students' progress and the time they spend on each lesson. Lessons are divided into chapters so the student can go consecutively and has a good oversight of all the content. Also, MOODLE offers a possibility of creating an online quiz in its environment. I will use this option in the future because, besides the fact that it provides a chance of creating an interesting and versatile online test (true or false, calculating, fill in the blank etc.), it also has a possibility of time limitation of the test (starting and ending time).

2.3.6. Experiment in classroom in Bosnia and Herzegovina

In order to be sure that the content was being developed in the right direction, experimental classes were conducted in April and June, 2007 in Bosnia and Herzegovina. Two schools were involved in the experiment with more than one class conducted using online content.

First experiment was conducted in Mostar Gymnasium High School on April 24 and 25. The teacher was Vladimir Sarovic. Three first grade groups and two second grade groups were included. The classroom is equipped with 24 computers connected to the Internet and every student is sitting in front of one computer. The professor is using a computer which is connected to the overhead projector so that everybody could see what the teacher was doing. The flash file was easy to download and there were no difficulties running the examples.
The first graders didn't encounter programming before so they did a lesson part and some examples from the interactive lesson part. The teacher first explained the theoretical part and then they tried to solve the examples by themselves. In some cases, the teacher assisted with the solving. Students were motivated and surprised by the new way of learning a lesson. The only registered remarks were concerned with the site navigation – some of the directions were ambiguous. This problem was corrected afterwards.
The second graders first refreshed their memory of flowcharts (because they studied it in the beginning of the year) by solving some examples. Then, they took an online test. Most of them didn't solve the whole test which made me realize that I've put the standards a little too high so I made an easier version of the test afterwards.

Second experiment was conducted at ElectroTechnical School of Prijedor on June 5. The teacher was Olivera Banjac. One group of 15 third graders was included in the experiment. Although they had Informatics for three years, this was their first encounter with the flowcharts and programming. The first problem was running the web-site. It was downloading really slowly even the Internet connection wasn't bad. This phenomenon

left unexplained because there were no logical reasons for this to happen especially because the site is not “heavy”. They did the lesson part, accompanying every chapter with the corresponding examples from interactive lessons. The students understood the tasks completely and they had no problem comprehending what was asked from them. They solved all the interactive lessons that the teacher asked them too. The only setback they encountered was of a technical nature. They would click the wrong *next* button or click the option *final solution* too soon etc. This made me see some flaws in design and made me rearrange some buttons and options on the site.

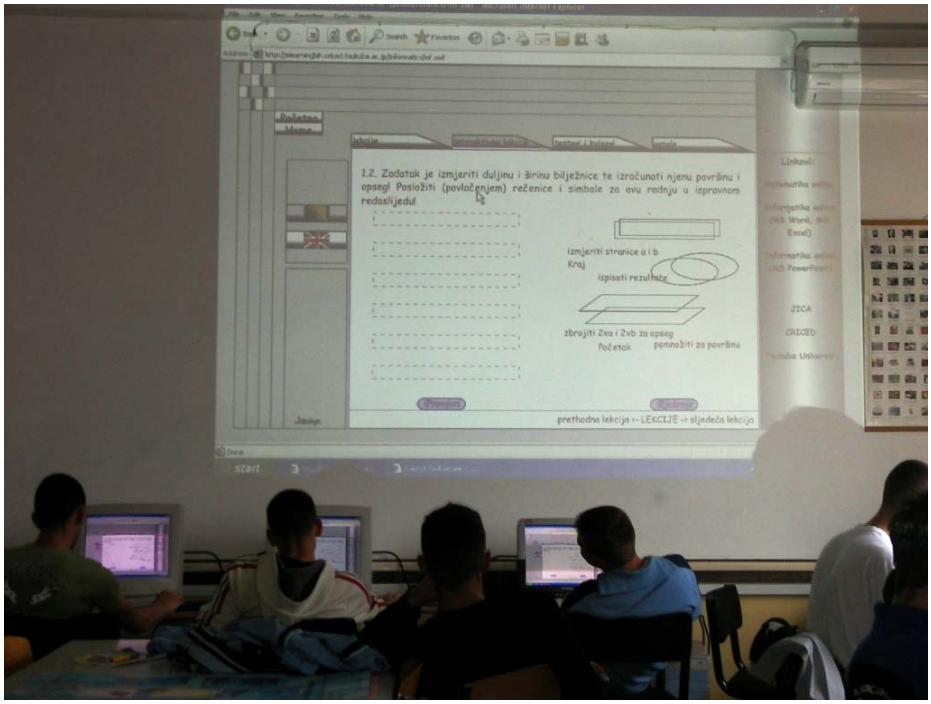

Image 2.3.11.: Students learning using online content

After that the teacher asked of students to take the test to see how much they understood and remembered from what they’ve just learned. Because I used a Flash template for creating a test, there were problems on many computers with running it. Only three computers were able to run the tests, the others needed some special plug ins. Even though the students had an easier version of the test than the one used in the first experiment, they mostly managed to answer correctly only half of the test (5 questions). This is, actually, a good result because they’ve just learned about flowcharts and didn’t have time to grasp the concept completely.
The students already had the chance of learning in this way so they weren’t surprised by the unconventional approach. The overall assessment of the class by the teacher was very positive. The material was orderly and gradually presented. The examples were concise and understandable.

2.3.7. Conclusion

The lesson of flowchart is usually very abstract for students to comprehend and truly understand. They usually just resort to mechanic memorization of the most used structures and examples. With this developed content I hope to bring more dynamics into the lesson of flowchart and in that way making it more interesting for the students and making them more motivated for learning. By using some real life situations, the students can easily comprehend. Also, because numerous examples are available, they can work extra from home to catch up on what they are not totally clear with.

Advantage of this Informatics web-site is that it can be easily broadened and in that way it's making a good foundation for developing additional content from the area of Programming.

In the future, I plan on expanding these contents with additional examples related to Programming. I am also planning on using these contents by myself to see how students are reacting to it and then make changes accordingly.

I hope this content will be of great help to many Informatics teachers and it will help them introduce a new way of teaching and organizing their class in an interactive way.

3. Concluding remarks

This has been a project that lasted three years. We are the last generation of trainees that were in Japan for 10 months developing new skills and acquiring new knowledge. All of us 9 trainees have created, by joint work, various interactive online contents from areas of Mathematics and Informatics. The termination of this project doesn't mean that our work is also over. We are planning many activities upon our return to Bosnia and Herzegovina.

Those activities are:

- continuing the development of our content
    - developing additional content related to current lessons or some other lessons that are related to the current
- promotion of our content
    - using created content teaching in our personal classes thus spreading the awareness of available content among the students
    - promoting created content among the colleagues of affiliating institutions
    - promoting the content and developing awareness about it to the colleagues in other schools and universities
    - trying to get support from the Pedagogical Institutes to approve these content as official content being used in the schools
- spreading the acquired knowledge
    - tutoring our colleagues who are interesting in modernizing their teaching process in different ways, i.e. by teaching them how to use interactive software, how to use available online resources, how to develop their own content etc.
    - seeking the help from the governmental institutions for organizing workshops (how to use ICT in education, how to develop personal content, how to use existing content etc.) or seminars (the importance of ICT in education, the benefits of modernizing the teaching process etc.)
- exchanging the gathered expertise
    - forming the network of all participant that were in Japan for training for exchanging news, ideas, projects etc.
    - seeking and contacting people who have similar experience in teaching and training and develop collaboration with them

We have learned so much in these ten months and we're planning on using that knowledge to start creating ICT learning environment in our country. Although, the Government of Bosnia and Herzegovina has still not fully recognized the importance of modernizing the teaching process, that doesn't mean that they wouldn't in the near future and that they're not opened for cooperation. It's just a matter of time when ICT education would make its full impact in our country and then we will have the chance to completely express our willingness for help and to contribute to educational reform in Bosnia and Herzegovina.

4. References

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4. **MATEMATIKA 4,** Textbook for 4th grade of High School in Mathematics, Neven Elezović i Branimir Dakić, Zagreb, 2003.
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5. Appendix

5.1 Presentations - indivisual final

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

JICA Training Program Final Presentation

Data: 27th August, 2007
Time: 14:30 ～ 15:45
Place: TBIC (JICA Tsukuba) 3rd Floor Seminar Room 4

✓Presentation

Jelena BRKIC

Development of e-learning Contents with ICT in Informatics Focused on Introduction to Programming

Mirjana MILIJEVIC

Development of Learning Contents with ICT in Mathematics Focused on elementary interactive set contents

Jovana STOJCIC

Development of Mathematics Learning Contents with ICT Focused on secondary interactive sequence contents

✓Closing remarks

Kyoko Kakihana (Tsukuba Gakuin University)
Tomoko MAEKAWA (JICA Tsukuba)
Sanae NAKASHIMA (JICA Tsukuba)
Masami ISODA (University of Tsukuba)

5.2 Presentations for JSSE conference

We wrote a paper for the national conference which will be held in August 2007 in Japan. We will present our outcome of this training each other. In what follows, the detail of the conference and the paper submitted are shown.

Japan Society for Science Education 31st Annual Contention

These: The Development of Science Education Research Which Proposes and Collaborates with Society

Date: August 17(Fri) – 19(Sun) 2007
Place: Hokkaido University
Organizer: Japan Society for Science Education
Website: http://certcms.shinshu-u.ac.jp/jsseam/modules/note0/