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The Eurasia Proceedings of Educational & Social Sciences (EPESS), 2014

Volume 1, Pages 237-242

**ICEMST 2014: International Conference on Education in Mathematics, Science & Technology**

## **METHODICAL AND MULTIMEDIA ENVIRONMENT FOR THE ACQUISITION OF ICT COMPETENCES IN THE FIELD OF LOGO PROGRAMMING OF FUTURE COMPULSORY EDUCATION TEACHERS**

Nataša ROGULJA

The Faculty of Teacher Education of the University of Zagreb

Ljubica BAKIĆ-TOMIĆ  
University NORTH Croatia

Tomislava LAUC

The Faculty of Philosophy of the University of Zagreb

**ABSTRACT:** The purpose of this paper was to propose and explore the methodical and multimedia environment required for the acquisition of ICT competences in the field of Logo programming of future compulsory education teachers. According to the student teachers' education curriculum, among other ICT competence requirements, the future teachers are to acquire relevant knowledge and skills in Logo programming. In order to determine the level of competence acquired, a methodical-qualitative evaluation of the environment, in the form of a web application, has been conducted by 50 students of The Faculty of Teacher Education of the University of Zagreb. Research results show that the environment contributes to the more effective acquisition of ICT competences of future teachers, especially in the field of computer programming.

**Key words:** ICT competences, methodical competences, compulsory education teachers, Logo programming, multimedia environment.

### **INTRODUCTION**

In the development of the National Curriculum Framework for pre-school education and general compulsory (7-14 years of age) and secondary education, which focuses on student competences, Ministry of Science, Education and Sports of the Republic of Croatia, in accordance with European and other countries, has adopted eight key competences for lifelong learning: *Communication in the mother tongue, Communication in foreign languages, Mathematical competence and basic competences in science and technology, Digital competence, Learning to learn, Social and civic competences, Sense of initiative and entrepreneurship, Cultural awareness and expression* (Ministry of Science, Education and Sports of the Republic of Croatia, 2011, p. 17).

The Faculty of Teacher Education of the University of Zagreb is training future pre-school and compulsory education teachers for their successful personal and professional development as teacher, professional and technician in the educational system (Măță, 2011). Student teachers, which will take on a roll as teacher of Informatics, require specific ICT knowledge and skills for effective and efficient use of digital learning tools in their teaching practice. When they graduate they receive a diploma which defines their ICT competences:

1. Using different operative systems and information technologies for educational purposes in compulsory education subjects; development and servicing of educational information systems and educational databases.
2. Development of various educational software with the help of information technology; ability to choose and use educational software.
3. Retrieval, processing and storage of computer data; text procesing, processing of sounds, drawings and images for educational purposes.

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- Selection and peer-review under responsibility of the Organizing Committee of the conference

\*Corresponding author: Nataša ROGULJA- e-mail: [natasa.rogulja@gmail.com](mailto:natasa.rogulja@gmail.com)

4. Using the Internet and network services: transmission, storage and authentication of various Internet information; using electronic mail.
5. Preparation and implementation of multimedia projects in Intranet/Internet environment (preparation of computer presentations, creation of web pages etc.); organization and participation in distance on-line communication and on-line learning.
6. Statistical analysis and presentation of data with the help of information technology.
7. Basic programming knowledge and skills.

The aforementioned ICT competences include methodical competences, with its didactical, pedagogical and psychological aspects, which define how student teachers use information technologies for educational purposes.

To achieve “Basic programming” competence, National plan and program for compulsory education, strictly defines “Problem solving and programming” lesson unit, which is conducted either by Logo programming language or by procedural programming language, like Basic and Pascal (Ministry of Science, Education and Sports of the Republic of Croatia, 2006, p. 310). Since The Faculty of Teacher Education of the University of Zagreb did not have any courses that would cover “Basic programming” competence, in the year 2013, we have started a new course for learning and teaching Logo for the 5<sup>th</sup> year students of Informatics module. In the first part of the course the student teachers learned philosophy, concepts and structures of Logo by listening to series of lectures and writing program assignments through which they learned how to program. In the second part of the course, the student teachers learned methodology of teaching compulsory education pupils Logo, developing multimedia projects which integrate different ICT skills and knowledge. This year, we developed a new methodical and multimedia environment as a *prototype – working raw material* for the acquisition of methodical and ICT competences in Terrapin Logo programming language, one of the dialects of Logo. Design, development and student teachers’ evaluation of the environment are presented in this paper.

### **Logo programming language**

Logo belongs to the 3<sup>rd</sup> generation of programming languages and it was created in the year 1967 by Seymour Papert and Wally Feurzeig, at Bolt, Beranek and Newman in MIT. It represents constructivist learning environment and powerful cognitive tool that enables and enriches critical thinking, creativity and higher order learning in learners. Logo’s “idealistic” idea was to use computer in education as a “tutee” (Reeves, 1998, p. 18), where learners develop problem-solving skills by teaching computer (writing programs) to perform different tasks (write text, draw pictures, create 2D and 3D geometrical forms, create animations etc.). In this way, learners could actively construct their own knowledge, and become designers, artists, organizers and presenters of that knowledge (Reeves, 1998). Today, in education, Logo is mostly known for its “*turtle graphics*” principle, where learners write program commands to move “graphical cursor” in the form of a turtle and draw line graphics on screen. There are many dialects of Logo and in Croatian schools three are frequently used: Terrapin Logo, MSW Logo and UCBLogo.

### ***Design and Development of methodical and multimedia environment***

Methodical and multimedia environment was designed by *Adobe Flash CS4 Professional* program for developing web pages and animations. Environment was created as a *prototype – working raw material* to serve as project assignments through which student teachers: redevelop and reevaluate environment by changing technical quality, usability and scenario (Crozat, Hu & Trigano, 1999); redesign and upgrade didactic and multimedia materials for their colleague students and compulsory education pupils.

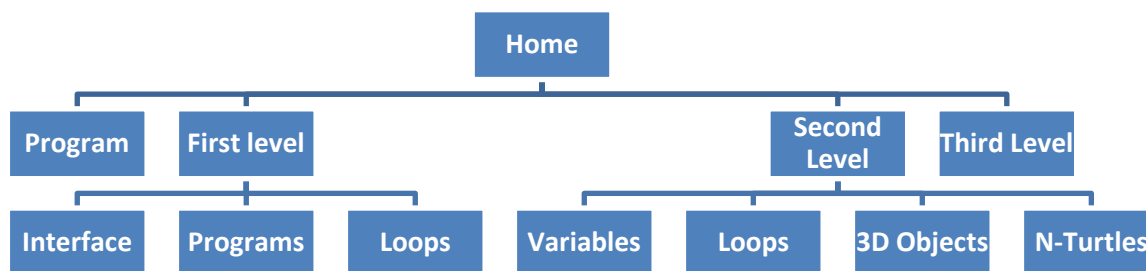


Figure 1. Navigational map of methodical and multimedia environment of Terrapin Logo language

Environment (Fig. 1) consists of five modules:

- **Home** – contains an archive of course material (PPT lecture presentations, student teachers’ projects analysis, homework, competition assignments, list of Terrapin Logo commands),
- **Program** – contains basic information (text and video presentation) of Logo and its development,
- **First Level:**
  1. **Interface** – textual and graphical description of Terrapin Logo interface,
  2. **Programs** – textual and graphical description and video tutorial on writing simple programs (procedures) with fixed parameters,
  3. **Loops** – textual and graphical descriptions and video tutorials on writing programs (procedures) for drawing regular polygons, REPEAT loop, FOREACH loop.
- **Second Level:**
  1. **Variables** – textual and graphical description of definition of complex programs (procedures) with variables,
  2. **Loops** – textual and graphical descriptions and video tutorials for WHILE loop, FOR loop, MAKE command,
  3. **3D Objects** – textual and graphical descriptions and video tutorials on writing programs (procedures) for drawing three-dimensional objects: cube, rectangular cuboid and sphere.
- **Third Level** – contains additional textual and graphical descriptions and video material of Logo as constructivist learning environment and *task type-oriented* teaching method (Papp-Varga, Szlávi & Zsakó, 2008) for problem-solving process through explorative “real life” lessons as integration of different school subjects.

## METHODS

### Objective

The aim of this research was to evaluate methodical and multimedia quality of the environment for the acquisition of methodical and ICT competences in learning and teaching Terrapin Logo programming language for the 5<sup>th</sup> year student teachers of Informatics module.

### Sample

Methodical-qualitative evaluation of the environment has been conducted by 50 students of The Faculty of Teacher Education of the University of Zagreb, 5<sup>th</sup> year, module Informatics. Students were from two generations: 2012/2103 and 2013/2014. Given that the number of men was insignificantly small compared to the number of women, the sample has not been divided on sub-samples.

### Instrument

Questionnaire was designed to gather information from student teachers of Informatics about methodical-qualitative evaluation of the environment. The questionnaire consists of three parts. The first part consists of four questions (2, 3, 4) which students teachers had to rate on an 5-point Likert-type scale in order to evaluate methodical quality of the environment for acquiring programming knowledge and skills in Terrapin Logo programming language. The second part consists of three questions (1, 5, 6) which students teachers had to rate

on an 5-point Likert-type scale in order to evaluate their methodical and ICT competences in teaching Terrapin Logo programming language. The third part consists of two questions (7, 8) where student teachers had to evaluate methodical appropriateness of the environment (5-point Likert-type scale) for compulsory education pupils of younger age (7-11) and methodical quality of the environment (writing personal opinions) from textual (theoretical), visual (graphical) and multimedia (video presentations) context.

### Data collection

The methodical and multimedia environment was uploaded as a web application on the Department of Informatics' official web page. One part of the data was collected by paper-pencil testing and other part by electronic mail.

## RESULTS and DISCUSSION

### Descriptive results

**Table 1. Mean values and standard deviations in evaluation of methodical quality of the environment for acquiring programming knowledge and skills in Terrapin Logo**

No.	Question	1	2	3	4	5	Mean	Std. Deviation
2a	Evaluate methodical quality of the environment in textual (theoretical) context	0	0	11	20	19	<b>4,16</b>	<b>3,25</b>
2b	Evaluate methodical quality of the environment in visual (graphical) context	0	1	4	13	32	<b>4,52</b>	<b>4,14</b>
2c	Evaluate methodical quality of the environment in multimedia (video presentations) context	0	0	3	16	31	<b>4,56</b>	<b>4,12</b>
3	Evaluate "virtual teacher-guide" of the environment	0	0	8	20	22	<b>4,28</b>	<b>3,43</b>
4	Evaluate the environmental level of motivation for learning Terrapin Logo	0	1	6	30	13	<b>4,10</b>	<b>3,94</b>

In question number 2, student teachers evaluated the methodical quality of the environment in textual (theoretical) context, with a mean score of 4,16 (SD=3,25), which means that most of them (39) consider textual context to be of very good and excellent quality. Visual (graphical) context of the environment was evaluated with a mean score of 4,52 (SD=4,14) which means that most of the student teachers (45) consider visual context to be of an excellent quality. Multimedia (video presentations) context of the environment was evaluated with a mean score of 4,56 (SD=4,12) which means that almost all the student teachers (47) consider multimedia context to be of an excellent quality.

In question number 3, student teachers evaluated "virtual teacher-guide" of the environment with a mean score of 4,28 (SD=3,43), which means that most of them (42) consider "virtual teacher-guide" exceptionally successful guidance.

In question number 4, student teachers evaluated environmental level of motivation for learning Terrapin Logo with a mean score of 4,10 (SD=3,94), which means that most of them (43) consider environment highly motivational.

**Table 2. Mean values and standard deviation in evaluation of methodical and ICT competences in teaching Terrapin Logo**

No.	Question	1	2	3	4	5	Mean	Std. Deviation
1	Evaluate the environment level of contribution to the acquisition of your methodical competences	0	0	5	24	21	<b>4,32</b>	<b>3,68</b>
5	Evaluate readiness to use this environment in your future work with compulsory education pupils	0	0	3	26	21	<b>4,36</b>	<b>3,91</b>

In question number 1, student teachers evaluated the environment level of contribution to acquisition of their methodical competences for teaching Terrapin Logo with a mean score of 4,32 (SD=3,68), which means that most of them (45) consider that the environment can greatly contribute to the development of their competences.

In question number 5, student teachers evaluated their readiness to use the environment in their future work with compulsory education pupils with a mean score of 4,36 (SD=3,91), which means that most of them (47) are ready to and are interested in using the environment in their future work.

In question number 6, student teachers evaluated their ability to design and develop similar environment for teaching compulsory education pupils Logo, using programs for developing web pages and animations. 32% of them stated they had the necessary ICT competences to design and develop such environment. 20% of them stated they did not have the necessary ICT competences, and 48% of them were not confident in their abilities to perform such a task. Most of the student teachers who expressed their readiness and were confident in their abilities, belong to first generation 2012/2013 of Logo programming language course, which implies that the second generation feels less confident about taking on such a task, which can be changed with adequate teaching practice after they received basic training in this field.

In question number 7, student teachers evaluated methodical appropriateness of the environment for compulsory education pupils of younger age (7-11), with a mean score of 3,98 (SD=3,75), which means that most of them (41) consider the environment to be highly appropriate for that specific age. In this case, student teachers had only one complaint on the textual (theoretical) context of the environment, suggesting upgrading it with a more detailed explanation of certain abstract terms, like “interface”, “loop”, “variable”, “procedure”, etc.

### ***Student teachers' suggestions***

In question number 8, student teachers evaluated methodical quality of the environment in a textual (theoretical), visual (graphical) and multimedia context. With regard to the textual context, they consider textual information to be “*well synchronized with the multimedia elements (video presentations)*” and highlighted the necessity to “*adapt the textual information of the environment to compulsory education pupils of younger age (7-11) who would go through the learning process with the guidance of their teachers*”. The reason for this is that the pupils of that age are not familiar with certain abstract terms, like “interface”, “loop”, “variable”, “procedure” etc.

With regard to the visual context, they consider visual (graphical) information to be “*sufficiently motivating for students, with good balance between visual and textual context and simple with concise information*”. They proposed “*increasing icon size in the entire environment and Home module and upgrading the environment with certain features that are visually attractive to children, like a picture or an animation of a turtle or some other character*”, which would play the role of a “virtual teacher-guide”. With regard to the design of the environment, they suggested redesigning it into a more adequate form by “*separating the content into two different modules: teacher module (guidelines and extra class materials) and pupil module ('step-by-step' guidelines in the learning process and detailed visual explanations of the program's interface)*”.

With regard to the multimedia, they “*liked very much 'step-by-step' explanations of the learning material*” and highlighted the importance of the “video tutorial” approach in the learning process. They described video presentations as “*very clear and refreshing*” and suggested “*adding more presentations with more detailed animations of turtle movements, where each movement should be covered with the corresponding Logo command*”. They also suggested increasing video presentations for “*complex examples in programming assignments, where learners could watch the video and solve the problem at the same time*”. It would also facilitate learning process for learners with “*attention deficit disorder, who could stop the video at any point*” and recapitulate their knowledge. From the phonetic aspect, the student teachers highlighted “*insufficient quality of the speaker in terms of accent and intonation of individual words in sentences, which can make it difficult for learners to accept and memorize the content*”.

Although the student teachers were asked to evaluate these three aspects of the environment, they added one more on their own initiative – *Programming context*. They suggested certain improvements in explaining “*'Tellall' Logo command when working with multiple turtles and placing a separate link inside the environment for the explanation of program loops, which would be visible and accessible to the learners*”. For better understanding of certain program terms, like “*program loops and interior or exterior angles of regular polygons*”, they highlighted “*the necessity to translate them into Croatian language, what would help learners to understand its principles better*”.

## CONCLUSION

Proposed methodical and multimedia environment presents an adequate tool for the acquisition of student teachers' methodical and ICT competences in the field of constructivist programming language, Terrapin Logo. Student teachers of Informatics have evaluated the environment with very high grades from all of its aspects. They consider it to be something "new in education and a very useful example of e-learning", which helps them to broaden their programming experience and upgrade their digital competence.

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