

Distance Education; e-Learning Solution

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Abstract

Teachers play important roles in technology-rich classrooms, making decisions that significantly affect students' learning. Initially, teachers decide "if, when, and how" they will use technology in the classroom. Those decisions include selecting learning objects that enlarge and enrich their repertoire of instructional techniques for presenting content.

Our article describes learning objects, explores why teachers would want to use them, and explains how to facilitate their use. Also, with this paper we aim at introducing a special e-Learning solution, Learning Objects. In particular this solution provides for the support of distance education in programming without permanent supervision by a teacher.

A learning object is a resource, usually digital and web-based, that can be used and re-used to support learning. Our Learning Objects are interactive visualizations of program code examples or programming tasks. They have been developed to help students to understand programming structures more easily. A Learning Object can cover any specific programming problem in any programming language. Learning Objects can also cover the problem-solving logic at the algorithmic level. A learning object focuses on one specific learning goal. Each learning object has to be independent, without links to other objects or resources. This independence

ensures the real reusability of the learning object.

Keywords: eLearning, Learning Objects, Distance Education

1. Introduction

Learning computer science and especially programming seems to be a difficult task for students today. What is the best way to teach computer science to novice students is a question; many teachers have been considering recently and is even more relevant now, than a few years ago, when computer science no longer seems to be an attractive subject to university students in Western Europe, America, Australia, New Zealand and even other parts of the world. What can we do to help students to gain better understanding of fundamentals of programming and feel the joy of running programming codes successfully? The answer is not simple and depends on what you consider most important in teaching.

Computer science students often have diverse backgrounds and learning styles that can call for miscellaneous learning and teaching methods. Research indicates that novice programmers have difficulty in understanding programming concepts, the syntax of codes and the interpretation of blocks of codes. Teachers are looking for new methods and support for their teaching, they want to help students and motivate them and learning objects with their visualization might be considered feasible support.

In the last years almost 250 LO's were produced within the scope of the Codewitz Project by several international teams. A detailed overview of the categories and numbers of the produced LOs is available on the Internet site of the project.

Characteristic for Codewitz Project is the fact that there exist only a few basic rules for the design of the LOs which caused a huge variety of solutions that have been developed. Besides implementing different user interfaces and having divergent levels of user interaction all solutions have their specific understanding of knowledge transfer and a corresponding learning philosophy. All the experience gathered by producing and using these LOs need to be sorted and evaluated. Some of our evaluation results regarding in the project implemented LOs we presented before on several conferences .

Accepted and mainly applied in distance education to day the concept of blended learning allows the usage of various content available on the WEB. Just because the growing part of it is the open source and can be used for free we observe the occurring wide integration of this open content into e-learning applications. But even if one can find in Internet encyclopedia like Wikipedia well described and presented documents about all possible topics they are not a priori prepared/ designed for learning as we defined it before – for empowerment to solve tasks or problems in particular situation or under special circumstances. Because of primarily orientation of Internet encyclopedia on scientific description of objects, events, processes, etc. they will never compete with FAQ which support the solution of real problems or tasks in the business and in the everyday life. From our point of view the acceptable distance education in general and e-Learning in particular has to combine both scientific and application oriented approaches. Especially

important is it in such service oriented areas like programming skills.

3. Codewitz learning objects

The students of basic programming courses usually do not make much progress (Kölling & Rosenberg, 1996). To improve the students' progress we start to produce and evaluate unique illustration, animation and visualization aids for students and teachers of computer programming, who are involved in the field of professional and/or higher education.

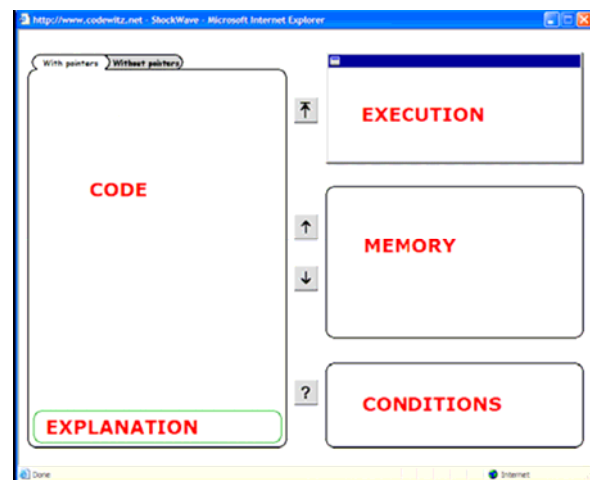


Figure 1

By reducing complexity in learning computer programming these aids, referred as Learning Objects help the learners to better understand and master, and the teachers to better explain and illustrate the problems connected to the use of basic and advanced structures in computer programming. The learning objects discussed in this paper are from the Codewitz (www.codewitz.net) project which is a Minerva Socrates project that emphasizes developing and producing interactive web-based learning objects for programming courses.

The idea of the program visualization learning objects is debugger like step-by-step

program execution in both forward and backward directions (Figure 2).

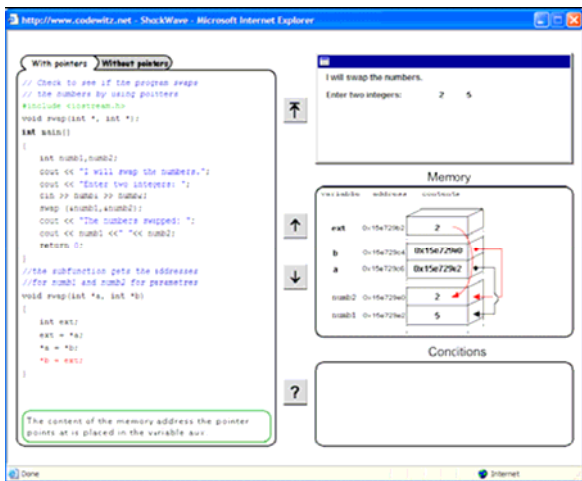


Figure 2

The program code is highlighted in each important step of the program execution and the run of the execution in code is also visualized by arrows when necessary. In each step of the program execution console is visible as well as the memory area. There are also areas for the conditions and for the short explanations of the current step. The memory part is the only one where the layout can be changed according to the subject as learning goal. These changes appear for example in case of arrays when the structure of the array is visualized.

The design of most of the objects is similar to the one in Figure 1 but some have a slightly different design as can be seen in Figure 3, where the task is explained for an exercise and a feedback given..

Learning objects in the Codewitz project are web-based standalone visualizations of programming tasks or code examples built for clear specific learning goals. The Codewitz learning objects are so far many for supporting C++ teaching and learning but some of the objects are also for teaching/learning Java (Figure 4).

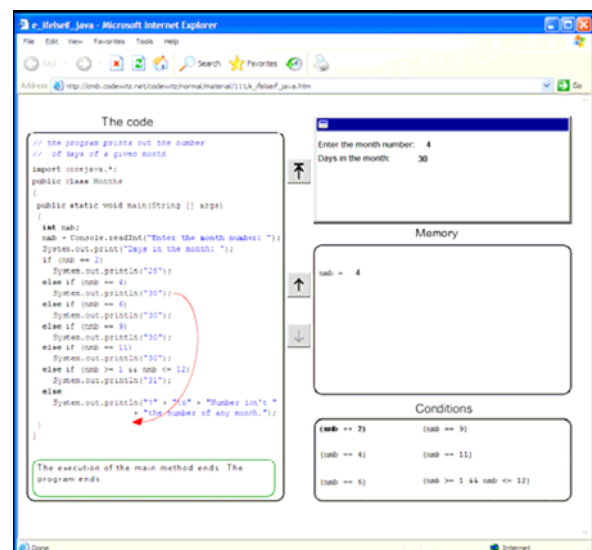


Figure 4

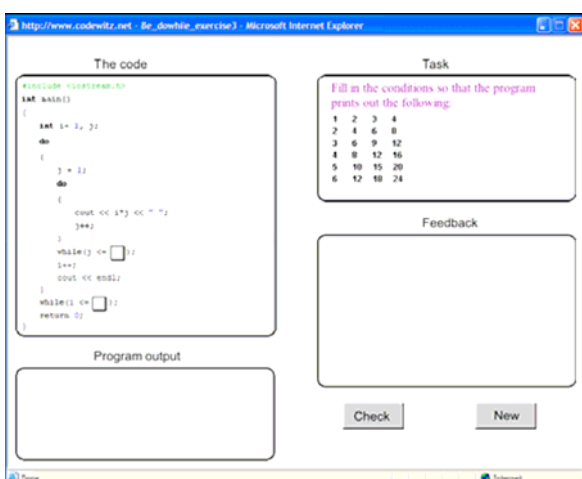


Figure 3

At the end of the project as many as 178 learning objects have been made and they are accessible through the project's website where pans for about 400 new objects can also be found. Figure 1 shows an example of a learning object which explains pointers. Here we can see that the object has an area for input/output from the student, execution that shows step by step what is going on and an area for Memory and Conditions. Many of the objects also have an explanation area.

To make the objects the partners could use different methods or programs and most of them used Macromedia Director so many of the objects need Macromedia Shockwave to run but some are made with Flash and some with Java (Figure 5).

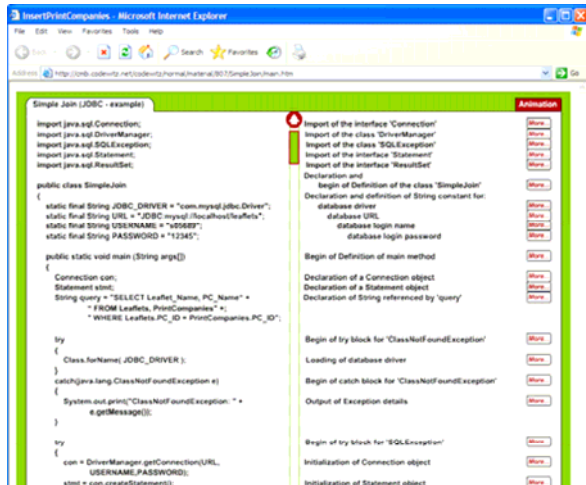


Figure 5

4. A case study

To improve the progress of the students of programming language courses, visualization learning objects are produced and used as learning material. In some institutions the students have different study backgrounds. Some come to the course with non-theoretical and some with theoretical studies behind them. The focus is set on the differences in the effects of program visualization learning objects on the students' course results.

The study was organized on the same course in two years: In the first year students do not have the program visualization learning objects as learning material available and in the second year they have the program visualization learning objects available. The students study exactly the same course.

The effects of the program visualization learning objects on the results are then analyzed by the final course points and grades and activity of the students and also with a survey about all learning materials available held at the end of the course.

The study was conducted in Technical University of Civil Engineering during years 2005-2007 for distance learning students who are involve in Romanian project (PIR) for rural education (225 students)

These civil engineering students have one obligatory programming course included in their studies. This course is called Programming Language and the course covers the first steps of programming like variables, selection, loops, arrays and functions. The Programming Language course is timed in the second semester of the second year of their studies and the scale of the course is three credits. The course consists of lectures and lab exercises. Each student has 28 lecture hours and also 28 lab hours .

Each year three groups of around 75 students are formed. The groups have the Programming Language course parallel with the exactly same content. It is assumed in the course everyone has no previous knowledge about programming.

The organization of the study was divided in two years. In 2005-2006 the students had the courses in a traditional way with no program visualization learning objects available. The 2006-2007 courses were organized with program visualization learning objects available for the students as learning material in the local network throughout the course. In 2006-2007 all the students were guided by the teacher to use the learning objects as the extra learning material.

The program visualization learning objects were occasionally also used as program examples by the teacher. The both year courses were held by the same teacher with the same material and with the same outside classroom assessments for the students. At the end exactly the same paper exam was given to the students in both years. The exam papers were not given back to the students. Thus the questions in the exam are considered not to be known by the next year students.

This study consists of two parts. The first one is the results of the courses in two years. The first study takes also into account also the activity of the outside classroom assessments made by the students during the course. The second study is the survey made for the students at the end of the course. In this survey the students answered to the questions concerning their background and the usefulness of different kind of learning materials in their learning process. This survey was conducted during the last lessons of the course.

The results consist of the final grade and the activity of the students. Final grade is between 1 and 10 where 4 is failed, 5 first grade for the completion of the course and 10 is the best grade (Figure 6).

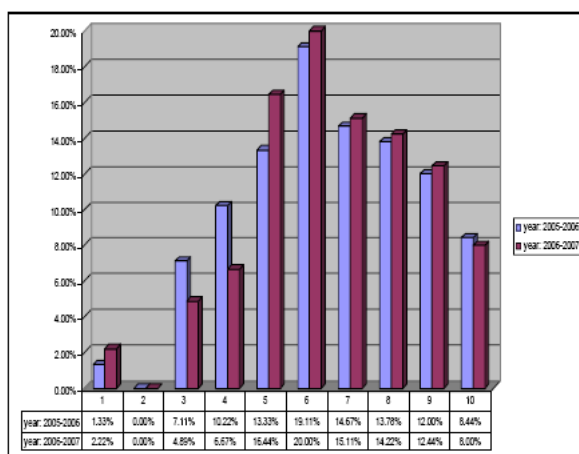


Figure 6

In the survey the students were asked about their programming skills before the course, about the skills in using computers in general, about all learning materials used in the course and program visualization learning objects (used only in 2006-2007 courses). The survey result about visualization learning objects was very good (Figure 7).

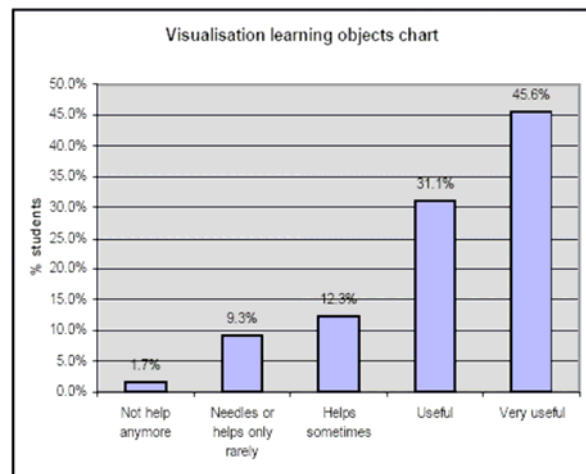


Figure 7

5. Conclusion

The gathered experience provides a profound basis for the improvement of the LO implemented in the Codewitz Project regarding their quality and quantity. The significant step on this way is to make use of the knowledge and experience of additional experts (like linguists).

Our future activities within Codewitz will respect the discussed guidelines to improve the production and usage of LOs. After the necessary adaptations to the Romanian learning culture the produced LO increases their potential to be applied in university and additional education in Romania.

Interactive learning object is an idea that many teachers welcome in their search

for new methods and support for novice programming students. What subjects to explain with the help of learning object is always a question and in the Codewitz project the need analysis was helpful for the project partners to choose where to begin. To introduce the learning objects to teachers and students is still an ongoing process and all teachers can become partners in Codewitz, get access to the material bank and take part in developing more interactive learning objects.

It is quite clear that students believe that learning objects can be useful for them as novice programming students. But it is also quite clear that more introductions and better integration of learning objects is needed to encourage students to use them more frequently as a normal part of their programming study. Only a part of the students seem to use extensive material outside the classroom and although they know about good material they somehow do not use it. Here we might have to deal with students learning style and their immaturity as learners. Codewitz learning objects are not the witchcraft we might need in teaching programming today but I believe it could be useful especially if it becomes integrated into teaching and learning and a natural part of students programming life.

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