Combining Virtual Learning Environment and Integrated Development Environment to Enhance e-learning

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Abstract— **The research was undertaken having in consideration two hypothesis. The first hypothesis is that integration of virtual learning environment (VLE) in the form of an e-learning interactive tool and integrated developing environment (IDE) for programming in Java language will contribute in improving the efficiency and quality in learning because of the enhanced graphical user interface and the "hands on approach". The learners can implement and test what they have learned and further extend their learning at the same time.**

The second hypothesis is that the designed graphical user interface of the virtual learning environment will contribute in facilitating its use by improving the results of the learning process, increasing the user-satisfaction and attention during learning that implicates improving the overal efficiency of learning programming in Java. The objective of the research was to investigate what are the possibilities for improving learning Java programing by creating an e-learning interactive tool with enhanced graphical user interface. An analyses of the traditional method of learning programming language and virtual learning environment approach has been realized. Issues have been identified and proposed solutions and recommendations while reviewing the current situations in these fields. The usability of the created virtual environment was reviewed, in order to assess and propose solutions to the identified issues. The outcomes of the research is a Java interactive tool as virtual environment for learning and practicing Java programming language. It provides an integrated help, that the learners need in order to learn Java language without exposing them to the need to leave the application framework. An editor is also provided with compiling option, option for running Java application or applet and capturing and validating the syntax errors from user side. This way we have promoted the Java learning environment as self sufficient to achieve its objective.

I. INTRODUCTION

During the last decades, due to the development of information and communication technology and the raising impact of the Internet, an access to a huge amount of information is enabled world wide. This offers new opportunities to acquire knowledge any time, anywhere regardless to the previous constraints, time and location. More and more information in a daily basis is presented in digital and multimodal form.

In order to use all this information in the process of learning electronic environments are created and used.

The impact of these technologies is reflected in the increased utilization of e-learning systems and virtual e-learning environments for learning.

However there is a certain skepticism regarding e-learning and virtual environments efficiency lately. This is the reason why we have analyzed e-learning systems and virtual e-learning environments. We are in an opinion that further research needs to be conducted to design a grounded theory that would focus on developing a good and efficient system for learning.

II. ANALYSES OF THE TRADITIONAL METHODS OF TEACHING

Based on our experiences and that of the other colleges from other institutions, related to teaching object oriented programming in a classroom, a conclusion is drawn that teaching and learning object oriented programming is much easer if an electronic environment and if new technologies are used.

Learning to program in object oriented language is difficult for novices in the traditional classroom method.

The instructor must transmit new ideas of programming concepts, writing, debugging and testing a code that is very difficult. The traditional method of learning is instructor-centered and depends on the methods the instructor uses. The method of teaching lectures on the table, even the visual format of the lectures in a computer, is not sufficient. To overwhelm all the elements of the process of learning to program, each element must be practically tested. The traditional method is limited in time, place and time duration of the class. The wide range of experiential background from novices to advanced programmers. Because of the diversity in the level of knowledge and capabilities of students, some might need to do revision on the lectures that is impossible in the traditional way of learning. Using the "hands on approach" that means the learned concepts can be tested and applied immediately, also is impossible in the traditional way of learning. In this method of learning, the students are more passive while offering people the opportunity to be active in the learning process through structuring the context in which problems are presented encourages a more natural style of learning. To outrun these difficulties and to complement the demerits of the traditional method of learning to program, today new methods are developed using the electronic learning environments and developing environments for practical application.

III. VIRTUAL LEARNING ENVIRONMENTS

Over the last years, the education and learning and teaching have been influenced by the rapid technology development.

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That is the learning process has been changed towards more interactive learning activities and authentic experiences according to [1].

The new learning environments are technology enhanced and supported and computer based environments called virtual learning environments.

[2] defines virtual learning environments as computer-based environments that are relatively open systems, allowing interactions with other participants and access to a wide range of resources. Such environments foster the "any time/any place" learning model that is not only a different way of delivering knowledge, but also a powerful means of creating knowledge. These new ways potentially have a wide range of advantages over traditional environments (e.g., convenience, flexibility, lower costs, currency of material, increased retention, and transcending geographical barriers) according to [3].

Learning to program is difficult. To help novices to learn programming we have focused our research on developing a virtual environment to facilitate learning to program in a sense of offering an electronic environment that should meet all the users needs and overrun the demerits of the traditional method of learning .

Usually while developing virtual environments pedagogical aspect is left behind without consideration. Therefore, to develop a quality e-learning virtual environment for learning Java we have focused on the pedagogical concept of the e-learning solution.

A research is made on how to design a quality e-learning.

According to [4] to design our e-learning solution we have followed the approach that design and use of e-learning must be grounded in a learning theory approach. "In order to develop the use of e-learning from a pedagogical point of view, it is therefore not enough to study the existing practice. Instead, it is necessary to have an understanding of theoretical principles of the learning process and of the ideal learning environment" [5]. The learning environment is important because it models the learning process of particular course in a technological medium, so we have to ideally model the learning process. That is the interface that the learners interact with and the learning activities are taking place to achieve the learning goals.

This means that the design of e-learning can not be based only in the existing practice, it is necessary to understand the relation between theory and practice to ensure that the design of practice is founded on the learning theory. This concept is shown in the following figure:

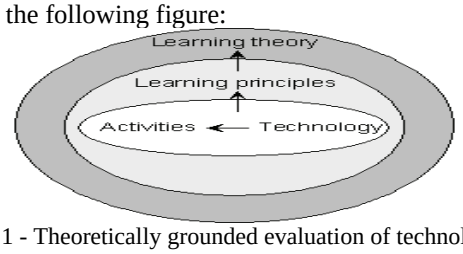

Figure 1 - Theoretically grounded evaluation of technology [2]

We have followed this concept as a pedagogical background of our e-learning solution. It describes that the different learning activities that are driven in the learning environment are supported by the e-learning technologies stated above. The learning principles are formed by the learning activities to be done to produce the learning outcome. The learning activities are crucial to define the features and abilities the learning environment has to support and are supported by the technology. According to the concept of grounded design in [4] that is "defined as the systematic implementation of processes and procedures that are rooted in established theory and research in human learning" (p. 102), the implementation of the learning activities are rooted in the learning theory and human learning theory.

IV. PEDAGOGICAL CONCEPT ADOPTED

We think that the cognitive and intellectual abilities of learners are crucial in the process of learning to program in an object-oriented programming language.

From the several years teaching experience, we concluded that learning to program in an object-oriented programming language is a complex process where the learning approach is not self sufficient. To support the cognitive learning in the process of learning to program we think that a constructive approach of creating knowledge should be enabled. We think the combination of the two approaches would give a better result on the process of learning. The model of the developed learning environment is founded on the learning activities that depend on the cognitive and intellectual abilities of learners and their abilities to individually construct a knowledge. The pedagogical concept in designing the e-learning virtual environment to learn Java is based on:

- Our e-learning solution for learning programming language Java is grounded on the cognitivist and constructivist learning theory where the learning environment consists of structured learning content integrated as online help content and editing-developing environment which enables creating and finding solution to problems, in the sense that they test different programming concepts of a given example (in the help content) or one created by the user.
- The independent student work supports their individual cognitive abilities to perceive the learning content and process it into knowledge and the individual and subjective construction of knowledge.
- The students work is based on their independent exploration of the learning content where they learn and even more on constructing their knowledge by testing what they have learned and creating new solutions of the given examples or problems or new problems.

V. ADVANTAGES AND DISADVANTAGES IN USAGE COMPARED AGAINST THE TRADITIONAL METHOD OF LEARNING

The virtual learning environment for learning to program in Java will have a simple GUI and will be easy to understand and use, and will be distributed for free download and the more important is the system doesn't need to be installed, meaning we minimize the needed requirements to a simple run of an application. To support the novice programmers our project provides a set of specially designed tools. It includes an editor for editing programs and file manipulation, visual tools for compiling and executing the program and help content that are all presented within a single user-interface

framework. This allows students to move from one activity to another with a minimized effort. All this provides a maximum support to the novice programmers since program construction can be conducted entirely through menu interaction.

It will offer just the essential functions needed to write Java code. This will allow the users to concentrate on the language structure and the principles of coding. The virtual environment offers a developing environment that enables the "hands on approach" that helps students to improve the quality in learning in a sense of immediate testing what they have learned. While the learning content is integrated as a help content, including links to external recourses, multimedia and audio content and the Microsoft avatar as an assistant in learning. This will offer students to learn and practically test the programming concepts, self-pace the process of learning and when and where they want.

To learn programming in Java in the traditional method, we have used the traditional format of lectures in the table or power point presentations that were transmitted by the instructor and were instructor-centered, and not flexible in aspect of time and place.

To write, debug and test a code was very difficult while creating an executive object was impossible with the concept ex-cathedra. Therefore, a simple text editor was used to write the code. To compile and execute the Java code, the Sun Java compiler - Javac was invoked writing a strict syntax-ed command that initiated an increased rate of errors.

In the following table is given the result of comparing learning to program in Java in the traditional method and using the developed learning environment, the same time the advantages of using the developed virtual environment against the traditional method of learning Java:

Variable	Traditional method	Virtual Learning Environment Java
Conducting learning	instructor-paced	self-paced
Flexibility of learning	non	time and place flexibility
Revision of the content	impossible	multiple times
Time duration of the class	limited	unlimited
Writing, testing and debugging	very difficult	easy
Compiling and executing a code	big rate of errors, task scenario 1	low rate of errors, task scenario 2
Learning activity	passive	active

Table 1. Traditional method versus Learning with VLE Java

Disadvantages:

There are still some disadvantages of using the developed virtual environment against the traditional method of learning Java:

1. The acquisition of some skills and concepts of programming depend on direct face-to-face contact with the instructor.
2. The classrooms enable to get an instant feedback from the learners which is very important in the process of learning.
3. The students that can not learn without help are disadvantaged.

The face-to-face training with an instructor leads to greater interaction during learning where the learner may acquire knowledge from the instructor and that leads to greater success

VI. USABILITY TESTING

We conducted usability testing based on performance measurement to quantify usability requirements such as time to complete a task, time to learn, rate of errors and subjective satisfaction defined by task scenario using the traditional method environment and the developed integrated virtual environment Java. Also we made an evaluation by direct observation of users while they were performing different tasks by using the traditional method environment and the developed integrated virtual environment, and users from two different classes were observed.

a. What do we evaluate?

In terms of usability:

- functionalities: can the user perform the requested tasks?
- time: are the tasks performed in a reasonable time?
- satisfaction: is the user satisfied?
- Mistakes: does the user make a lot of mistakes?
- comparison, in particular with text based interface tool.

The research conducted was based on qualitative research were we study the relationships between the study variables and afterwards we use exploratory research to research the factors influencing the graphical user environment and afterwards constructive research to construct the software solution.

We can view the results of the usability testing in the two used environments in the following tables:

Table 1. Usability research for Class-1 in the Traditional method and the developed virtual environment

Usability Attribute	Measuring instrument	Value to be measured	Traditional method environment	Integrated virtual environment
Time to learn	Task Scenario1	Time to complete task	600	400
Speed of performance	Task Scenario1	Time to complete task	600	400
Rate of errors	Task Scenario1	Number of errors	7	2
Subjective satisfaction	Task Scenario1	Satisfaction degree of users	2	5
* number. Subject satisfaction scale: very high 5, high 4, average 3, low 2, very low 1				

Table 2. Usability research for Class-2 in the traditional method and the developed virtual environment

Usability Attribute	Measuring instrument	Value to be measured	Traditional method environment	Integrated virtual environme
Time to learn	Task Scenario	Time to complete task	500	300
Speed of performance	Task Scenario	Time to complete task	500	300
Rate of errors	Task Scenario	Number of errors	5	1
Subjective satisfaction	Task Scenario1	Satisfaction degree of users	1	5
* number. Subject satisfaction scale: very high 5, high 4, average 3, low 2, very low 1				

VII. CONCLUSION

We have tested the viability of the variables chosen for the study of the developed Java Editor e-learning system. It also produced valuable information for the design of the subsequent studies. The conclusions may be summarized as follows:

- The variables provide both qualitative and quantitative and objective and subjective data.

The experiences introduced suggests the positive effects of using the Java Editor in classroom teaching/learning. In these classes, randomly assigned treatment groups experienced the Java Editor assisted learning in different ways, and the data were collected through the class experiences and questionnaires. Those questionnaires have shown positive opinions and high degree of user friendly concept embracement of the developed virtual environment.

Using this kind of user centered approach in building our graphical user interface and involving the users at each stage of the development and evaluation of the interface we have concluded that it resulted in a very user friendly graphical user interface. It is more usable, oriented towards the users and will certainly be used in the future from their side according to the satisfaction rate encountered during the usability testing.

According to the research results we acquired from the empirical study and compared to the previous years of the same java classes when for compiling was used the command based interface and for writing the code the notepad was used, the new developed graphical interface has several advantages. The developed graphical user interface system is easier to use and has better performance rate than the textual command line based interfaces which was usually used previously in java classes for compiling the java code. Also having everything they need in one place the students do not need to leave the application framework at all especially by having the multimedia and virtual assistant help. The option to capture the syntax errors was also welcomed from the users of both type's expert and novice.

In a perspective of learning a programming language, in general, to use a graphical user interface system is less expensive and less time consuming, a greater accuracy in the process of writing the code has been achieved, also compiling and running the code is much easier and linear process than the use of textual command-line based interface. Users are more involved in using the visual graphical interface and more confident than the previous users using command based textual interface. Our recommendations are to use this kind of structured approach described here to develop similar graphical user interfaces using the user centered approach that will include the users at all the development stages of the graphical interface.

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