

VIRTUAL LEARNING ENVIRONMENT IN SUPPORT OF THE TEACHING OF OBJECT ORIENTED PROGRAMMING

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Summary: This project developed a Virtual Learning Environment reflection of the information collected in surveys of students and teachers, in response to the needs of teaching and innovative proposals relevant to the profile of our current students.

Was implemented on the platform by its nature free DOKEOS collaborative and cooperative work with a methodology to accompany the class sessions, where each item proposed is a Learning Object.

Finally, piloted with a group of students who developed UNAB the first item and answered a survey that allowed us to analyze their behavior.

Keywords: E-Learning, Programming, oriented, Objects, Dokeos.

INTRODUCTION

In recent years there has been a significant worldwide reduction in the intake of students to engineering programs. Several factors influence this problem, from low levels in mathematics, the reduction of investment in science and mathematics of some governments (USA), to the perception of young people who work in this field will be exhausted, the latter is contrary to what employers say many countries: by 2020 there will be 20 million jobs Snider¹.

Mathematics is not the only reason why students do not enter or leave engineering programs. The difficulty in learning programming, as an essential element in the formation of an engineer, further aggravates the problem. Introductory courses in computer programming required pedagogical and technological strategies to attract and did not reject the students, but that in turn inform and actually achieve them lay the foundations for good programming, "The correct programming does not fall from the sky "Jadud². Once connected the importance of using appropriate technology tools, the identification of object-oriented programming as one of the most influential programming paradigms in recent years Kölling³ and clearly identified as one of the most critical issues, the intention is born propose a learning mechanism that can support the teaching of OOP.

As a complement to the objective of this project seeks to achieve a completely new perspective, which includes ICT, Web 2.0 and looking for a fully autonomous learning in students. Similarly it is hoped will be used from a classroom supplement or as proposed face meetings entirely online with online teaching guidance. This solution is proposed through a model of e-learning to help resolve these difficulties on an introductory course in computer programming on the subject of OOP and some of the following hypothesis: It is possible to design a strategy and -learning applied to teaching computer programming to help improve the teaching and learning in this area. As advances have been seen where the diversity of educational proposals programming is an effective result in the students, according to studies by Prucz, Migri, and the results delivered by national projects such as high trajectory CUI2 University of Andes, who have advanced the effectiveness of these proposals with students Villalobos⁴, Villalobos et al⁵.

1 Jon, S. (n.d). Computer, engineering enrollment up. USA Today,

2 Jadud Matthew (2005) A First look at Novice Compilation Behaviour using BlueJ.

3 Kölling Michael (1999) The Problem of teaching object-oriented programming Part I: Languages

4 Villalobos Jorge (2007) Cómo enseñar a programar: un enfoque efectivo.

5 Villalobos Jorge et al (2005) Looking for a new approach to teach/learn a first computer-programming course

Results showed a document with the state of the art of teaching object-oriented programming, design of a Virtual Learning Environment in place to teach specific topics of computer programming, two survey instruments in and out, results of the evaluation of Virtual Learning Environment and finally implemented a research paper to disseminate research results and their contributions to the field of pedagogy and TIC.

We worked a schedule that allowed meet the objectives proposed in the time and responded with a methodology that addresses both the research, development of the proposal, the implementation in a real way and the results obtained from it.

STATE OF THE ART

Programming education has entered the field of e-learning from different perspectives and using different methodologies, the following lists some examples of progress in this area worldwide:

According Misoko⁶ intends to implement Web-based teaching mainly by the personalization of learning as a means to advance the study of programming using the method of "watching others." For this purpose tools were created where students create a code and get feedback from the teacher via the same tool, allowing you to produce code with the recognition of errors and independently with guidance and support for their teacher to comment and provides means for deepen the student. The result was the increase in student learning. This study shows a need for programming solved with excellent results using the e-learning, so check our initial hypothesis and purpose of this study.

In the Queensland University of Technology in the Faculty of Information Technology, Nghi et al⁷ worked on the Environment for learning to program (EPL), which provides a web-based interactive environment for teaching programming in the early years, through an active, collaborative, online and constructive environment to help technology students to program successfully. The University has made it easier to work collaboratively with benefits for both teachers and students by encouraging feedback, practice and allowing students to progress at their own pace. EPL allows easy integration of notes, tutorials and practical exercises, with the possibility of coaching at any time and anywhere and the amount you need. This study shows the strength of the web-based education in solving various problems that often occur when classroom teaching of programming in Java, is a great example for its success, according to our objective and projection.

On the other hand, there has been progress at the University of Regina in the Department of Computer Science with the creation of an intelligent tutoring system based on Web for computer programming has come even to not only be a behavioral tool, but really smart and that can help students navigate through the online material, recommending learning goals and appropriate reading sequences generated thus achieving highly efficient and active to learning. A fact that led to the realization of this project and that precisely matches our initial hypothesis and because of our study is that empirical studies show that one to one tutoring is the most effective teaching and learning is a solution well made that shows how you can approach the teaching of programming in e-learning in an effective manner.

6 Heo Misoko (2003) A Learning and Assessment Tool for Web-based Distributed Education.

7 Truong Nghi, Bancroft Peter y Roe Paul (2003) A Web Based Environment for Learning to Program

Across the globe our problems reach places like Taiwan, where universities have joined efforts to formalize a study 4-Yuin Wu⁸ et al to provide a Web-based solution called "DRW" which offers 5 programming activities with multiple difficulty levels based on the taxonomy Bloom's cognitive, providing online: code, execution and annotation tools, to conduct the training and assignments via Web-based programming. Again offer very satisfactory statistics of the application of this system. Study is very consistent with what you want this project because it addresses not only a tool but a complete methodology through activities designed for the Web, as well as the expectations that were generated in different fields after the results of the project.

In the Department of Computer Science at the University of Warwick, and Mike⁹ Jirarat a study whose findings and conclusions provide a very consistent contribution to the objectives outlined in the construction of the remedy provided in our project, as well as being successful, it is based is a feature of collaborative e-learning and co-evaluation by peers (students). It has been found that constructive criticism against the work of others, encourages students to make best efforts to correct your mistakes by seeing them in other jobs. It also presents some features to improve, as the possibility of affecting students subjectivism in assessing the work of others.

Studies show that students can learn to program through 5 different ways: Following, where students learn by experiencing through monitoring of a unit, Building Code, where the learning of programming through the learning experience of code Understanding and integrating, where the act of programming is experienced through the understanding and integration of concepts, Problem Solving, which is experienced through learning what it takes to solve a problem and participating, which is experienced by discovering what is a programmer. Christine Bruce et al¹⁰

However, having clear as efforts to improve programming, we must know our track progress in particular: The Object Oriented Programming (OOP). This topic is presented some difficulties to learning such as developing a strategy to decompose a problem, understand the mechanics of programming, passing parameters, return values of methods and variable declarations, abstract programming techniques used in different situations and finally understand and use concepts of

8 Hwang Wu-Yuin et al (2008) A web-based programming learning environment to support cognitive development

9 Sitthiworachart Jirarat y Joy Mike. (2003) Web-based Peer Assessment in Learning Computer Programming

10 Bruce Christine, Buckingham Lawrence, Hynd John, McMahon Camille, Roggenkamp Mike, Stoodley Ian (2004) Ways of Experiencing the Act of Learning to Program: A Phenomenographic Study of Introductory Programming Students at University.

object-oriented programming such as inheritance, abstraction, specific classes and interfaces Keefe¹¹.

Another conclusion is that the problems found in this area are due to choice of languages and teaching aids wrong. Kölling¹². A suitable environment must have seven key areas: ease of use, integrated tools, support objects, support for reuse of code, learning support, support groups, availability Kölling¹³.

Similarly, in our particular subject teaching OOP, there are different strategies and methodologies that have been implemented over the years, achieving an effectiveness rate that forces us to take them into account when developing the objective method this study. One of these is called "Object-first" which is to introduce students to the concepts, classes and instances before procedural elements start in the programming language of Fang¹⁴.

Additionally it is concluded that often took a rather simplistic view of a holistic development front which leads to include ideas and concepts through learning gradually instead of having an integrated perspective from the outset. Börstler¹⁵.

Now in addition to these developments is important to note also that the conditions for effective and be given the use of these new methodologies, imparters they need to prepare in an advanced level of ICT use and the design of teaching skills and training projects. Order to ensure regular interaction space that contains the basic components that determine the didactic nature of teaching-learning process such as learner motivation, dominance by the teacher of what to teach, teaching tools and proximity to the reality as a means of connection between other experiential learning Vargas Gamboa¹⁶.

A very interesting study related to the topic seen that provides several conclusions very appropriate given the nature of it: the Colombian context, analysis and design of a First Course in

11 Keefe Karen et al (2006) Adopting XP Practices for Teaching Object Oriented Programming

12 Kölling Michael (1999) The Problem of teaching object-oriented programming Part I: Languages

13 Kölling Michael (1999) The Problem of teaching object-oriented programming Part II: Languages

14 Wee fang et al (2005) A student model for object-oriented design and Programming.

15 Börstler Jürgen and Sharp Helen (2003) Learning and Teaching Objetc Technology

16 Vargas Germán, Gamboa Sarmiento Sonia Cristina (2008) Didáctica en la condición postmoderna. De las competencias a la cooperación

Computer Programming and the subject of OOP is that developed by CUPI2 project. This project consisted of an initial survey of all the experiences of the University so far in their programming courses, the findings address the strategies implemented so far and the study of the possible factors why some groups may be more successful than in other Villalobos et al¹⁷.

It then has multiple support tools and online resources used by different universities, including conclusions and successes from them link these experiences in our project and so achieve our primary objective.

17 Villalobos Jorge et al (2005) Looking for a new approach to teach/learn a first computer-programming course

DESCRIPTION OF EXPERIENCE

Investigative Process Description

Consistent with the objectives proposed in this project and with the goal to offer a product very close to solving the problem, we conducted a thorough investigation of the problem of teaching computer programming. Bearing in mind the theme and line of this project: teaching through e-learning, begins with reviewing the state of the art of teaching programming in order to identify the progress made in this area by existing research groups. Thanks to this search is unable to contact various national universities mainly have taken steps in this topic, such as: The University of the Andes, who have formed a group called CUPI2 and have made great strides with presentations at national and international at the head of Dr. Jorge Villalobos, and the Universidad Francisco de Paula Santander through its GIDIS group who have made progress in developing ICT-supported environments for learning programming fundamentals.

Current Diagnosis

Analyzing all the information gathered, it was decided to plunge into matter through a mechanism that would enable anonymous feedback from engineering students who have completed their first semester and therefore their first contact with the scheduling.

We evaluated some online system to analyze its pros and cons and decided to use the survey tool LimeSurvey. So the sample is very close to reality is made contacts with the universities that best represent the area where is located the headquarters of the investigation, among which are mentioned: Universidad Autónoma de Bucaramanga, Universidad de Santander, Universidad Pontificia Bolivar and Universidad Industrial de Santander.

It made the invitation to the main contacts at the universities mentioned, that his students enter the link: <http://elearning.limequery.com/index.php?sid=33729&lang=es> where they could fill out the survey published through the system chosen: LimeSurvey, which contained questions that allowed us to share their experiences and what perception they had of topics covered, among others may be mentioned:

- Prior experience the course in terms of programming
- work or personal experiences different courses
- A utility that the student is facing the issue of scheduling
- Degree of complexity of some major issues
- Importance of the strategies employed
- Evaluation of course aspects of programming fundamentals.

The survey was open for about 20 days to the students and received the answer of 50 people, those who filled out completely, offering results that allowed a glimpse more clearly the points of greatest need.

Since the teaching-learning process is made between at least two actors: one who teaches and who learns, we decided to investigate what they thought the teachers who taught this course, through their experience and knowledge of discipline and what was his deal with the problem in perspective question.

This will once again invited teachers from the universities mentioned above and others located outside the area to share their experience with us. It had the support of 7 professors who kindly resolved the major concerns that were addressed to two points in particular: the aspects that make teaching consider programming is complex and the supports and strategies that are used by them for teaching the same. Variety of responses was obtained which highlights important issues such as the relationship between the student's career course with his motivation and enthusiasm for programming, because the utility that the learner finds what he is learning. Likewise, the need for basic knowledge existing at the time of entering the first programming course.

RESULTS ACHIEVED

In developing this project were achieved different results in each stage of them as well:

Starting collection was achieved through a tool the feelings and views of two different actors of the teaching - learning Object Oriented Programming: The student and teacher. This instrument yielded features that were taken into account in the design of the proposal, such as:

1. Need for more didactic learning
2. Call for papers with projects throughout the education process.
3. Subject to appropriate more difficult by students.
4. Optimal initial characteristics that must be a student for a better appropriation of knowledge.

It is worth noting that as a result of this survey stood the perception of these actors from different contexts and involving different universities in the metropolitan area allowing an interconnection and approach for future work.

After obtaining these references we proceeded with the design tool of this project. To start with an effective design approach is part of a clear definition of the context on which this proposal is made tool, so starting out with a realistic scenario that allows us to achieve effectiveness.

One of the most important consideration in the production of a teaching tool, is the clear identification of end users who use our product to our case, we define the characteristics of the user taking into account the profile of our students who have different advantages should be exploited within the framework of development of our proposal. It then proposes a possible tool for students digital natives who find it very easy to use technological tools and those with immediate acceptance to such proposals, in addition to being students of Engineers there is a very high chance that they know the use and management Web 2.0 tools and have a high degree of acceptance by them, allowing us to use them properly and take great advantage of their application and have an initial gain motivation and knowledge of entry.

For this proposal begins with the approach to develop the following skills:

- Establishes an autonomous and independent way and time to study the various technological tools that support will be provided within the solution.
- Understands concepts on Object Oriented Programming.
- Develop a project application where he is author and builder through the application of concepts learned.

- listening comprehension and English language
- Uses and uses the tools of Web 2.0
- Works and leverages collaborative work with peers

To help achieve the responsibilities mentioned, the proposal provides the following instructional strategies:

1. Segment on the main themes of Object Oriented Programming for better assimilation of the content to be viewed sequentially and orderly.
2. Use a free online platform that will allow students to review as many times as needed throughout the theme you want, with a communicative approach to collaborative work groups.
3. Perform an initial test to enable students to observe and get a qualitative view of itself and identify the issues that will strengthen as well as a means of validation against the knowledge of input compared to output knowledge.
4. Provide multimedia materials to cover the topics making and different forms of learning and the student repeats necessary.
5. Propose practical exercises mainly focused on the teaching needed to make a simple relationship between reality and layout of this
6. Learning divide in 5 times, each consisting of a learning object containing material, learning activities and two tests to validate learning, one will be presented at the beginning to have an assessment and to make a comparison that leads us to corroborate effectiveness of our AVA and continue improving and a final test that will let you check your learning effectively compared with the initial test

Given these assumptions described above, it is proposed to start with a segmentation approach themes in 5 major topics that will more effectively track the student's learning process, offering a bit more control by the teacher address strategies to implement to finally work focused on learning objects for each of the issues, drawing on the reuse of course materials and other proposals later. These issues would be handled as follows:

- Abstraction: Software Engineering Analysis and Design Phase.
- Implementation: Declaration of attributes, methods, hiding information, access to builders, packet handling and encapsulation.
- Class Design: Inheritance, over-writing methods, access control methods, overloading methods and data type conversion.
- Advanced: class attributes, class methods, variables final static statements, abstract classes and interfaces.

- Java: Development in the language (code).

The proposal has its main justification in collaborative work, especially cooperative, based on autonomous learning and reflective educates the student in their learning and contextualized through a classroom project. The latter has its foundation in the response of the surveys where students give high marks to the use of development projects within the classroom as an effective way of learning.

Subsequently choose an LMS that has the characteristics consistent with our methodology and where we can carry out your proposal designed. To this end we chose DOKEOS platform on which we proceeded to the implementation of Virtual Learning Environment which was distributed in 5 main themes identified above. We propose a learning sequence or schedule a learning object, the learner will continue and will be controlled via the accompanying face and control of reports submitted by the tool. This itinerary will have different times that have some prerequisites that will control each step and ensure a path with clear goals and objectives.

In compliance with the qualitative goal starts the first phase of the process with the Abstraction theme through the presentation of a test of 5 who self-closed questions in the tool and may submit as many times as you like, giving a clear and accurate feedback the error and the reasons why it is wrong that response. Such work will allow students learn from their mistakes to find itself the solution to the test presented.

Following the test we propose a learning activity consisting in the implementation of the first phase of work concerning the issue of abstraction, where the student through an approach will place the data context to propose a solution developed.

To carry out this learning activity the student will have the collaborative tools that DOKEOS available to students, giving way to the plurality of voices and polyphony of the symphony. This use of the tools must be coordinated in two ways, one of them is the proposed use of didactic and pedagogic each case, these tools are forums, Wikis, Blogs and chat.

Once you develop all the exercises in the subject, the student presents a similar test to the initial 5 closed questions where you can see a final diagnosis that will demonstrate the knowledge gained through this proposal and compare it to provide initial validation statistics compared to the effectiveness of the proposal.

5 moments arise establishing consistent with the 5 sub-themes which has divided the main theme to be established in line with the approach of the curriculum and the moments in which students

address the issues proposed in this tool. Each one of them with learning pathways and duration according to class attendance and progress in subject matter.

Finally the pilot test was conducted with a group of 30 engineering students the fundamentals of the subject UNAB Programming first half, which according to their level could develop the theme of abstraction throughout the process of this object learning.

The group presented the initial test has mainly focused on the conceptual and score low in most failed. Then proceeded to perform the learning activity and send it through the tool tasks, this activity only made 20% (6 students) throughout the group.

It continued with the presentation of a video where an expert discipline which in turn is a teacher gave an introduction to OOP and usefulness of the abstraction, and an explanation and clarification of how it could address the proposed exercise for a total understanding and ownership of the item.

Thereafter, in the face when was the last test or final test where students corroborated their learning, unlike the initial test, this test was more focused on the application of knowledge in the conceptual part. This verification throw some low scores indicating that they have greater clarity on the concept that the implementation of these concepts.

Face session was completed with the signing of the survey and concept values the opinion of the students in front of the tool and passing through it, and got a very good rating of the majority even though in many cases can be observed virtual education reserve to itself by the students.

This final survey instrument allows us to see any improvement to launch another test again taking into account the findings and the conclusions drawn from this first stage.

CONCLUSIONS AND FUTURE WORK

We can say that our exploration phase of the existing developments, from the perspective that teachers and students of the subject of planning, implementation and testing, some points are concluded:

Students expect and need more practical education, focusing on solving problems based on independent learning, but guided by both their teachers and monitors higher semesters will surely know the problems and difficulties that students are going and easy way overcome.

Pilot test was conducted with students at the basic cycle of first-year Engineering Fundamentals of Programming, according to the results and the development of the test, we conclude that the proposed use is necessary for students to advance knowledge address the concepts in Object Oriented Programming so that the top (Abstract) be a reinforcement, ie according to the study group aims to start with students in second semester.

Since the thematic approach spans the full learning issues OOP is proposed for future work to implement the proposed environment through several semesters so that it can be addressed fully and obtain a validation of all tools.

Collaborative tools like wikis, chat, blog and forums designed to provide lasting support and collaborative construction must be accompanied by a strong motivation from the classroom by the teacher for the use and exploitation of these, proposing discussions and promoting their value in the academic period, through the investigation of external material and answers to questions that students can observe.

It attempts to update and modify the questions presented in the test periodically, so that students do not pass this information through the following groups and so these tests may not be valid. It also proposes a constant search for material that can be updated documentary proposal, taking into account the characteristics that this type of material should be about teaching and multimedia.

A possible factor to consider is the difficulty that occurs in the interdisciplinary students, and students from areas other systems have high motivation and denial to the proposal, given its low and interest in this subject.

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