UGC Approved Journal

**IJIREEICE**

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

**International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering**

**ISO 3297:2007 Certified**

Vol. 5, Issue 8, August 2017

# Validation of a Model to Improve Content Assimilation in Object Oriented Programming

**Ivelisse Teresa Machín Torres**[1]

Professor, Technical Department, José Martí University, Santi Spíritus, Cuba[1]

**Abstract:** The contemporary world requires more and more rigorously the use of information technologies, so it is necessary to improve teaching of programming. The object-oriented paradigm models the real world, and adds a different structure to programming. Their learning is not always easy to assimilate, there are difficulties in syntax and semantics, as well as in programming logic. The present report contributes to the validation of a model, which integrates concepts and methods of Object Oriented Programming, using multiple intelligences, to improve the assimilation of contents. The model involves several components and enhances the traditional architecture of the tutors systems. In the validation process, the pre-test and the post-test were performed to evaluate the behavior of two groups: experimental and control. The results of the validation show that the experimental group reached higher levels in the variables subject to editing, which shows results favorable to its application.

**Keywords:** Multiple intelligences, model, intelligent tutors, object-oriented programming.

## I. INTRODUCTION

The use of information technologies and their best application is currently a key issue in the development of any nation. The economic, social and cultural benefits derived from the technological factor will belong to those who manipulate them properly.
The use of virtual spaces for technical and professional training has generated new forms applicable to the teaching-learning process, in which face-to-face sessions are minimized. These new forms allow for greater speed and efficiency in the communication process, as well as access to a wider range of information sources than is provided through traditional media. By increasing the technological factors, flexibility in the integration of techniques in terms of space, time, content supply, didactic resources, and improves access to educational systems from a distance [1] increases.

The profitability and scope of this training is made possible by an increase in specialized staff, environments with better computer and logistical services, modern infrastructures, easy creation and implementation of programs. The rupture of the physical gaps is made possible by using internet as the main channel for the process of knowledge management, breaking with the presence.
There are active agents that modify and use the methods and concepts of object-oriented programming (OOP).The OOP is a programming paradigm that comes to innovate the way to obtain results. Objects manipulate input data to obtain specific output data, where each object provides special functionality.
Many of the pre-designed objects of the current programming languages allow grouping in libraries or libraries, however, many of these languages allow the user to create their own libraries.

The OOP is based on techniques such as inheritance, cohesion, abstraction and encapsulation. This is taught in all universities that develop careers related to informatics and other technical courses that include it within their curricula.
The teaching of OOP presents difficulties that are evident in the low results and retention rates. It has deepened on the difficulties among which are:
Difficulty 1: Students do not know how to describe the problems that arise.
Difficulty 2: Write code that does not meet the defined standards.
Difficulty 3: The solutions do not express exactly what you need.
Difficulty 4: Misuse of terms or structures.
Difficulty 5: Abstracting the essence of a problem.
Difficulty 6: Deficiencies repeatedly in the management of language semantics.

Frequent updates of programming environments and languages are factors of influence that hinders the learning of some students, since the programming environments are designed for professional use. There are, a large number of tools and interface options Graphs that are overwhelming for students who are just starting, so it ir necessary for programming environments designed specifically for beginners' learning [2].

UGC Approved Journal
IJIREEICE
ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering
ISO 3297:2007 Certified
Vol. 5, Issue 8, August 2017

These difficulties have been identified by several authors [3], [4]. On the other hand, [5] report the results of a study where it is evident that the teaching of programming presents deficiencies that are reflected in the low rates of integration.
In the discribed context, the main objective of this article presents the validation of a model to strengthen the concepts of OOP supported in the Theory of Multiple Intelligences [6].

## II. INTELLIGENT TUTOR SYSTEMS

The models for applying OOP to different environments are increasingly necessary in the current context. The interactivity of the medium by itself does not ensure successful situations, it is necessary to foster dynamics that promote the construction of knowledge [7]. Otherwise, the students are entangled by the large amount of disorganized information that exists on the subject.
Intelligent Tutoring Systems (ITS) emerge as a better alternative to the technologies used nowadays for computer-aided teaching. Developments in this field aim to provide tools that teach the student similarly to an experienced human tutor. To achieve this, artificial intelligence techniques are used in the generation of learning paths, selection of activities, support during activities, evaluation, presentation of contents, among others.

Work on ITS architectures has structured its design in the form of modules, sources of knowledge and their interactions. The traditional architecture that responds to most of the developments made in the first moments is constituted by three modules, then extended to four. Among them, there is a one-to-one relationship with the types of knowledge involved in the process [8] an element that, together with the author tools, contributes to the development of systems by non-computer experts [9]. This direct relationship between models and modules has led to the indistinct use of both terms to refer to the component of the system that has such responsibility [10].

The definition of STI is linked to the ability of the system to adapt teaching through AI techniques [10][11]. The distinguishing characteristic of ITS is their ability to generate feedback during the course of activities using AI techniques. But definitions based on these characteristics are very general. On the other hand, in a more explanatory way, ITS are the support for orientation in problem solving, knowledge management and the ability to generate feedback during the development of activities [12]. In this way it is possible to make the cognitive diagnosis in the modeling of the student, using AI techniques.

In several papers [13][14] [15] it has been reported some support to the students in learning theoretical elements through different types of activities. However, the interest of this research lies in the field of solving theoretical and practical problems through the use of IM. Emphasis is placed on the approaches used to integrate OOP concepts and methods, which allow the student to work on the basis of the mistakes made.

Studies describing the successful application of ITS in different domains of knowledge are reported. Its application reports significant gains in learning over other types of systems used to support the teaching-learning process [9] [16] [17]. The main cause of these positive results is the feedback received by the student during the activities [18] [19]. It is emphasized that there is a direct relationship between the amount of feedback and these gains [20] [21].

Among the ITS there aresystems such as Lisp Tutor [22], ELM-ART [23], SQLT-Web [24], and HESEI [25]. These systems show that their application favours the achievement of learning gains. In contrast to this effectiveness, it is worth noting that only the SQLT-Web has been used exhaustively in real-world environments and the rest only in laboratory tests with students in conditions that can be considered controlled [26] [27].

The model that has been developed to improve the content assimilation in the OOP supported in the multiple intelligences is defined as the conceptual representation that integrates tools, methodologies, frameworks of work and an inference system to facilitate the management of the knowledge regarding the programming [28]. This model is based on the following principles, qualities and premises.

The principles underlying the proposed model for the application of programming are standardization, interoperability, flexibility, relevance, functional independence and updating.
Among the qualities of the model is the breadth, the systemic approach, it's comprehensive quality and the possibility of continuous improvement. In view of its application currently, the model takes into account premises they take into account premises such as the qualification of the developers, the support of the institutional will and the existence of duly catalogued teaching materials.
The main components of the model are: Management of Smart Profiles, Generation of tutoring and Technology support as there is showedin figure1.

UGC Approved Journal
IJIREEICE
ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526
International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering
ISO 3297:2007 Certified
Vol. 5, Issue 8, August 2017

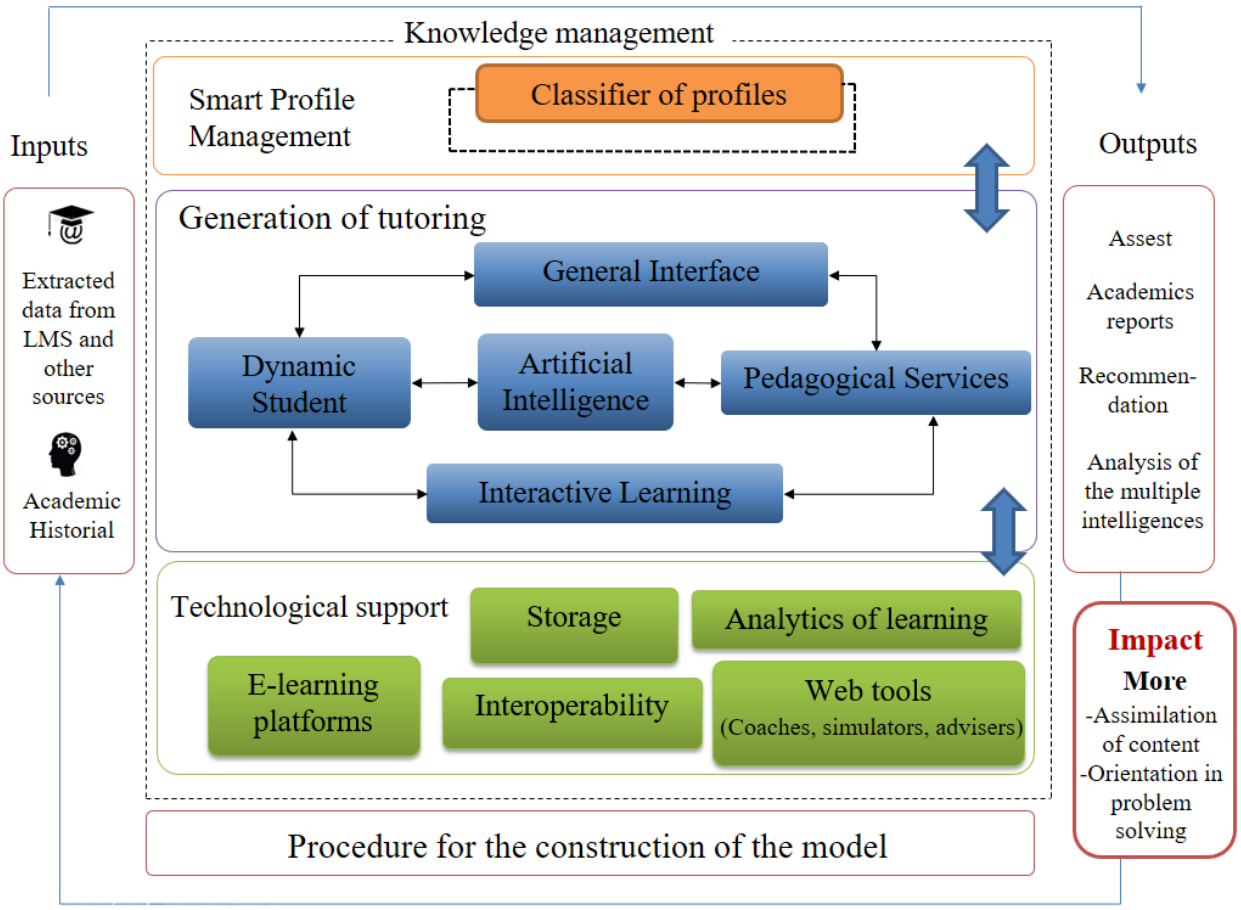


Fig. 1Model to improve the assimilation of contents and orientation in solving problems in Object Oriented Programming. Source: self-made

## III.METHODOLOGY

In order to evaluate the results of the introduction of the proposed model, in particular the change in students with respect to: knowledge management, content assimilation, problem solving orientation, a quasi-experiment was carried out. The exams were applied to a group of 25 students, before (pre-test) and after (post-test) of the application of the model to evaluate the behavior of the dependent variables contemplated in the hypothesis.

The same exams were applied to a control group of 25 students who developed their studies without using the model. In this way the quasi-experiment of the type Pre and Post test with control group was carried out.

Before introducing the MACPOO model and for both groups, a diagnostic test was applied in order to identify the climate in the classroom, study habits, use of resources, and level of satisfaction with learning, motivations and perceptions of the students against teacher's methodology. In addition, through the pre-test it was determined the degree of assimilation, understanding and application of concepts of OOP in problem solving.

The next step was to organize and to carry out for the experimental group a set of practices through the computer tool that instantiates the proposed model [29]. All students enrolled in the subject language and programming technique, specifically in the subject of object-oriented programming, received the same orientation and developed the same activities during the investigation except those planned with the tool that instantiates the MACPOO model.

After the intervention with the proposed model, the post-test was carried out in order to analyse the scores obtained by the different groups.

## IV.RESULTS

The results obtained by comparing the pre-test and post-test values (before and after the application of the model) are presented in the experimental group in relation to each of the indicators of the dependent variables. The results are expressed as a percentage in each of the 3 categories of the variables as it is shown in Table 1.

UGC Approved Journal

IJIREEICE

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering

ISO 3297:2007 Certified

Vol. 5, Issue 8, August 2017

TABLE I PRE AND POST MEASUREMENTS OF THE EXPERIMENTAL GROUP. SOURCE: SELF-MADE.

| Variables | Categories | Pre | Post | Value P* |
|---|---|---|---|---|
| Logical Mathematics Intelligence | Low | 0,72 | 0,20 | 0,0001 |
| | Mean | 0,20 | 0,48 | 0,0099 |
| | High | 0,08 | 0,32 | 0,0072 |
| Linguistic Intelligence | Low | 0,75 | 0,25 | 0,0002 |
| | Mean | 0,21 | 0,49 | 0,0105 |
| | High | 0,04 | 0,26 | 0,0050 |
| Interpersonal Intelligence | Low | 0,77 | 0,36 | 0,0048 |
| | Mean | 0,20 | 0,50 | 0,0063 |
| | High | 0,03 | 0,14 | 0,0385 |
| Knowledge Management | Low | 0,82 | 0,45 | 0,0109 |
| | Mean | 0,12 | 0,31 | 0,0338 |
| | High | 0,06 | 0,24 | 0,0186 |
| Guidance in solving problems | Low | 0,77 | 0,20 | 0,0001 |
| | Mean | 0,14 | 0,41 | 0,0403 |
| | High | 0,03 | 0,39 | 0,0001 |
| Content assimilation | Reproductive | 0,57 | 0,20 | 0,0119 |
| | Productive | 0,20 | 0,44 | 0,0229 |
| | Creative | 0,23 | 0,36 | 0,1586 |

The measurements performed in the control group did not show significant differences in any of the studied variables.
The statistical analysis shows the results of performing a hypothesis test concerning the difference of two proportions of samples from binomial distributions.
In most cases, better results are seen in the post-test, because the obtained values in the performance of the different intelligences change after applying the model from a low level to a medium or high level.
The measurements performed in the control group did not show significant differences in any of the intelligences studied, when comparing the proportions of cases in each of the different categories.
These results clearly indicate that the intervention performed means an increase in the students' ability to perform in the role of programming.
It is considered necessary to deepen, from a theoretical perspective, the effects of the application of the model for other types of intelligences and to evaluate the possibility of organizing workshops with the objective of promoting the use of the model as a complement to the training of students.

## V. CONCLUSION

The process of diagnosis of the existing models in the literature for the teaching of OOP focuses on identifying the elements that make up the ITS of programming and techniques used, which is an important element to consider.

The use of MACPOO model facilitates the understanding of the concept of object as an instance of a class and of methods as behaviors or actions performed by an object; clarified the principle of concealment of attributes and the form in how values are assigned to them as long as they can be accessed.
The results of the experiment allow us to conclude that the model developed favors problem solving and helps to enhance multiple intelligences, as well as improves the assimilation of contents in programming.

## ACKNOWLEDGMENT

The author thanks the experts and institutions that supported the research and made it possible to show the results that are presented.

UGC Approved Journal

**IJIREEICE**

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

**International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering**

**ISO 3297:2007 Certified**

Vol. 5, Issue 8, August 2017

## REFERENCES

[1] R. Azevedo, M. Taub and N. Mudrick, "Technologies supporting self-regulated learning," by The SAGE Encyclopedia of educational technology, M. Spector, C. Kim, T. Johnson, W. Savenye, D. Ifenthaler and G. Del Rio, Edits., CA: SAGE, 2015, pp. 731-734.
[2] J. E. Sánchez-García, M. Urías-Ruiz and B. E. Gutiérrez-Herrera, "Analysis of learning problems of object-oriented programming," Ra Ximhai, vol. 11, no. 289-304, July-December 2015.
[3] L. R. Ríos, "Intelligent teaching-learning environment for logical programming", SSP, 2009.
[4] M. Lezcano and V. Valdéz, "Some Experiences in the Use of EAC Systems for the Teaching of Artificial Intelligence," Revista DivulgacionesMatemáticas, vol. 6, no. 165-182, 1998.
[5] H. Hakimzadeh and R. Adaikkalavan, "Successful Implementation of an Active Learning Laboratory in Computer Science," Proceedings of the SIGUCCS'11, California, 2011.
[6] H. Gardner, Structures of the mind: the theory of multiple intelligences, Mexico: Economic Culture Fund, 2016.
[7] R. Azevedo, "Metacognition and multimedia learning," Cambridge handbook of multimedia, Cambridge England, Cambridge University Press, 2014, pp. 647-672.
[8] W. Clancey, Methodology for Building an Intelligent Tutoring System, London: Lawrence Erlbaum Associates, 1984.
[9] K. Brawner, H. Holden, B. Goldberg y R. Sottilare, «Understanding the Impact of Intelligent Tutoring Agents on Real-Time Training Simulations,» de Proceedings of the Interservice/Industry Training, Simulation, and Education Conference (I/ITSEC), 2011.
[10] M. L. Barrón Estrada, R. Zatarain Cabada, R. OramasBustillos y G. Alor Hernández, «Experiments with Students using an Intelligent Enviroment for Java,» de Proceedings of the International Conference on Intelligent Tutoring Systems, Zagreb, 2016.
[11] K. VanLehn, Student Modelling, E. M. Polson, Ed., Foundations of Intelligent Tutoring Systems, 1988, 55, 78.
[12] Vázquez Cano, «The technological challenge for the sustainability of the massive open online course (MOOC)», Panorama, vol. 9, no. 17, pp. 51-60, 2015.
[13] V. Krishnamoorthy, B. Appasamy y C. Scaffidi, «Using intelligent tutors to teach students how APIs are used for software engineering in practice,» IEEE Transactions on Education, vol. 56, nº 3, pp. 355-363, 2013.
[14] S. Riscoand J. Reye, «Evaluation of an Intelligent Tutoring System used for Teaching RAD in a Database Environment,» de Proceedings of the Fourteenth Australasian Computing Education Conference, Melbourne, Australia, 2012.
[15] A. N. Kumar, «An Evaluation of Self-explanation in a Programming Tutor,» de Proceedings of the 12th International Conference on Intelligent Tutoring Systems, Honolulu, HI, USA, 2014.
[16] K. Vanlehn, "The relative effectiveness of human tutoring, intelligent tutoring systems, and other tutoring systems," Educational Psychologist, Vol. 46, no. 197-221, 2011.
[17] G. Paviotti and PG Rossi, Intelligent Tutoring Systems (ITS): a European point of view, Intelligent Tutoring Systems: an overview, G. Paviotti, PG Rossi and D. Zarka, Edits., 2012, pp. 9-15.
[18] V. Aleven, "Rule-Based Cognitive Modeling for Intelligent Tutoring Systems," Advances in Intelligent Tutoring Systems, Springer-Verlag, 2010, pp. 33-62.
[19] M. J. Eagle and T. Barnes, "Evaluation of Automatically Generated Hint Feedback," Proceedings of the International Conference on Educational Data Mining, Memphis, Tennessee, USA, 2013.
[20] M. Chi, K. VanLehn and D. Litman, "Do micro-level tutorial decisions matter: Applying reinforcement learning to induce pedagogical tutorial tactics," Proceedings of the International Conference on Intelligent Tutoring Systems, 2010.
[21] J. Dabolins and J. Grundspenkis, "The Role of Feedback in Intelligent Tutoring System," Applied Computer Systems, vol. 14, pp. 88-93, 2013.
[22] B. J. Reiser and J. R. Anderson, "The LISP tutor: it approaches the effectiveness of a human tutor," Byte, vol. 10, no. 159-175, 1985.
[23] G. Weber and P. Brusilovsky, "ELM-ART: An Adaptive Versatile System for Web-Based Instruction," International Journal of Artificial Intelligence in Education, vol. 12, pp. 351-384, 2001.
[24] A. Mitrovic, "An Intelligent SQL Tutor on the Web," International Journal of Artificial Intelligence in Education (IJAIED), International Journal of Artificial Intelligence in Education, 2003, vol. 13, no 2-4, p. 173-197 pp. 173-197, 2003.
[25] N. Martínez, "Model for Designing Intelligent Teaching-Learning Systems Using Case-Based Reasoning," 2009.
[26] [19] T. Dadic, Intelligent Tutoring System for Learning Programming, Intelligent Tutoring Systems in E-Learning Environments: Design, Implementation and Evaluation, 2011, pp. 166-186.
[27] E. J. Altuna and L. Guibert, "The Intelligent Tutors Systems and their Impact on the Teaching of Programming," Memoirs of the XV International Congress of Informatics in Education, INFOREDU 2013, Havana, 2013.
[28] I. T. Machín Torres, "Model to improve the assimilation of contents in programming," IJARCCE, vol. 6, no. 47-53, 2017.
[29] I. T. Machín Torres, "Intelligent tutoring system for the application of programming through intelligence analysis," Scientific, vol. 29, pp. 1-16, 2017.

## BIOGRAPHY

**Ivelisse Teresa Machín Torres** Engineer in Computer Science. Professor, José Martí Pérez University. Researcher in the area of educational technology. Writer. Aspirant of Doctorate in Technical Sciences.