Strategic Learning, towards a Teaching Reengineering

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Abstract. This article presents the strategic learning meta-model (SLM). We describe the architecture of the SLM, which consists of three layers: reactive layer, intelligent layer and infrastructure layer. The purpose of this paper is to present the reactive layer of the SLM and in particular the model that constitutes: the regulation model. This model was tested with a series of cases which indicate an increase in student performance in a particular course. Furthermore briefly presents the design of intelligent layer of SLM, which consists of a set of ontologies, this paper only presents the design and implementation of 3 of the ontologies that comprise the ontology model. Finally, the strategic learning meta-model proposed integrates the principles of mediator evaluation, customizing of learning route, monitoring and personalized attention, work in learning communities with the aim of providing better learning opportunities, optimizing the physical and human resources an institution, with the aim of reducing desertion rates.

Keywords: Strategic learning meta-model, self-regulated learning, ontological model, diversity and assessment.

1 Introduction

Mexico educational models do not respond to the problem of school failure leading from the courses reprobation to the terminal efficiency. This problem becomes relevant internationally and is manifested in the publication of articles and books. Is imminent the necessity of proposing new alternatives to experiment and find alternative solutions to the problem of reprobation [1].

Since 1995, Baena [2] deals with this problem by performing an analysis of the students' failure and desertion rates in the specialty of Political Science at the Political and Social Sciences Faculty of the UNAM. He focus is on the teaching-learning process and proposes a change in the teaching methodology.

In 1999, Juan Pozo and Carles Monereo [3] constitute a research community in which productive dialogue peer opens an options range and proposals aimed at connecting the disciplinary content learning with learning strategies, they agree on the importance of the dichotomy of disciplinary content and strategies or learning process in order to achieve a strategic learning. Talk about strategic learning involves a commitment to the integration of mechanisms that allow students to learn to learn, considering: a) the student's ability to manage their own learning, b) the adoption of autonomy in their learning, c) the provision of methodologies and tools for continuous learning throughout life[1].

In this paper we present the psychoeducational theoretical framework that supports the architecture of strategic learning meta-model. An analysis of various authors was made and are taken up basic concepts to define the layers that make up the architecture of the strategic learning meta-model constituted by three layers: a) reactive (regulatory model), b) intelligent (ontological model); and c) infrastructure (Virtual Environment of Custom Learning).

2 Psychopedagogic Theoretical Framework

Authors as Weinstein [4], Pintrich [5], Castañeda and Lopez [6] and Monereo [7] have positions for which models have been developed that attempt to encompass aspects comprising learning strategies, strategic knowledge representation referred to teaching and learning contexts, in which self-regulation and motivation are essential. Below we briefly describe some of these models.

Weinstein model: learning strategies are the thoughts and behaviors that students engage in their learning, which influence the cognitive processes associated with the encoding of information, registration memory and learning outcomes. Weinstein classified the strategies into two blocks, which focus on the information that is going to learn and those are supported by meta-cognitive aspect and emotional. These strategies are integral part to the learning regulation [4].

Self-regulated academic learning model of Pintrich: Pintrich 's model, focuses on the integration of motivational and cognitive components. For them, the use of cognitive, meta-cognitive strategies promoted self-regulated learning [5].

Integral assessment model of Castañeda and Lopez: They propose a comprehensive evaluation model encourages the development of cognitive skills, affective, motivational and social, needed to the learner reach efficient learning, motivated, self-regulated and independent. Their model considers four types of learning strategies: 1) Information acquisition strategy, 2) Strategies for the recovery of learning, 3) Learning organizational strategies, critical and creative processing, and 4) Self-regulation strategies. The model incorporates two functions: motivation and strategic learning. Strategic learning is multidimensional, related the discipline learning, skills of self-regulation and mutual reinforcement among equals [6].

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1 http://uil.unesco.org/es/portal/areas-de-negocio/politicas-y-estrategias-de-aprendizaje-a-lo-largo-de-toda-la-vida/

Monereo model: according to Monereo, Pozo and Castelló [8], it is necessary to provide to learners of personal strategic resources also influence the curriculum, the organization of counselors and teachers to create contexts that promote the strategic use of knowledge. Monereo [9] presents interaction between contexts in strategic knowledge construction as shown in Figure 1.

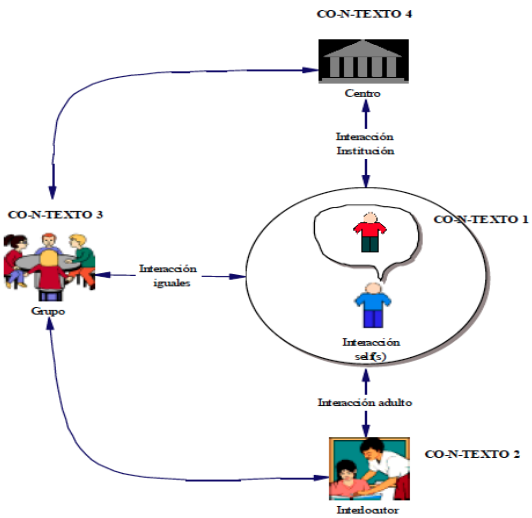

Fig. 1. Interaction between contexts [9]

The models and papers presented by various authors, considered as a key element of strategic learning: meta-cognition, self -regulation and motivation.

However, these models lack of contexts and strategic actions to facilitate the functionality of the learning regulation, do not define the actions to be performed to ensure that the learner reaches a strategic learning. Therefore, in the section 5 we propose a strategic learning meta-model.

3 Strategic Learning and Education Mediated by ICT

Strategic learning is based on the cognitive paradigm to recognize that the learner acquires not only information, but also learn cognitive strategies of two kinds: a) procedural cognitive strategies, to acquire, retrieve and use information; and b) the meta-cognitive strategies, associated with the reflection on their own learning processes [10]. The psychopedagogic proposed of strategic learning, whose principle is "learning to learn" and aims to transform the student into a strategic learner, self-regulated and reflective by Hernandez [11], cannot be excluded from the Information and Communications Technology (ICT). Therefore, the purpose of the pedagogical intervention in distance education is to develop in the learner the ability to perform meaningful learning alone in a new learning environment mediated by technology. (Cited by Rocha) [12].

Therefore, under the framework presented in this research, in Section 5 we propose a meta-model that defines the architecture of a platform to support distance education or part-time attendance under the strategic learning approach.

3.1 Diversity and evaluation, Key Factors in Strategic Learning

The evaluation process includes a set of didactic methods, is subjective and of multidimensional nature, occurs in different times and spaces, interactively involving the persons involved in the educational process, as proposed in concept of mediator evaluation Hoffmann and Anijovich in [13]. The mediator evaluation principles are: a) ethical principle of valuing differences, focusing on the idea that all students learn forever, b) teacher pedagogical principle of action research, which finds that students learn more if they have a better chance of learning, c) the provisional dialectical principle and complementary proposes significant learning for life [13].

In this paper we present a meta-model that implements the principles of mediator evaluation through an excellence monitoring cycle that creates a synergy in which it is possible to observe the student, identify recurring errors, and verifies the harmony in the collaborative environment mediated by Information and Communication Technologies [14].

4 Related Work

In the existing works have been several proposals for self-regulation of learning, as the DIDEPRO model [15] which is defined as last generation model, focused on the study of self-regulated learning, but from an interactive design and interdependent of teaching-learning process by using ICT. In addition there are experiences that incorporate new design schemes for self-regulation on e-learning in particular the work of Lee, Barker and Kumar [16] which describe the research done on the initial development of the e-learning model, instructional design framework, research design as well as issues relating to the implementation of such approach.

There are other works that highlight the importance ubiquitous learning such as the work of Joo and Park [17] in which it is proposed u-SM(Ubiquitous Scaffolding and Mentoring) teaching and learning model which applies the scaffolding and e-mentoring. In addition, it embodies and applies the designed u-SM model. Then it examines it affects in studying achievements and attitudes of students and verifies the application possibility of the u-SM teaching and learning.

There are also proposals ubiquitous learning, some as the work of Barbosa and others, [18] they presents the proposed GlobalEdu content management model, as well as its model of interoperability among repositories of learning objects that are used throughout the educational processes carried in the system.

5 The Proposed Model

The goal of the architecture of Strategic Learning Meta-Model (SLM) is to improve student performance, make strategic learners, self-regulated and self-reflective, encouraging learning through an educational environment that integrates psycho-pedagogical model, an ontological model and emerging technologies that enable ubiquity.

The strategic learning meta-model provides an architecture consisting of three layers: the reactive layer, intelligent layer and the infrastructure layer. The proposed meta-model is based on the principles of mediator evaluation described in section 3.1.

5.1 Architecture of the Meta-model for Strategic Learning

The SLM architecture integrates three layers: 1) the first layer is the reactive layer, consisting of a regulatory model, which aims to maintain the interaction between actors in different contexts which allow the regulation of learning until they self-regulate; 2) The second layer is the intelligent layer, integrated by an ontological model (ontologies set) that personalizes the student's learning activities, and 3) the infrastructure layer, which enables communication through various technologies, applications, devices and media, forming a Virtual Environment of Customized Learning (EVAP for its acronym in Spanish). Figure 2 shows the meta-model that integrates the layers constituting SLM architecture.

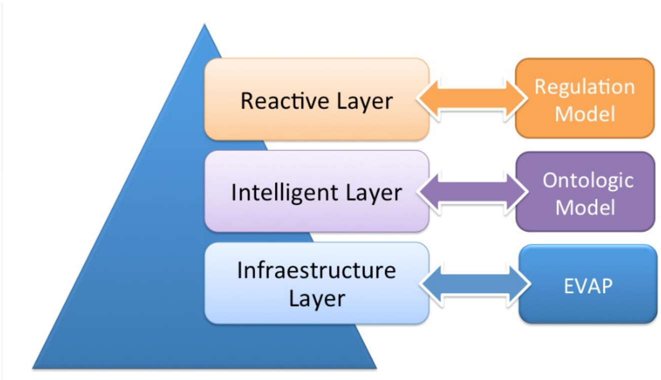

Fig. 2. Meta-model of the strategic learning

Each layer is formed of a particular model, which together can offer students an environment to achieve a strategic learning.

Reactive layer. The reactive layer within the SLM, contains the regulation model - which involves the excellence monitoring cycle. The aim of the reactive layer is to meet the requirements of the pedagogical principle of teaching action research, focused on providing better learning opportunities. This sets the interactions that occur in different contexts considering the reactive actions of the actors involved.

Intelligent layer. Intelligent layer of SLM is formed from an ontological model (ontologies set) , making up the domain of knowledge (general course, multimedia educational resources for self-study , multivariate learning activities) , and the student learning profile from the NLP theory and VARK of Fleming Neil and Mills Collen [19] and the neuroscience total brain theory of Ned Herrmman [20] .

Infrastructure layer. The infrastructure layer is responsible for enabling interface between the intelligent and the reactive layer. It aims to provide interfaces that allow users to connect to the system from any device (computer, laptop, tablet, ipad, cell phone, etc.), while automating the actions of the previous layers and provides ubiquity.

There are a considerable number of models and techniques within the SLM layers. However, for purposes of this article, only expose those built in the reactive layer and a brief definition, design and implementation of some ontologies of intelligent layer of meta-model proposed.

5.2 Regulation Model

The reactive layer within the SLM contains the regulation model. The regulation model that we propose incorporates some elements Monereo model presented in Section 2 and shown in Fig 1, which integrates the actors, contexts and their interaction. However, the Monereo model does not contemplate facilitators. Therefore, in the regulation model proposed, we consider the interaction with two facilitators who favor accompaniment of students and the motivation, which encourages strategic learning. The objective of the regulation model within the reactive layer is error detection (learning opportunities) and maintain the harmony of the educational environment through motivation, support, and self-knowledge of the student.

The interaction between contexts is the foundation of strategic learning as it integrates self-cognition, self-regulation, motivation, and cooperative learning. This is integrated into the excellence monitoring cycle that determines the interaction mechanisms between actors in the Architecture of Strategic Learning Meta-Model (SLM).

Regulation model components, constitute the elements of excellence monitoring cycle (as shown in Figure 3), consists of four actors: teachers, learners, facilitator A and facilitator B. Three of which are evaluators, and be evaluator is to know, understand, accept students into their own differences and their own learning strategies. The teacher is responsible for program evaluation activities, verify the results and re-plan the educational activity. The facilitator A identifies recurring errors of students to provide feedback to the teacher and retake the points that were not clear. The facilitator B is responsible for verifying harmony in the collaborative environment through the support and monitoring of the students progress. The answer of the learner is the starting point to identify strategies to improve learning. The interaction between all involved in the regulation model can learn while teaching and teach while you learn it, encouraging cooperation by sharing knowledge.

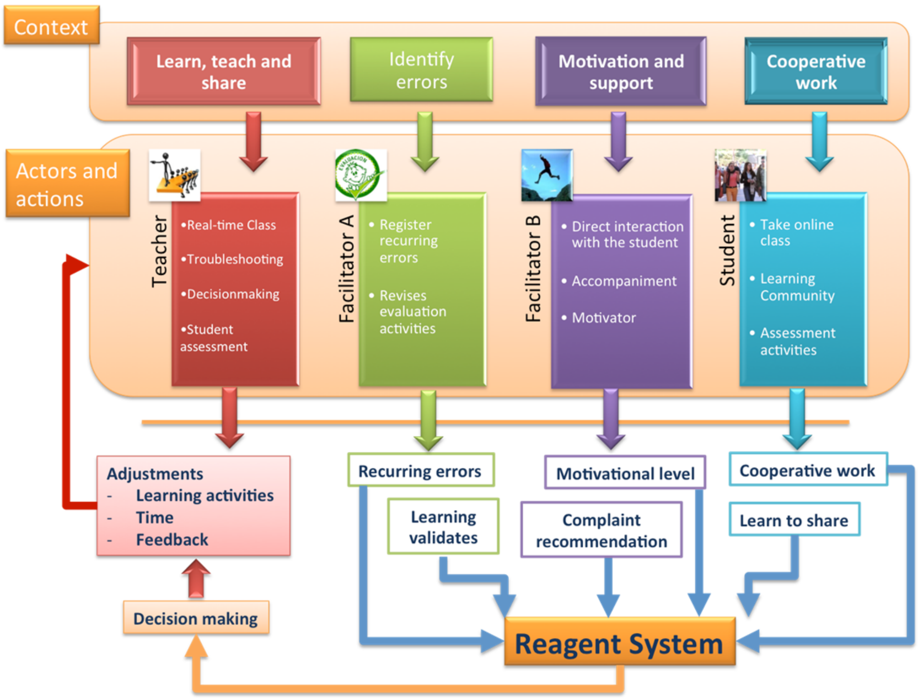

Fig. 3. Regulation model

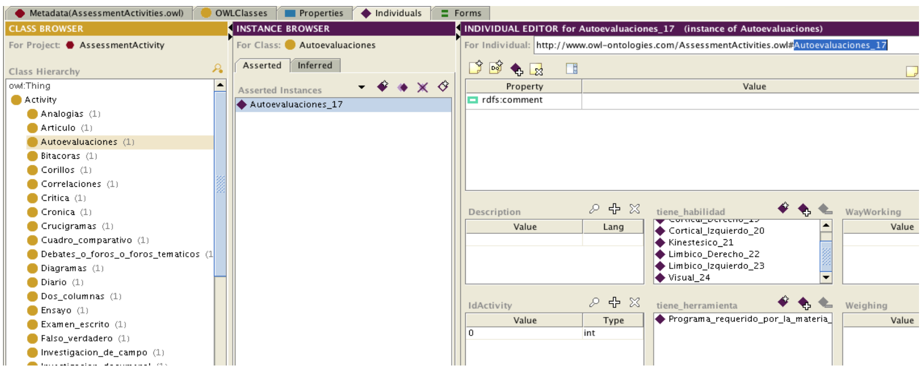

Fig. 4. Learning activities classified by the learner profile

5.3 Ontological Model

The ontological model is the intelligence of the system, through inference rules determines the customization of multimedia educational resources for self-study and learning activities according to the profile of each learner. The ontological model is composed of five ontologies, the top three are the profiles, courses and activities ontologies. The profiles ontology incorporates cognitive theories that will determine the learner's learning profile. The courses ontology, consider the instructional plan, multimedia educational resources for self-study and cognitive skills that students must develop. Finally, the activities learning ontology allows activities customization in accordance with learner's learning profile.

We show in Figure 4 the learning activities classified by the learner profile. Profiles, activities and courses ontologies were designed and implemented in Protègè, [21], as shown in Figure 5.

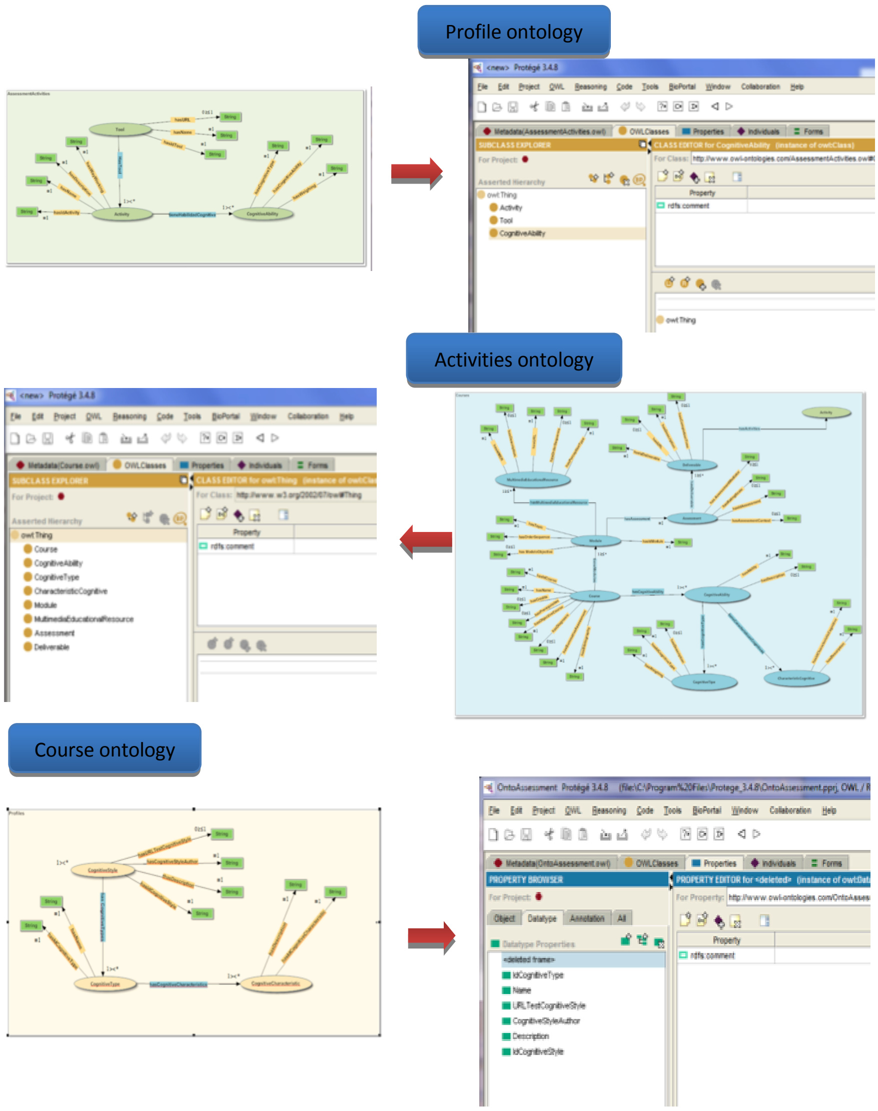

Fig. 5. Design and implementation of profiles, activities and courses ontologies

In Figure 6 we show the cognitive skills ontology considered in evaluation activities.

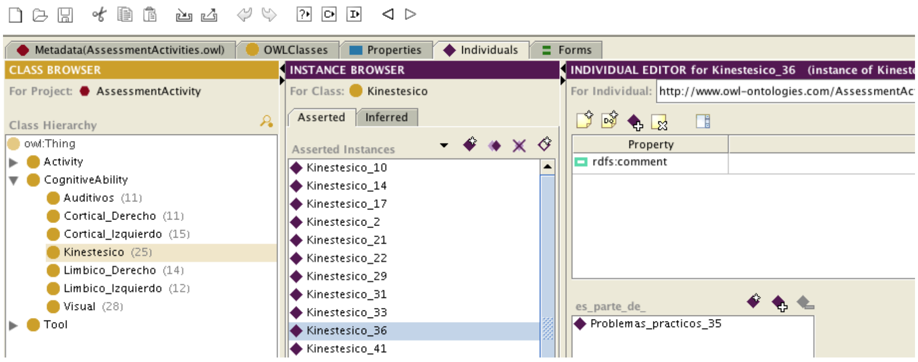

Fig. 6. Cognitive skills ontology considered in evaluation activities

6 Application Case

The first part of the proposed architecture (SLM), in particular the regulation model of the reactive layer, its performance was verified through an application case carried out during the trimesters 12P to 13I in groups with modality: Course No Presential (CNP), of Structured programming course (required course for engineering students) in the Autonomous Metropolitan University – Azcapotzalco (UAM-A).

6.1 Methodology

To address the problems described in Section 1 about failure and terminal efficiency, particularly in the UAM-A, were carried out several experiments. The design of experiments considered a set of variables that were modified to obtain good results in learning, reduced desertion and increased approval. Each experiment was performed in a different trimester, it was adjusting the variables involved in order to optimize the resources needed to address groups in CNP modality, and improve student learning.

6.2 Experiments

Table 2 shows the experiments and modifications to the variables involved. The sample size is approximately 100 students who enroll in part-time course contemplating a total of 500 engineering students who enroll in structured programming course per trimester. To calculate the sample size we use the following formula:

$$n = \frac{N\sigma^2 Z^2}{(N-1)e^2 + \sigma^2 Z^2}$$

For a population N = 500, 95% confidence Z = 1.96, and since there is no other values, then σ = 0.5 and e = 0.05. For N = 120, there is a minimum sample size n = 92.

The variables involved in the experiments are detailed in the Table 1.

Table 1. Variables for test cases

Variable	Values	Indicators
Assessment Activities	Unique for all Various Activities according to learning profile	% Approval
Creation of learning communities	Random Free choice of student according to their learning profile	% Desertion Integration
Monitoring the teaching – learning process	Teacher Hierarchical Excellence monitoring cycle	% Desertion Motivation

The experiments started from the trimester 12-P and conclude in 13-I, which allows 3 repetitions with different values in the variables involved, as shown in Table 2.

Table 2. Changing variables in the test cases of the trimester 12-P to the 13-I

	Cases		
Variable	**12-P**	**12-O**	**13-I**
Creation of learning communities	Free	Random	Combining thinking styles (diversity)
Assessment Activities	Mind Maps. Programs, Exams	Mind Maps, Self-Assessment , Exams, Programs	Self-Assessment, Exams, Programs
Monitoring	Excellence monitoring cycle	Excellence monitoring cycle	Excellence monitoring cycle
Cognitive tools	Virtual classroom	Collaboratory	Collaboratory

The first variable shown in Table 2 is the formation of learning communities, considering the free conformation to student's decision, random and according to their learning profile (maintaining diversity). The second variable is the assessment activities which have passed from homogeneous activities as mind maps, programs and exams to activities as self-assessment, programs and exams. The third variable is the monitoring and it has been maintained in this excellence monitoring cycle. Finally, the last variable is cognitive tools, which have passed from virtual classroom to collaboratories.

6.3 Analysis of Results

Structured programming course is part of the basic trunk so all engineering students must attend it. In this course the student is confronted with a new way of driving the teaching-learning process, understand the use of the platform, learn the subject discipline of course, develop critical thinking and abstract. This causes that students acquired new cognitive skills during the trimester.

Table 3 shows the results in each of the trimesters regarding the students' performance. Where attended students is equal to the number of students enrolled less truancy.

Table 3. Results in the test cases of the trimester 12-P to the 13-I

Trimester	Enrolled	Truancy	Attended	Approved	Performance
12-P	250	57	193	60	0.310880829
12-O	212	149	63	32	0.507936508
13-I	150	56	94	53	0.563829787

Figure 7 shows the results of average performance obtained in each experiment. The performance is calculated as the ratio of students approved between students attended. Clearly, the performance starts at 0.31 for the first experiment until the 0.56 in the third experiment, which shows a tendency to improve learning, applying the proposed model in Section 5.

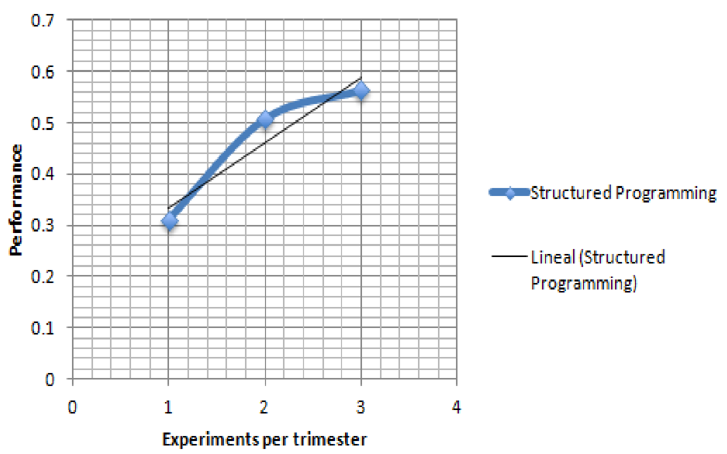

Fig. 7. Performance obtained in experiments

7 Conclusions

Based on the preliminary results of performance obtained shows a positive increase in the average performance of students who participated in the experiments, which covers part of the objective proposed in this research. Therefore, the Strategic Learning Meta-Model proposed in this paper is an alternative solution for problems such as: school failure, desertion, coverage and attention of students in massive groups because SLM optimizes both human and physical resources.

The backbone of the SLM is the regulation model of the reactive layer that gives life excellence monitoring cycle in which recurring errors are detected, maintaining a harmonious work environment and again provides personalized attention which in turn encourages learning communities work encouraging key values like a sharing knowledge, helping others to achieve success in community. The intelligent part of the SLM is the ontological model whose function is to recommend learning activities and tools that support the development of some cognitive abilities. This work is done manually on the platform from the provided recommendations. However the complete ontology is in construction and is part of future work to try automating the process through ontological model built.

The SLM potency the evaluation as a mechanism not only for change, but also for strategic learning. The evaluation, by customizing learning activities and self-regulation is an excellent learning strategy for both students and teachers. Evaluation becomes the main engine of a new culture of learning, enabling them to continue learning throughout life.

References

1. Jiménez M.G., Vega L., Bernal J.: La reprobación escolar como objeto de estudio de la investigación educativa. En: Primer Congreso Latinoamericano de Ciencias de la Educación (2010)
2. Baena, Paz G.: Trayectoria escolar en la licenciatura de ciencias políticas (4ta. Ed.). Estudios políticos. México. No. 7, Época, pp. 117−138 (1995)
3. Pozo J., & Monereo, C.: El apendizaje estratégico (1° edición). Aula XXI / Santillana. Madrid España (1999)
4. Weinstein, C., Powdril, L., Husman, J., Roska, L., Dierking, D.: Aprendizaje estratégico: un modelo conceptual, instruccional y de evaluación. In: S. Castañeda (coord.), *Evaluación y fomento del desarrollo intelectual en la enseñanza de ciencias, artes y técnicas.* México: Miguel Ángel Porrúa, pp. 197−228 (1998)
5. García, T. & Pintrich, P.R.: Regulating motivation and cognition in the classroom: the role of self-schemas and self-regulatory strategies. In: D.H. Schunk and B.J. Zimmerman (Eds.) Self-Regulation on Learning and Performance: Issues and Applications, NJ, Hillsdale, Lawrence Erlbaum Associates, pp. 132−157 (1994)
6. Castañeda, S. & López, M.: *La psicología cognitiva del aprendizaje, aprendiendo a aprender* [antología]. México: Facultad de Psicología, UNAM (1989)
7. Monereo, C.: De los procedimientos a las estrategias: implicaciones para el Proyecto Curricular Investigación y Renovación Escolar (IRES). Investigación en la escuela. 27, 21−38 (1995)

8. Monereo, C., Pozo, J.I., y Castelló, M.: La enseñanza de estrategias de aprendizaje en el contexto escolar. En: Coll, C.; Palacios, J; Marchesi, A. (Comps.). Desarrollo Psicológico y educación II (Edición revisada). Madrid: Alianza (2001)
9. Monereo, C.: Hacia un nuevo paradigma del aprendizaje estratégico: el papel de la mediación social, del self y de las emociones. Revista de investigación educativa, 5(3) 239−265 (2007)
10. Angulo, L.: Proyecto: educación en línea. Revista Electrónica Educare, vol. XIII, pp. 123−133 (2009)
11. Hernández, G.: Miradas constructivistas en psicología de la educación. México: Paidós Educador (2006)
12. Rocha, E.: Educación @ Distancia. Retos y Tendencias. Universidad Autónoma de Nuevo León. México: Arbor (2007)
13. Anijovich R., Cappelletti G., Hoffmann J. et al.: La evaluación significativa (1ª ed.). Buenos Aires: Paidós SAICF (2010)
14. UNESCO. Hacia las Sociedades del Conocimiento (2005)
15. De la Fuente, J. & Justicia, F.: El modelo DIDEPRO de regulación de la enseñanza y del aprendizaje: avances recientes. Revista electrónica de investigación psicoeducativa, 13, vol 5 (3) pp. 535−564 (2007)
16. Lee, S., Banker, T., & Kumar, V.: Learning preferences and self-regulation - Design of a learner-directed e-learning model. Communications in Computer and Information Science 257 CCIS, pp. 579−589 (2011)
17. Joo, K. & Park, N.: Design and application of the u-SM teaching and learning model for an efficient ubiquitous learning. In: 2013 International Conference on Computing, Management and Telecommunications, ComManTel 2013; Ho Chi Minh City; Viet Nam; 21- 24 January 2013, Article number 6482402, pp. 264−268 (2013)
18. Barbosa, D., Barbosa, J., Bassani, P., Rosa,J., Martinis, M.: Content management in a ubiquitous learning environment. International Journal of Computer Applications in Technology, 46(1), pp. 24−35 (2013)
19. Fleming N. & Mills C.: Not Another Inventory, Rather a Catalyst for Reflection. To improve the Academy, Vol. 11, p. 137 (1992)
20. Herrmann, N.: The creative brain. Búfalo: Brain books (1989)
21. Protégé 3.0. http://protege.stanford.edu/