v. 3, n. 17, 2023

Journal of
Engineering
Research

AN AGILE FRAMEWORK: ACADEMIC SOFTWARE PROJECT MANAGEMENT

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Abstract: Project-Based Learning (PBL) is a strategy frequently used in Computer Science Educational Programs. This article outlines an applied research using the paradigm of the agile approach adapted to the development of academic projects as a learning strategy in higher level educational programs. In this sense, the main objective of the research is the design of a model capable of being reproduced in order to formulate innovative projects with the construction, use and/or implementation of technologies to meet the expectations of the development of skills in the area. of computer science focused on project-based learning (ABP) and the generation of knowledge. The methodology used responds to the deductive method, in which the precepts of agility, the Scrum framework and the PBL could be contrasted with the purpose of defining and designing an agile model of academic projects that allow the integration of competencies, skills, knowledge and technologies that add value to the approach of the proposed project. Finally, as a result obtained, the model created and the discussion of the findings and achievements obtained are exhibited. Experimental studies of the model and its adaptation to other contexts in different areas of educational work remain for future lines of research.
Keywords: academy, agility, model, project, scrum.

INTRODUCTION

A project in the educational field (educational project) can be defined as an initiative or set of activities with clearly defined objectives based on problems, needs, opportunities or interests, of an educational system, of an educator, of groups of educators or of students, in order to carry out actions aimed at human formation, the construction of knowledge and the improvement of educational processes.

Project-based learning (ABP) is the didactic use of a project, which must be planned, created and evaluated, in small groups of students, in order to respond to the needs raised in a given situation. Project-based learning is a methodology that is developed collaboratively that confronts students with situations that lead them to propose proposals to a certain problem (Cobo Gonzales & Valdivia Cañotte, 2017).

Project-based learning focuses on students so that they acquire skills and abilities. This way, its possibilities to promote the development of (Zambrano Briones, Hernández Díaz, & Mendoza Bravo, 2022) are highlighted:

- The internal motivation of the student towards the study,
- Interaction and collaboration among group members
- Fluency in the oral and written presentation of their ideas and assessments,
- The responsibility of the student in solving the tasks,
- The expansion of the spectrum for your work location,
- The link between theory and practice,
- Spaces for the joint construction of knowledge and skills,
- Social skills that multiply the dimensions of their communication with others and the environment,
- Analytical perspectives to solve the problems it addresses,
- Self-confidence, based on the recognition of their strengths and weaknesses.

The PBL presents a learning model with which students work actively, plan, implement and evaluate projects that have real world applications beyond the classroom (Latorre

Cosculluela, 2021).

However, the PBL does not explicitly describe how to carry out the proposal and development of the project. To date, it is very complex to be able to say that there is an accepted or standardized model, guide and/or manual that allows teachers and students to implement the development of academic projects, achieve meaningful learning and finish successfully.

Specifically, the need for a guide that offers the possibility of managing a project and leads to significant learning is recognized.

Derived from the above, the objective of this study is the design of a model capable of being reproduced in order to formulate innovative projects with the construction, use and/or implementation of technologies to meet the expectations of the development of skills in the area. of computer science.

METHODOLOGY

In the study, one of the most used strategies throughout time was used, the syllogism, whose deductive reasoning goes from the universal or general to the particular, linking the major and minor premises to reach the conclusion. In this research, the theory was based on and through a logical-deductive process, the key elements for the development of the proposed model were contrasted and specified (Latorre, Del Rincón, & Arnal, 2005).

The methodology used, based on the deductive method, contemplated three steps:

- Definition of the First Premise: The theoretical foundations and analysis of agility, project-based learning (ABP) and the Scrum framework allowed establishing a mutual correspondence for the definition of the agile model in the formulation of academic projects.
- Definition of the Second Premise: The agile model was designed for the formulation of academic projects based on the first premise.
- Drafting of the Conclusion.

DEVELOPMENT

The First premise starts from the theory, that is, the scientific theoretical foundations that give rise to and support the Second premise, in order to reach a conclusion. In this research, those foundations are closely related to three primary precepts:

- Project-based learning (ABP)
- Agility and the Scrum framework; and
- Academic projects with the use of ICTs

Project-based learning (ABP) is the didactic use of a project, which must be planned, created and evaluated, in small groups of students, in order to respond to the needs raised in a given situation. Project-based learning is a methodology that is developed collaboratively that confronts students with situations that lead them to propose proposals to a certain problem (Cobo Gonzales & Valdivia Cañotte, 2017). The ten phases established to develop the PBL and the actions to be carried out in each of them, according to Hernando Calvo (2016) are:

- Phase 1: Starting point (main theme, initial question and what we know).
- Phase 2: Team formation.
- Phase 3: Definition of the final product (definition of objectives).
- Phase 4: Organization and planning (assignment of roles and times).
- Phase 5: Information gathering (review of the objectives, recovery of previous knowledge, introduction of new concepts and information search).
- Phase 6: Analysis and synthesis (pooling, problem solving and decision making).

- Phase 7: Production (application of new knowledge, implementation of basic skills and development and execution of the final product).
- Phase 8: Presentation of the project (preparation, defense and review with experts).
- Phase 9: Collective response to the initial question (reflection on the experience, use of instant messaging systems).
- Phase 10: Evaluation and self-assessment.

It is considered relevant to mention that the characteristic element of the PBL is the culmination of the project with a final product. Hence, the opportunity to apply the agile approach, capable of optimizing the development of the project and the achievement of the expected competencies (Ortiz Colón & Ortega Tudela, 2018).

Agile is a lightweight software development method that seeks to be more efficient than traditional development models. Agile tries to do more with less (Mathis, 2018):

- Greater team decision making.
- Faster development time.
- Faster troubleshooting.
- Better customer satisfaction.
- Smaller teams.
- Less expense.
- Less wasted work.
- Fewer features in the final product that either don't work or are never used.

Agile methods have a common philosophy and principles with certain specific aspects that differentiate them. The idea is that in each situation the method that best suits the project to be addressed is chosen. But what makes a method agile? What do these methods have in common? The Agile Manifesto spells out these defining characteristics. All of them consider collaboration a key element. Both the people who are building the product and the customer must work in constant communication and feel like members of a great team. On the other hand, a method is agile if it allows you to build a product incrementally, that is, to create something very simple initially and to gradually enrich and complete it. Another common factor of these agile methods is their simplicity. Its rules are simple and common sense, but, yes, experience and professionalism are necessary to obtain the maximum benefit from them. There are agile process or management methods such as Scrum or Kanban (Gómez Lasa, Álvarez García, & De las Heras del Dedo, 2018).

Agile values represent the main attributes that a process must have to be considered agile.

Agile is the use of an adaptive life cycle. This is a general concept, a practical approach was needed to be able to carry out projects based on this concept. For this reason, the Scrum framework was defined (K. Rad & Turley, 2019).

Scrum is an agile project management methodology, founded on the principles of a learning organization. The principles of a learning organization are systems thinking, personal mastery, mental models, shared vision and team learning (Harrison & Thackeray, Teaching Systems Thinking as a Foundation of Scrum, 2020).

The Scrum framework consists of three phases: Pre-game, in some other texts such as Planning, Game "Development" or Development and Post-game or Completion (Chimarro Chipantiza, Mazón Olivo, & Cartuche Calva, 2015).

According to Chimarro, Mazón & Cartuche, the Scrum life cycle includes:

1. Pre-game phase

a) Vision and analysis: Business vision

b) Planning: Product backlog list (priorities and effort estimates)

c) Architecture: Software architecture

2. Game Phase

a) Sprint backlog list: Goals for the next Sprint (requirements)

b) Sprint: Analysis, design, evolution, testing and delivery

c) New increased product

3. Post-Game Phase

a) System tests: Documents

b) Integration: Final version

On the other hand, Fullan and Langworthy (2013) state that ICTs can promote "deep learning" as long as educational projects address these issues:

- Education of character, with honesty, self-regulation and responsibility.
- Citizenship, global knowledge, sensitivity and respect for other cultures.
- Effective communication, orally and in writing, with a variety of digital tools.
- Critical thinking and problem solving.
- Collaboration, such as the capacity for teamwork, learning to cooperate and the development of skills for learning in social networks.
- Creativity and imagination, with a component of economic and social activity, such as entrepreneurship.

Through the expert group technique, an analysis is carried out between the theoretical foundations previously presented and the integration correspondence between them is established. Table 1 shows the correspondence and integration association between PBL, Scrum and the inclusion of ICTs in the deep or meaningful learning.

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As a result, a strong tripartite correspondence and integration is established between the analyzed theoretical precepts.

After obtaining the results of the alignment or correspondence of the studied precepts, it is necessary to specify the elements and actions to follow in the project formulation process for the definition and design of the agile model.

The Scrum framework proposes the definition of a reduced set of structures that help people-oriented and goal-oriented project management, made up of: roles, artifacts, and events (activities) (K. Rad & Turley, 2019).

The three roles of Scrum are:

- Product Owner (Owner or owner of the product)
- Scrum Master
- Developers (Product development team)

The five events of Scrum are:

- The Sprint
- Sprint Planning
- Daily Scrum
- Sprint Review
- Sprint Retrospective

The three artifacts of Scrum are:

- Product Backlog
- Sprint Backlog
- Increase

Likewise, the critical points of the general process are summarized (Schmitz, Mahapatra, & Nerur, 2019):

- Agile projects begin upon approval of a project charter. The Product Owner's vision is broken down, refined, and ordered into a set of User Stories that become the Product Backlog List (PBL).

Phases of Project-Based Learning (PBL)	Adaptation of the Scrum framework	Inclusion of ICT skills in meaningful learning
1. Point • Initial question • Main topic • What do we know	1. Identification of the need or problem	1. creativity and imagination
2. team building	2. team building	Citizenship, global knowledge, sensitivity and respect for other cultures.
3. Definition of the final product • Definition of objectives	3. Definition of the objectives and scope of the project • Vision	Critical thinking and problem solving
4. Organization and planning • Assignment of roles • Definition of tasks and times	4. Organization and planning • Assignment of roles • Creation of the Product List (priorities and estimates)	Character education, with honesty, self-regulation and responsibility. Collaboration
5. Information gathering • Review of objectives • Recovery of prior knowledge • Introduction of new concepts	5. Information gathering	Collaboration
6. Analysis and synthesis • Sharing • Problem resolution • Decision making	6. Analysis and synthesis • The Planning or The Planning (Sprint Planning) • Software Architecture	Effective communication Critical thinking and problem solving Collaboration
7. Production • Application of new knowledge • Putting basic skills into practice	7. Production • Sprint Backlog • Sprint o Daily meetings (every 24 hours) o Review meeting of each iteration (Sprint) o Retrospective meeting of each iteration (Sprint) • New product increased • System tests • Integration	Effective communication Critical thinking and problem solving Collaboration
8. Project presentation • Preparation • Defending • Review with experts	8. Project presentation • Integration and final version of the product • Documents	Character education, with honesty, self-regulation and responsibility.
9. Collective response to the initial question • Reflection on the experience • Use of instant messaging systems	9. Project delivery and closure • Retrospective of the project	
10. Evaluation and self-assessment	10. Evaluation and self-assessment	
Significant learning	**successful project**	**Significant learning**

Table 1: Correspondence and integration between PBL, Scrum and inclusion of ICTs in deep or significant learning.

- A Sprint Planning provides estimates in terms of relative time and effort, and then selects the PBL items to be addressed in the next Sprint, thus creating a Sprint Backlog List, SBL).

- Then, the team starts an iteration (Sprint) with a fixed duration, to create, develop and enable the product features associated with the User Stories identified in the SBL.

- During the iteration (Sprint), a brief daily meeting (Daily Scrum) is held at the beginning of each working day with the entire project team. This meeting highlights progress, difficulties and provides relevant project information for the entire team.

- After each iteration (Sprint), a series of meetings are held. A review meeting (Sprint Review) focuses on product feedback to influence product refinement and evolution during future iterations. This gathering may result in new or changed elements of the PBL as feedback is translated into new User Stories.

- A Sprint Retrospective meeting focuses on project and process improvement. The iteration retrospective meeting can lead to alternate resource assignments, a different sequence of tasks, tooling changes, or other process-related adjustments to improve team performance in subsequent iterations. Finally, a new iteration begins with its Sprint Planning, and the process restarts with a new iteration (Sprint).

- The project life cycle ends when the product owner accepts the final deliverable or product.

Below are the results of the deductive, non-experimental analysis with the definition and design of an agile model for the formulation or proposal of academic projects within higher level studies in educational programs in computer science.

RESULTS

As a second premise, the model called Agility Project ABP is designed. This is intended to serve as a guide to formulate an academic project and integrate the precepts of the first premise. Figure 1 shows the general process of the Agility Project ABP model.

Next, the main processes of the Agility Project ABP model are described:

i) Assignment of roles. The Agility Project ABP model distinguishes three participation roles:

(a) The educational institution, which acts as the owner of the idea and/or project thanks to its institutional nature.

(b) Advisor or instructor, teacher or staff attached to the educational institution that is responsible for directing or guiding the development of the proposal, following the Agility Project ABP model.

(c) Project team, students and/or people attached to the educational institution that proposes the project and will be directly responsible for its development after authorization.

ii) Creation of the Product Backlog or List (priorities and estimates). The Product Backlog represents everything that is needed in the product. Each record (item) in the Stack has four attributes: description, order, estimate, and value. It is a unique source of information about what is required for the product (Malhotra, 2020). The Product Backlog does not have a format, however, User Stories have been taken as a key element. Table 2 shows the Product Backlog of the Agility Project ABP Model.

i) Creation of the iteration Stack. Once an iteration (Sprint) has started, the User Stories to work on in a two-week period are chosen

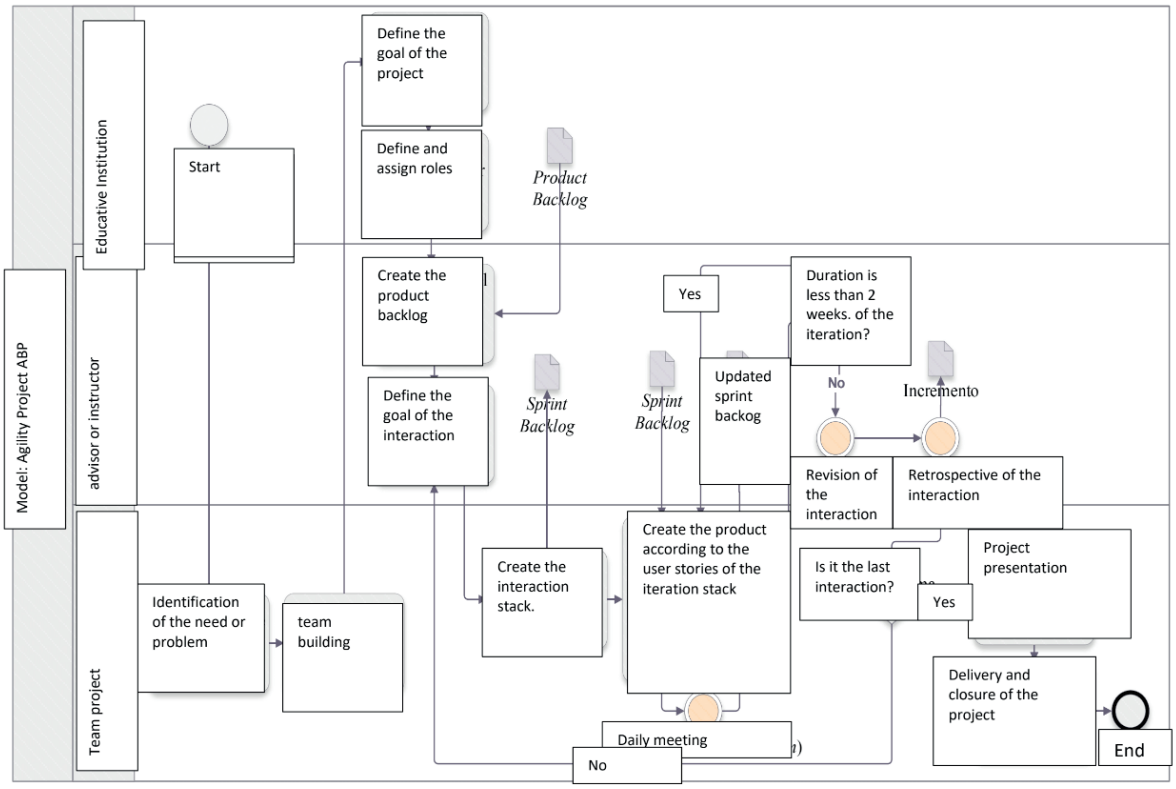

Figure 1: Agility Project ABP model. Source: Own source.

The Product Backlog				
Title	**Description**	**Order/ Estimate/ Worth**		
Name	As a project team I want to establish the project name to clearly and concisely describe the final deliverable and its main functionality.	01	1d	1
Problem Statement	As a project team I want to write the problem identified to carry out the research study	02	2d	3
team building	As an advisor I want to know the participation of the work team to	03	1d	1
Goals	As a project team I want to formulate the general and specific objectives of the project to establish the main functionality of the final deliverable	04	1d	3
Scope or goals	As a project team I want to write the project scope to expose the functionalities, tools and benefits of the final deliverable	05	2d	2
Organization and planning	As an advisor I want to make an action plan estimated time and duration for the development of the project	06	1d	3
Information gathering	*As a project team I want to carry out a study of historical projects and documentation related to the project to define the development architecture of the project*	07	5d	3
Analysis and synthesis	As an advisor I want to establish the action plan and the technological architecture for the development of the project	08	5d	2
Production	As a project team I want to make the deliverable with the defined scope to meet the established objectives	09	45d	3
Project presentation	*As a project team I want to deliver the final product to be evaluated*	10	1d	3
Project delivery and closure	*As a project team I want to deliver the final deliverable to finish the project*	11	1d	2
Evaluation and self-assessment	*As an advisor I want to evaluate the project team to determine the achievement of the generic and specific competencies developed by the team during the project from the final deliverable and its presentation.*	12	1d	3

Table 2: The Product Backlog of the Agility Project ABP Model. Source: Own source.

from the Product Backlog. Accordingly, the final product or deliverable is created. The events and artifacts used within the iteration achieve the optimization of the work and the development of the general and specific competencies identified in the first premise.

ii) The Evaluation and self-assessment process must strengthen the achievement of the objectives of the project and significant learning. According to the analysis carried out, the evaluation instrument best adapted to the Agility Project ABP model is the rubric. The elements to include are: Competence, Indicator, Evidence and Level of achievement. For example, for the rubric on the use of ICTs in the project:

(a) Competence 1: ability to define an academic project that solves a defined problem with the use and/or implementation of ICTs

(b) Indicator 1.1: Identifies, recognizes and distinguishes the use of ICTs for the development of the project in the contextualized innovative practice of the problem.

(c) Evidence 1.1.1. Describes the designated ICTs and verifies the compatibility of their integration for the development of the project.

(d) Level of achievement not suitable 1.1.1.a The ICT functionality for the project is not clearly described. Insufficient level of achievement 1.1.1,b The ICTs designated for the project are partially described, but not the integration compatibility between them. Sufficient level of achievement 1.1.1.c All the ICTs designated for the project are described, and partially the integration compatibility between them. Satisfactory level of achievement 1.1.1.d All the ICTs designated for the project are described, and the compatibility of integration between all of them.

(e) Evidence 1.1.2. Demonstrates the domain ability (knowledge and management) of the ICTs designated in the project.

(f) Level of achievement not suitable 1.1.1.a Does not respond to the characteristics or technical description (name, edition, version, requirements, architecture, provider, licensing, etc.) of the ICTs designated to the project. Insufficient level of achievement 1.1.1,b The characteristics or technical description (name, edition, version, requirements, architecture, provider, licensing, etc.) of the designated ICTs are partially described (in a percentage less than 80%) for the project. Sufficient level of achievement 1.1.1.c The characteristics or technical description (name, edition, version, requirements, architecture, provider, licensing, etc.) of the designated ICTs are partially described (in a percentage greater than 80%) for the project 1.1.1.d All the characteristics or technical description (name, edition, version, requirements, architecture, provider, licensing, etc.) of the ICTs designated for the project are described.

DISCUSSION OF RESULTS

The study sets the Deductive Method as a research framework, which was strongly adapted to the first premise due to the need to analyze and know the theoretical foundations and bases of the research. On the other hand, in the second premise, the definition of the model can be represented by means of a process diagram of the activities and elements proposed for the development of an academic project. However, a considerable difficulty is recognized in the implementation of the model without its theoretical bases. That is, the model is very strongly aligned to the knowledge, understanding, and mastery of the theoretical precepts considered in the study: project-based learning (PBL), agility, and the Scrum framework.

The Agility Project ABP reliably responds to the first established premise, in the same way, it integrates and aligns all the theoretical foundations analyzed. By enunciating the

detail of the most important processes of the model, the usefulness and added value that it provides is verified. Specifically, when reflecting on the use/application of this in educational contexts of computer science, it can be affirmed that its applicability is viable and would guarantee efficiency, effectiveness, quality, satisfaction and the development of skills in the task of developing a project.

The evaluation and self-assessment process is also revealed as critical to validate, verify and ensure the development of generic and specific competencies. As well as significant learning. For this reason, it is necessary to design own evaluation rubrics that are the means of weighting the knowledge acquired throughout the project.

CONCLUSIONS

Finally, Project-Based Learning (ABP) is a student-oriented learning strategy through which he manages to acquire knowledge in a self-taught way, these students form teams to develop projects in order to generate products, services or satisfy the client in relation to with linked resources and assigned time.

Agile project management is known as a set of methodologies that enable rapid and flexible project development, focused on early delivery of business value, continuous improvement of project products and processes, and delivery of well-proven products that reflect customer needs.

Despite the fact that Scrum is a tool for creating software, it is currently implemented as a didactic tool in schools, institutes and universities, which helps to create group and collaborative work, when combined with the supervision and guidance of Some teacher or subject expert can help develop good quality projects, bringing benefits to students as well as motivating them to improve their critical thinking skills and strengthening their communication skills.

On the other hand, Scrum is a project management framework where people can deal with and solve complex and adaptable problems, productively and creatively delivering products with the best possible value.

Taking all this into account, a deductive analysis is made, whose first premise establishes the theoretical foundation and the second, the design of a model or action plan to follow in the development of academic projects that allow the development of meaningful learning. Undoubtedly, it can be concluded that the Scrum framework is totally similar to the PBL phases and, additionally, it also allows the development of skills specific to the use of ICTs in projects. It is important to mention that the design of the Model diagram guarantees its replicability and implementation. But, it is highlighted that disciplinary knowledge of Scrum and the agile approach is essential. When working with academic or educational projects, it is essential to attach elements that allow the proper evaluation of knowledge (knowledge, abilities, aptitudes and attitudes) in the training of students during or at the end of the project. Let's not put aside the difficult task of providing quality education.

Future lines of research, among others, there is a need to design the artifacts and evaluation instruments for project-based learning in established case studies that lead the academic-scientific community to apply new approaches and perspectives in the work of their chair that guarantees meaningful learning through applied, experimental and/or field research. Similarly, there are two paths that are looming for future studies: there is a huge bias in how to use the project-based learning (PBL) strategy in education at all levels, and the stream of Scrum for life, whose purpose is to apply Scrum as a framework in any problem, field and context to optimize processes, activities or tasks promoting the

agile approach or agility.

THANKS

We thank Dr. José Alberto Abud Flores, Rector of the Autonomous University of Campeche for the provision and funding granted for the publication of this article. In the same way, attention is extended to the MAC. Francisco Javier Barrera Lao, Director of the Faculty of Engineering for the empathy of promoting, managing and supporting scientific research studies in the area of Education and Information and Communication Technologies. Finally, to recognize MTE Nancy Georgina Ortiz Cuevas, Coordinator of the Computer Systems Engineer Educational Program, for promoting academic and disciplinary research work that leads to professional advancement of the university academic community.

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