

MENDIVE



REVISTA DE EDUCACIÓN

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Original article

Agility in the management of graduation projects

Agilidad en la gestión de proyectos de graduación

Agilidade na gestão de projectos de licenciatura

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Received: March 7th, 2022.

Accepted: April 22nd, 2022.

ABSTRACT

In university contexts, new situations emerge that underpin innovations. The article presents an agile strategy based on SCRUM practices (as a project management methodology). The method describes the phases defined to systematize the experiences and make explicit through an agile process framework based on the principles of the SCRUM method. The subject Final Degree Project was defined as the

context of sketching and validation of the proposal, scope of implementation the design, production and defense of an integrating work of the Bachelor's Degree in Information Systems. This proposal adopts practice. This proposal adopts SCRUM practices based on previous experiences, and focused on the management of these end-of-degree productions appropriate to the context of the Computer Science discipline in relation to the information technology industry. Finally, the need to adopt agility in university contexts in the knowledge society is highlighted, considering the profile of the students of the XXI century in which many of them present experience in the industry.

Keywords: Higher Education; processes; projects; SCRUM; university diploma or dissertations.

RESUMEN

El objetivo del artículo es presentar una estrategia ágil fundamentada en las prácticas de SCRUM (término proveniente del deporte Rugby, que significa apoyo colaborativo entre jugadores para agilizar una anotación); en este caso, innovar en la gestión de los proyectos de fin de carrera. Se recurrió a métodos de nivel teórico que delimitan y sustentan la propuesta, y de nivel empírico, para sistematizar las experiencias y explicitar a través de un marco de proceso ágil sustentado en los principios del método ágil SCRUM. Se definió como contexto de esbozo y validación de la propuesta la asignatura Proyecto Final de Carrera; ámbito de implementación: el diseño, producción y defensa de un trabajo integrador de la carrera Licenciatura en Sistemas de Información. Esta propuesta adopta prácticas de SCRUM en base a experiencias previas, y focalizada en la gestión de estas producciones de finalización de carrera adecuadas al contexto de la disciplina Informática, en relación a la industria de las Tecnologías de la Información. Finalmente, se resalta la necesidad de adoptar la agilidad

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en los contextos universitarios en la sociedad del conocimiento, dado el perfil de los estudiantes del siglo XXI, en el que muchos presentan experiencia en la industria.

Palabras clave: diploma universitario o tesinas; Educación Superior; procesos; proyectos; SCRUM.

RESUMO

O objetivo do artigo é apresentar uma estratégia ágil baseada nas práticas SCRUM (um termo do desporto do Rugby, que significa apoio colaborativo entre jogadores para acelerar uma pontuação); neste caso, inovar na gestão de projectos de fim de grau. Foram utilizados métodos teóricos para delimitar e apoiar a proposta, e foram utilizados métodos empíricos para sistematizar as experiências e torná-las explícitas através de um quadro de processo ágil baseado nos princípios do método ágil SCRUM. O contexto para delinear e validar a proposta foi definido como o curso de Projecto de Grau Final; o âmbito de implementação: a concepção, produção e defesa de um projecto integrado para o Grau de Bacharel em Sistemas de Informação. Esta proposta adopta práticas de SCRUM baseadas em experiências anteriores, e focalizou-se na gestão destas produções de fim de curso adaptadas ao contexto da disciplina de Informática, em relação à indústria das Tecnologias de Informação. Finalmente, a necessidade de adoptar agilidade nos contextos universitários na sociedade do conhecimento é realçada, dado o perfil dos estudantes do século XXI, muitos dos quais têm experiência na indústria.

Palavras-chave: diploma universitário ou dissertação; ensino superior; processos; projectos; SCRUM.

INTRODUCTION

In Higher Education, the evaluation of learning constitutes a complex activity, which implies a constant critical and reflexive look, oriented to the significant construction of knowledge.

In careers belonging to technological disciplines such as those that deal with the study of information systems, in addition to academic aspects, those linked to the professional field must be considered.

In the Argentine Republic there are numerous national and regional programs aimed at promoting the training of professionals in Information and Communication Technologies (ICT). Simultaneously, local governments and companies are consolidating along the same lines.

The Chamber of Software and Computer Services Companies and the Software Promotion Law are one of the key factors to achieve improvements in ICT-related companies. These are constantly reviewed according to emerging regulations such as the Knowledge Economy Law (2020).

In Northeast Argentina (NEA) strategies are adopted to strengthen the development of these technologies. Among them, the activities promoted by the Technological Linkage Unit of the National University of the Northeast (UNNE), where this study is focused; the formation of the IT Corrientes Pole and the IT Chaco Pole; the creation of the Development Cooperation Agency between the UNNE and the municipalities of the provinces of Corrientes and Resistencia; and the launch of the Corrientes node of the UNNETEC-INNOVAR business incubator.

The National University of the Northeast (UNNE), in its context of influence, is committed to innovation and local and regional development, and motivated to

participate in this sector of the knowledge economy. The training of qualified human resources is promoted, from whom a performance with social responsibility is expected. The university as an agent of change, innovation, and given its high commitment to sustaining society, is committed to ensuring that its professionals consider and develop issues related to the context in which they work. This is how it contributes to university social responsibility.

Agile Strategies in Higher Education

In the context of the Informatics discipline, agile methods provide an organization or a team with the flexibility to adopt a group of principles and practices, previously selected, based on their culture, their values and the types of systems they develop (Mariño, Alfonso and Arduino, 2020).

There is a diversity of agile strategies widely validated in Higher Education spaces. Some that implement SCRUM are summarized below, in Mariño and Alfonso (2014), which they adapt to the Final Application Work subject. Müller Amthor, Hagel, Gensheimer and Huber (2020) describe its use to increase team values in students as a self-regulated and self-motivated agile learning framework. Klopp *et al.* (2020) carry out an evaluation in three universities that participate in a project generating ideas of the application of SCRUM addressing multiple perspectives.

Ivetiæ and Iliæ (2020) examine specific cases that apply agile project management in multiple areas of universities such as Governance and Structure, Curriculum Design, Teaching, Learning, Assessment, Online Courses and Virtual Classroom. Mariño, Alfonso and Arduino (2020) describe a proposal adaptable to various educational contexts. Otero *et al.* (2020) mention the adaptation of agile methodologies in the classroom to improve learning based on their adaptability to the modification of requirements that arise over time and

considering the flexibility of the student's self-regulation capabilities. Vila Grau and Capuz Rizo (2021) analyze the application of SCRUM in the classroom as a teaching method. An approach to the growth of agility in the teaching field is presented through the application of SCRUM as a working method and describes the context that led to the expansion of agility and the evidence that supports it.

Contextualization of agility in graduation projects

Final Degree Project (PFC) is an annual subject of the Degree in Information Systems (LSI). Its general objective is to complete the academic and professional training of students, enabling the integration and use of previously acquired knowledge, emerging issues and that are deepened and applied in the resolution of professional, academic and scientific problems. A graduate thesis or dissertation, following the UNESCO Thesaurus, would consist of a first level university diploma. In the subject, the contents treated correspond to topics of research methodology and Professional and Social aspects following the RedUNCI (2018).

In a professional and complex context, skills and abilities linked to professional practice are promoted. The above coincides with the guidelines established by CONFEDI (2018) in the new prevailing educational models for this type of career, and which provide the student with a broader vision of their profession and its contribution to the knowledge society.

To achieve graduation within the stipulated time, various strategies are defined and the professional skills required by the Information Systems and Services Sector (SSI) are strengthened, adopting active methodologies in favor of meaningful learning. Thus, the link from the university with its context through governments, industry, entrepreneurs, among others,

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constitutes a scenario that connects the deepening of a disciplinary area, the professional field and the resolution of a problem identified in reality.

The objective of the article is to present an agile process framework based on SCRUM practices, illustrating how a project management methodology is applied to manage the PFC project. The proposal is specified from the conception of the idea, its elaboration process, to finalize the presentation for its formal approval.

MATERIALS AND METHODS

The subject Final Project of the Degree in Information Systems was established as the context of the investigation. This was characterized in previous studies, highlighting that the students involved may or may not be working in various contexts.

In the design and development of the research, methods of the theoretical level were applied, such as the analytical-synthetic; in this case it was applied in the:

- Identification of antecedents around agility in the context of education, particularizing in the university context.
- Background review of the use of SCRUM in the management and control of projects.

The inductive-deductive method was used, in order to go from general to particular knowledge. Specially to analyze and reflect on the adaptation of SCRUM in the control management of projects that link from the academy to the resolution of problems identified in the context. In addition, it was based on the proposal described in Mariño and Alfonzo (2014) defined for a similar subject Final Application Work, for the

previous study plan of the homonymous university career.

At an empirical level -based on theoretical-level methods, it used the analysis of observations and notes made in recent years, which included the academic period prior to the pandemic (2018, 2019) and the activities developed in the period 2020 and 2021 in a context of Preventive and Mandatory Social Isolation (ASPO), in which they went through different situations according to current institutional regulations. Other sources were also used that facilitated the analysis that supports the proposal described in this article. Among this documentation, the following are mentioned: the reports of the subject -which show that the number of students in pre-pandemic and pandemic periods who defended the degree completion projects were similar-; the final reports, which highlight that the students deepen different areas of the discipline and its application to the resolution of problems of the context, as a challenge that they assume at the end of the studies.

The population was defined as the students who owe the PFC. The sample was made up of students who attended the 2018 to 2021 school years and those students who defended their PFC in conditions of regular or free students.

The aforementioned favored the development of a process framework based on SCRUM practices, defining the PFC subject as the validation context.

RESULTS

The methodological proposal is based on the agile management of projects based on SCRUM, the validation context being the subject Final Degree Project. His choice is based on the highlighting of this approach in 66% of the people who responded to the

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15th Annual State of Agile survey (Digit.ar 2021).

In the period prior to the pandemic caused by SARS-COV-19, it was observed that many students are doing internships or working; these practices contribute significantly to the strengthening of disciplinary and personal skills highly valued in the market. With the advent of ASPO, the University issued different regulations, innovating in teaching and learning modes. In particular, the process adopted by the aforementioned subject was adapted to this particular situation. In addition, the performances of the students in various work contexts were adapted to the new situation; even the Teleworking Law in Argentina (Legal regime of the Teleworking contract, 2020) was enacted, presenting new opportunities for the Information Systems and Services Sector. The implementation of this law makes it possible to regulate the remote work modality, ensure work continuity in the context of the ASPO, and regulate the rights and obligations of people regarding their employment relationship that takes place remotely, among other aspects.

Due to the above, the explicit and implicit activities addressed in the subject, as well as the process described in Mariño and Alfonzo (2014) justify this proposal.

Agile project management with SCRUM

SCRUM is defined as a collection of processes for project management (Deemer, Benefield, Larman, & Vodde, 2009; Sutherland, 2012).

SCRUM is an agile methodology especially suitable for projects in complex environments, characterized by changing requirements, and its fundamental aspects are innovation and flexibility. The goal is to deliver products that meet customer requirements in small increments (Sutherland, 2012; Mariño, Alfonzo, and Arduino, 2020).

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Project management in SCRUM is structured in work cycles called Sprints. These are incremental iterations of one to four weeks, and they happen one after the other. At the beginning of each Sprint, the cross-functional team selects items (customer requirements) from a prioritized list and commits to completing the items by the end of the Sprint. During the Sprint you cannot change the chosen items. At the end of the Sprint, the team checks in with project stakeholders, and shows off what they've built. In this sense, it is a practice that adds additional value to the client and enhances teamwork to achieve maximum efficiency in a continuous improvement scheme: the Sprint.

The team gets feedback and observations that can be incorporated into the next Sprint. SCRUM emphasizes products that work at the end of the Sprint, that is, they are done (Deemer, Benefield, Larman, & Vodde, 2009).

As an agile method: it is an adaptive development mode, rather than predictive; it is people-oriented, rather than process-oriented; employs the incremental build model based on iterations and revisions.

The practices used by SCRUM to maintain agile control in the project are: revision of the iterations; incremental development; Evolutive development; team self-organization and collaboration.

SCRUM was chosen as the basis of the proposal, since this methodology provides partial and regulated advances of the final product, depending on the needs of the recipient; generated in a team, facilitates the development of projects with immediate results. Sutherland (2012) points out that SCRUM can be developed in three groupings:

- Product Owner, owner of the product: is the voice of the client and responsible for generating tasks to be

developed based on their requirements or needs.

- Scrum Master: is the project leader and responsible for avoiding any inconvenience that the development team may encounter.
- Team Members, members of the team, discuss the development of the application.

Furthermore, Sutherland (2012) states that the heart of the SCRUM methodology is the Sprint. Each Sprint can be considered as a project that specifies the artifact to be built, the design and a flexible plan that guides the work to be done. The main roles, artifacts, and events are summarized in Figure 1.



Fig. 1- SCRUM Roles, Artifacts, and Main Events

Source: Deemer, Benefield, Larman, and Vodde (2009)

The subject Final Degree Project

The Final Degree Project subject is the university environment on which the proposal is designed and validated. It should be clarified that practices dealt with in the homonymous subject, which was dictated for the previous study plan, were taken up and refined. It was characterized in detail in Mariño and Alfonso (2014), Mariño and Alfonso (2019). Previous works described the

learning strategies that contribute to the realization of the PFC, in its different phases.

Agile process framework based on SCRUM in the Final Degree Project

The Final Degree Project is constituted in a process of construction of significant knowledge that is characterized in: its iterative and incremental evolution, in its requirements and in its functionality; the elaboration times limited to the regulations and conditions of the curricular space; the project elaboration process; the emphasis on the integration of previous knowledge, emerging knowledge and the resolution of context problems mediated by Information and Communication Technologies (ICT).

The summary indicates the feasibility of implementing some of the agile practices of SCRUM in the management and control of the process associated with the PFC. This article exemplifies the agility associated with college graduation.

The management activities included in the proposed methodology is: planning; time estimation; the management of human resources involved: teaching staff, guidance teachers, students, examining board and risk management.

Next, the roles, practices and artifacts based on SCRUM and particularized to the described educational context are mentioned. They were defined as roles:

- Product Owner. Professor coordinator and responsible for the subject. It accompanies the teachers of the subject and guiding teachers (Scrum Master) in the definition of the project until its defense. In the first instance, the acceptance of the product to be delivered is delimited and the requirements of the project are established and the priorities of the

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list of tasks are indicated, one of them being the feasibility of the project.

- Scrum master. Made up of the teachers of the subject and the guidance teachers, who advise and guide in the preparation of the project until its defense.
- Team. The team is made up of the student or two students, responsible for preparing and developing the project. Also, guidance teachers can be included, bearing in mind that, in many cases, they are the ones who delimit the project or define it if it is inserted in an R&D&I project, an internship, a subject, a company, or a business.
- Examining court. Composed of three professional professors, who evaluate the product of the PFC. One of them, is the coordinator and person in charge of the subject or Product Owner.
- The management of PFC project requirements consists of a list of tasks that guides the development of a technological product in a chosen disciplinary area and that makes up the Product Backlog. It ends with the defense of the same, prior to a review and feedback process. It should be clarified that, in this context, depending on the moment of the PFC that takes place, the established phases are: definition of the project, development of the project, defense of the project (See table 1).
- Product Backlog. Represented by the requirements established in the Program and Regulations of the subject. Annex II indicates the document to be completed and that formalizes the PFC project, and Annex III establishes the writing of the final report and presentation of the IT product generated within the framework of the PFC.
- Manage the risk continuously, through the subject meetings, the review and retrospective meetings

with the guiding professors (in the process), the examining board (at the time of the evaluation).

- Prioritization, estimation and definition of the scope of each required version, through the product stack. It is a continuous process, which implies continuous feedback and can be affected by the technical, social or organizational feasibility offered by the validation context of each PFC project.
- Planning meeting. Sprint planning meeting based on the Product Backlog. In this context, the roles that intervene vary in the first two moments of the project: definition and project, Product Owner (responsible for the subject) participates, who prioritizes the tasks to be included in the Sprint Backlog, the Scrum Master (team of teachers of the subjects, guidance teachers) and the Scrum Team (the student or team of two students). At the time of finalizing a PFC project, the Planning Meeting incorporates two evaluators who make up the examining board, who evaluate and thus provide feedback on each project, prior to the defense.
- Sprint Backlog. It contains the selected tasks of the Product Backlog, which differ according to the moments of the PFC, by what passes (planning, design, development and defense). It is worth clarifying the difference between Product Backlog and Sprint Backlog; the first indicates the "what", while the second the "how", based on the objectives associated with each PFC project.
- Management of the Sprint Backlog. At the beginning of each iteration, the requirements are selected and the effort of each task is estimated, according to the moment of the PFC that takes place: planning, project definition, project development, project defense. As an example, in

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the first version of the PFC project, the delimitation of the area of interest and an advance in the section identified as introduction are requested, and so on.

- Sprint. It is made up of the design and development phase (see table 1). Each version of the project is built based on previous reviews and validated according to the requirements included in the Sprint Backlog. The duration is 3 weeks. At the end of all the iterations, the project is accepted.
- The meetings. They are carried out face-to-face or virtually, including planned classes, tutorials and others according to the requirements associated with each project. The roles assumed by the different human resources are contemplated.
- Sprint Review. At the end of the Sprint, the Scrum Team presents the PFC draft version with the endorsement of the guiding teacher. Everyone involved in the project attends: Product Owner, Scrum Master and the Scrum Team.
- Burn down charts: they are applied to manage the project based on tasks and a Sprint. The visualization facilitates the understanding of the process.

Figure 2 illustrates the implemented process framework, which integrates the SCRUM practices and artifacts, mentioned above, with the practices associated with the design, development and defense of the PFC. As it is visualized, the Sprint iteration process is represented in the tasks that make up the elaboration of each version of the project; that is, the generation of a new draft version that iteratively and incrementally adjusts until it outlines and accepts the project idea. It should be clarified that the Stack of tasks or Product Backlist is modified in the different phases associated with the proposal.

In this case, the products associated with the phases are the different versions of the PFC project associated with the Planning and Design phase, the progress of the product and the report that are progressively generated in the Development phase, and those associated with the Defense Pfc. Table 1 summarizes the activities linked to the PFC project considered in the agile proposal.

Table 1- Phases of the proposed agile process framework

PHASES	ACTIVITIES	CHORES
Planning and Design	Review of disciplinary areas	<ul style="list-style-type: none"> • Identification of Disciplinary Areas of Knowledge (ADC) in which each PFC project is framed. • Review of the chosen disciplinary area of knowledge. • Review of potential guidance teachers. • Identification of relevant publications in the chosen area.
	Selection of the topic included in a disciplinary area	<ul style="list-style-type: none"> • Identification of viable topics for the PFC project, according to ADC and current regulations. • Review and selection of guidance teachers. • Identification of relevant publications in the area. • Determination of previous knowledge or work experience of the student in the subject.
	project design	<ul style="list-style-type: none"> • Drafting of the project by the student or a team of two students, playing the role of Scrum Team. • Project review. The advisory teacher

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		and teachers of the subject included in the role of Product Owner and Scrum Master, respectively, intervene. It represents an iteration of up to three versions, and each version represents a sprint that lasts from 2 to 4 weeks depending on the student's profile.			coordinator intervene, included in the role of Scrum Master and Product Owner, respectively. Endorsement of presentation. The guiding teacher and coordinator intervene, included in the role of Scrum Master and Product Owner, respectively.
Developing	Realization of the project	<ul style="list-style-type: none"> Construction of the IT product as outlined in the student's project, under the supervision and guidance of the advisor professor and teachers of the subject, included in the role of Scrum Master and Product Owner, respectively. IT product preview presentations. Each advance represents a Sprint, which lasts from 2 to 4 weeks, depending on the student's profile. 	Final delivery		Delivery of the final version of the PFC project. Endorsement of the presentation. Evaluation of the PFC, examining board, included in the role of Scrum Master and Product Owner, respectively. Feedback report to the student team (Team Members). Making adjustments -if applicable-; students agreeing with the guidance professor and the coordinator (intervening: Team Members, Scrum Master and Product Owner, respectively). If applicable, revision of the correction according to the 1st evaluation of the PFC, by the examining board (roles of Scrum Master and Product Owner intervene, respectively). Final presentation, according to current regulations. Approval management, performed by the Product Owner. Defense of the PFC, presentation of the role member(s) identified as Team Members, with evaluation of the Scrum Master and Product Owner, respectively. Documentation Management completion of the PFC.
	Revision	<ul style="list-style-type: none"> Review of the guiding teacher under the role of Scrum Master. Review of the subject staff - teachers and coordinator- included in the role of Scrum Master and Product Owner, respectively. 			
Defending	Final revision	Review of documentation, as established in current regulations. The guiding teacher and			

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		<p>In this case, the activities (Sprint Backlog) include qualification certificates, completion of files associated with the start and defense of the PFC, others associated with the current Regulation.</p>
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Source: based on Mariño and Alfonso (2014)

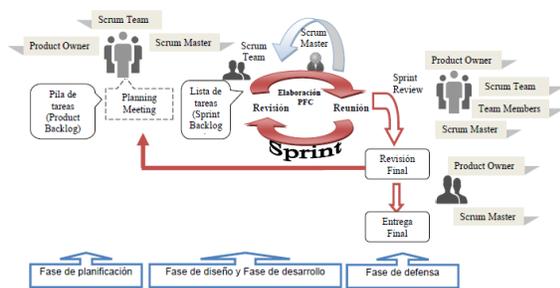


Fig. 2- Agile process framework to manage the PFC project design process

Source: based on Mariño and Alfonso (2014)

DISCUSSION

Project administration and management offers a diversity of standards and approaches that can be applied in multiple contexts, from an interdisciplinary perspective. Circumscribed to the educational field, universities, as complex and self-organized organizations, can adopt and adapt agile strategies with a view to fulfilling their objectives of excellence in teaching, research, extension and knowledge transfer activities; such is mentioned in Ivetiæ and Iliæ (2020), Klopp *et al.* (2020). Meanwhile, other experiences can be contextualized to teaching and learning processes: Mariño and Alfonso (2014); Müller Amthor, Hagel, Gensheimer, and

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Huber (2020); Otero *et al.* (2020); Marino, Alfonso and Arduino (2020). Agility in project management offers a context of continuous, progressive and retrospective improvement that was accentuated with the advent of the pandemic caused by SARS-COV-19.

In Mariño and Alfonso (2014) agility was proposed to manage end-of-course projects. The experience in these years in the aforementioned subject, as well as the increased demand for services and products of the Information and Communications Technology industry, and the situation caused by this pandemic, allowed the review and expansion of the process framework previously defined agile. That is, the management, development and defense of graduation projects validated for a certain context of Higher Education, whose students are inserted in the labor market before the end of the career. This process framework can be adapted to other scenarios of a similar nature developed at different educational levels.

Acknowledgments

Study developed within the framework of PI "IT in Information Systems: models, methods and tools", Accredited by the General Secretariat of Science and Technology, National University of the Northeast.

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Conflict of interest:

Authors declare not to have any conflicts of interest.

Authors' Contribution:

The authors have participated in the writing of the work and analysis of the documents.



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