

Mobile Application for Delivery of Medicines Through Motorcycle Taxis in Emerging Areas of the North of Lima, Perú

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Abstract

In recent years, there has been a concern to bring research closer to university academic activities with the purpose of creating spaces for the practice and development of new capabilities that allow the discovery of formative research in university students through the use of Information and Communications Technologies (ICT). The objective of this research was to determine a project management framework to develop formative research capabilities in students by applying the scientific method during an academic semester in higher education. The study carried out has a quantitative, pre-experimental approach and is oriented to the Scrum framework for project management under agile environments. The results show the development of the model under the Scrum approach to develop the necessary capabilities in formative research during an academic semester. It is concluded that the Scrum project management framework allows developing ICT solutions by being a referential framework to develop projects in formative research, providing the necessary capabilities and activities, so that the student can understand the basic guidelines of research, ICT, while, at the same time, knowing and developing an agile framework for project management that can be applied to various needs.

Keywords

Formative research, project management, Scrum, mobile applications, ICT.

1. Introduction

The global outbreak of the pandemic has presented schools worldwide with a series of unexpected challenges. Information and Communication Technologies (ICTs) have the potential to address the technical challenges associated with remote learning. However, it is important to note that relying solely on the online adaptation of traditional courses utilizing ICT tools may not guarantee effective learning outcomes. One potential strategy for enhancing the efficacy of distance learning involves augmenting the level of engagement [1]. Despite the plethora of technological advancements presently accessible, there appears to be a consensus among educators and experts on the superior efficacy and ease of the conventional in-person instructional approach in attaining the intended educational goals. The level of engagement and active involvement exhibited by students throughout their classroom sessions, along with their inclination to cultivate cross-cutting competencies, plays a crucial role in optimizing academic achievement and fostering the effectiveness of the educational experience [2]. Creating an active learning environment and fostering student engagement in classroom discourse can provide considerable challenges [3]. In recent years, innovative teaching strategies have been introduced into the education system to improve the participation and engagement of students who are in the learning process [4].


CITIE 2023: International Congress on Education and Technology in Sciences, December 04–06, 2023, Zacatecas, Mexico

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The advancement of society relies significantly on universities, which play a crucial role in fostering inquiry skills and integrating information. Furthermore, universities are responsible for generating new knowledge to address the specific needs and challenges of their respective contexts [5]. Research is an important part of training, development and professional improvement, the results of which are observed in the socioeconomic development of a country [6]. Formative research has gained importance in the curricular plans of universities because it can be seen as a strategy to train students in research [7]. Develop different perceptions about undergraduate students [8]. Formative research aims to disseminate existing knowledge and promote that students assimilate it as knowledge, that is, develop the necessary capabilities for lifelong learning, necessary for professionals to update their knowledge and skills [9].

One of the most frequently used work methodologies or approaches that has been developed in recent years is the Scrum approach for projects, it is characterized by being dynamic and participatory with the entire work team. This work approach is based on agile environments that are aligned with the values and principles of the agile manifesto, which highlights characteristics such as the emphasis on the value of WIP (Work in Progress) [10]. It is an iterative approach that allows the planning and management of project processes that require special speed and flexibility to be successful [11], focuses on early value delivery, scope flexibility, team input, continuous product and project process improvement, and product delivery [12].

The extrapolation of the Scrum framework to education pursues purely practical learning based on experience with the objective of achieving the full development of their autonomy, capacities and abilities [13]. The Scrum methodology is an innovative teaching framework that helps students learn while performing complex tasks in the real world. It is a project management framework that is frequently used in business and industry. Projects are increasingly adopting the Scrum methodology [14], as it emphasizes collaboration, adaptability and flexibility. At its core, Scrum promotes a self-organizing team structure in regular feedback and continuous improvement cycles. The framework consists of defined roles, events, artifacts, and rules that enable effective project management and goal achievement [15]. Scrum, being widely recognized as a prominent agile methodology, places significant emphasis on the pivotal position of the Scrum Master in overseeing the diverse roles within a project. Nevertheless, it is observed that numerous organizations tend to assign this role as an additional duty to an existing team member [16].

The roles of the scrum framework are described below:

Table 1.
Scrum Approach Roles

Role	Description
Product Owner	Person who maximizes the value of the requested product and the team's development work. It is responsible for interpreting the interests of the applicant for the product or service.
Development team (Team Project)	They perform the requested work of delivering a potential product increment at the end of each iteration or each Sprint.
Scrum Master	Person who is responsible for coordinating with the development team and ensuring that the work is understood and executed.

Table 1 indicates the identification of the main roles within the Scrum work approach: The **Product Owner** is the person who knows and requests what needs to be done and will be in charge of ensuring the needs and requirements that have to be covered for the purpose of the project. He is usually the person designated by the client who requests the service; The development team (**Team Project**) is the human group in charge of executing the base activities of the project for the preparation of the components of the product or service that are needed and that allow the fulfillment of what is requested by the Product . Owner ; and finally, the **Scrum Master** is the person in charge of coordinating with the project team for the execution of the tasks

and activities to be developed and will remain in permanent contact with the Product. Owner so that the activities can be developed appropriately according to the initial requirements that allow the purpose of the project to be fulfilled. Table 2 describes the components necessary for the process iteration.

Table 2.
Components of the Scrum process

Components	Definition
Product Backlog	Prioritized list of the product to be delivered.
Sprint Planning Meeting	Meeting where the Product Owner describes the highest priority functions.
Backlog Iteration	List of project elements that the project team agrees to deliver.
Sprint	The intervals or iterations into which the development of the project is divided.
Meeting daily (Scrum meeting)	Daily monitoring meeting of the project activities to be developed.
Sprint Review	Scrum team meeting when they present what they achieved during the development of the Sprint. Generally, it takes the form of a demonstration of the new functionalities or results obtained in the Sprint.
Sprint Retrospective Meeting (Sprint Retrospective)	Meeting in a short period of time dedicated to the end of each Sprint to provide feedback and deliberately reflect on how the team can do and find ways to improve their activities.

Source: Modified from Corey Baham (2019) [17].

In Figure 1 you can see the sequence of the Scrum work approach, where the prioritized list (Product Backlog) is determined by the activities to be carried out, the Sprint Backlog is the sprint intervals to be developed, the period of each sprint can be from one to four weeks, every day (24 hours) a follow-up meeting will be held, in which 3 specific questions will be asked: What activities were carried out yesterday? What activities will be carried out today? What difficulties do they generate? the activities? [18], and at the end of the sprint, the incremental product or service of the original order to be executed will be delivered by the client or user who requested the project for review (Sprint Review), subsequently, after being approved, the meeting will be held for the feedback (Sprint Retrospective).



Figure 1: Agile Scrum Approach [19]

Some aspects to consider within this work approach are the Scrum Team, which must be a team that can cover all the necessary skills to obtain the proposed results, it must be oriented to be self-managed and self-organized to comply with the assigned activities, and likewise, they must have sufficient powers to make decisions about how to carry out their work [20]. The designation of roles in the early stages of the project is regularly given by the skills and abilities that each of the members of the team has. In the case of new projects, the team is consolidated with the necessary skills and as the deliverables are developed, the team is gaining experience and capabilities about the activity.

During the last years, the city of Lima has been growing in a disorderly manner towards the extremes, this growth is accompanied by very few urban areas and many human settlements that have been growing uncontrollably in the hills surrounding the center of Lima, only in the As of 2017, it is estimated that there are more than 200,000 inhabitants in the Independencia district [21], one of the four districts that are located north of the historic center of Lima, in these places of disorderly growth, the population has not taken into account adequate demographic development, causing access to be very difficult, this is where the need for use motorized light vehicles has been quite popular for mobility. Figure 2 shows a photograph of what life is like in these districts.



Figure 2: Slopes of the hills of Lima, Peru [22].

Various businesses such as chicken shops, markets, pharmacies, among others, carry out their commerce in established premises, still developing traditional commerce in which buyers go to the market, however, it has been identified that in the case of pharmacies, medicines can only be delivered to people who are in a position to be able to reach the establishment, and cannot be delivered by other means, except in person, causing many patients who have an illness not to be able to receive medications or not to be able to look for different pharmacies when The one closest to the home does not have the product because it is far away.

The objective of this research was to use formative research applying the scientific method under the Scrum framework to develop a mobile application for transporting medicines in rural and remote areas such as human settlements, taking advantage of the low cost and overpopulation of motorcycle taxi drivers in non-accessible areas of the city. northern area of Lima.

2. Methodology

Because it represents a set of procedures organized sequentially to verify certain assumptions, the study carried out has a quantitative approach. The order is rigorous, but we can redefine some stages; Each phase precedes the next [23], of a pre-experimental type, since they have the lowest control of variables and do not assign subjects to the experiment randomly. In this type of experiments, the researcher has no control over the extraneous or intervening variables, the subjects are not assigned to the experiment randomly nor is there a control group [24]. The methodology used is oriented under the approach of the Scrum framework for carrying out projects in agile environments. Which is made up of the following steps to follow:

2.1 Project development activities such as the following:

- Identification of the study topic
- Problem Statement
- Problem objectives _

- Justification
- Solution development.

2.2 Identification of the roles of the Scrum components.

2.3 Activities to be developed through the Scrum framework (see table 3, table 4 and table 5)

2.4 Final report of the work carried out.

The activities to be considered within point 2.3 are detailed below.

Table 3.
Sprint 1 activities.

Sprint 1			
Week	Goals	Topics	Activities
1	Identify project requirements	<input type="checkbox"/> Requirements for direct or indirect functionalities or activities for the project.	<input type="checkbox"/> Meeting of group members. <input type="checkbox"/> Identification of the necessary requirements to be developed for the success of the project.
2	Identify alternative solutions	<input type="checkbox"/> Alternative solutions to the identified problem.	<input type="checkbox"/> Identify three alternative solutions. <input type="checkbox"/> Select the best alternative for the development of the project. <input type="checkbox"/> Justification of the selected alternative. <input type="checkbox"/> Feedback meeting for the finished Sprint <input type="checkbox"/> Elaborate Sprint 2 report.

Table 4.
Sprint 2 activities.

sprint 2			
Week	Goals	Topics	Activities
3	Prepare user stories.	<input type="checkbox"/> Role of the users. <input type="checkbox"/> Specific objective for each user story <input type="checkbox"/> Benefits obtained for each user story.	<input type="checkbox"/> Meeting of group members. <input type="checkbox"/> Identify the role of the participant in each user story. <input type="checkbox"/> Identify the objective for each user story. <input type="checkbox"/> Identify the benefit obtained by each user story. <input type="checkbox"/> Identify the tasks to be developed for each user story.
4	Prepare tasks for each user story.	<input type="checkbox"/> Tasks to carry out. <input type="checkbox"/> Time for each task. <input type="checkbox"/> Time per user story. <input type="checkbox"/> User story prioritization.	<input type="checkbox"/> Establish the estimate of the associated time until the completion of each task and user story. <input type="checkbox"/> Validate user stories. <input type="checkbox"/> Prioritize the list of user stories for development.
5	Identify the definition of finished for each user story.	<input type="checkbox"/> Definition of finished. <input type="checkbox"/> Criteria of acceptance.	<input type="checkbox"/> Determine the end of each user story. <input type="checkbox"/> Establish user acceptance criteria. <input type="checkbox"/> Feedback meeting for the finished Sprint <input type="checkbox"/> Elaborate Sprint 4 report.

Table 5.
Sprint 3 activities.

Sprint 3			
Week	Goals	Topics	Activities
6,7,8, and 9	Develop the tasks scheduled.	<input type="checkbox"/> Project execution. <input type="checkbox"/> Task development unitary. <input type="checkbox"/> Articulation of tasks in each user story <input type="checkbox"/> Checking the expected benefit for each user story. <input type="checkbox"/> Verification of the benefit for the requirement	<input type="checkbox"/> Meeting of group members. <input type="checkbox"/> Develop the activities or tasks of each user story. <input type="checkbox"/> Review the definitions of finished for each user story. <input type="checkbox"/> Articulate the tasks performed for each user story. <input type="checkbox"/> Articulate user stories for each requirement. <input type="checkbox"/> Find out the benefit required. <input type="checkbox"/> Validate the requirements to verify the requested benefit with the development carried out.
10	Validation of the applicant/user	<input type="checkbox"/> Review of finished deliverables. <input type="checkbox"/> Approval of the activities developed. <input type="checkbox"/> Deployment of activities developed.	<input type="checkbox"/> Approval of the requested benefits. <input type="checkbox"/> Feedback meeting to be held with the project team.

of the project
or activity.

- Execution of the project with the capabilities developed by the team.
 - Monitoring of activities in project execution.
-

3. Results.

3.1 Project development activities

Identification of the problem

All groups participating in the course were asked to find a reality to be covered using low-cost ICTs, for which one of the groups identified the need for medication care for various patients in remote and highly populated areas of difficult access in the city of Lima, Peru.

Problem Statement

Based on the identified problem, the problem statement was established, for which the needs of transportation, medical establishments and access to applicants were previously evaluated, determining the following main research problem: What could be an ICT solution that Allows you to acquire medicines in areas that are difficult to access?

Problem objectives

The following general objective was determined: Develop a mobile application for transporting medicines that seeks to facilitate their acquisition in remote areas, taking advantage of the low cost and overpopulation of motorcycle taxi drivers with the following specific objectives: Facilitate the acquisition of medicines, Identify areas with little access to the purchase of medicines, Determine the main difficulties that the implementation of the system will present, Establish a sales format that is accessible and easy to use for users.

Justification

The justification of the proposal consisted of developing a service that helps promote independent pharmacies through the use of motorcycle taxis as a means of transportation, since they have a large presence in the limits of the capital, presenting an alternative that promotes formality in this area given that many drivers do not even have the corresponding license to drive the vehicle in question. In addition to this, it was accompanied by a SWOT analysis that indicated as a strength the generation of a trustworthy service and a simple interface for the user, as an opportunity the lack of deliveries (delivery) in remote areas according to the situation in which They found lack of knowledge of the market and poor management of resources as a weakness, and possible low acceptance by the user public as a threat.

3.2 Roles of Scrum components

Within the Scrum framework, the following roles will be identified:

Product Owner: This is the teacher responsible for the project activity who will act as the person who wants to cover the need by developing a project.

Project Team (Team Project): These are the members of the team to develop the requested activity, it will be made up of 6 students per team.

Scrum Master: In the student team, a responsible student will be designated who will act as Scrum Master for the coordination of activities within the project. He will be in charge of ensuring the monitoring and compliance of the activities to be carried out within his team. as well as monitoring, which for flexibility can be two to three times a week.

3.3 Activities to be developed through the Scrum framework

For the development of the solution, the first Sprint to be developed was proposed (after having adequately stated the problem and formalized the objectives and scope to be developed). All the necessary requirements will be identified to satisfy the needs of the project. Requirements gathering is the process of defining and documenting stakeholder needs to meet project objectives. [25]. These requirements must take into account the functional and non-functional requirements of the software development project. After all the project requirements have been identified, they must be prioritized to determine which one or which will be the first to develop and as they are developed over time the list must always remain prioritized. During Product Owner management, it is necessary to create a shared understanding of the requirements [26]. Next, Table 6 shows the list of identified functional requirements.

Table 6.
Requirements functional.

ID	Request	Description	Priority
RF1	The user communicates with the driver	The user will have methods to contact the driver available to request the service.	5
RF2	Claim generation _	The client may register a message in case of non-compliance with the service	5
RF3	Alert generation _	If the service cannot be fulfilled, an alert will be generated to the user and the provider.	4
RF4	Order Status	Real-time location of the order and average delivery time.	4
RF5	Trading history _	The history of operations carried out will be generated.	3
RNF1	Interface simple	Dynamic interface with user and driver	3
RNF2	Compatibility for low-end equipment	The system will be developed under a lightweight application approach.	3
RNF3	User validation _	User tests will be carried out according to the development carried out.	3
RNF4	Support in third-party applications	APIs will be established that allow the interface of additional applications.	3

In the second Sprint, which lasts 3 weeks, the elements of the Scrum framework must be identified, such as what a user story is. In this initial stage of knowledge, the user stories will contain the elements required minimums, they will identify the elements of how (role), I want (something), for (benefit), to determine user stories [27], and similarly, the feature will be written with respect to the detailed task or DoD (Definition of Done) that will be executed to complete the Sprint [28] of each user story, which will allow them to know to what extent each of these should be built or developed. All the tasks to be carried out for each user story will be identified, the basic activity to be developed for each task will be evaluated, to follow up. and compliance during the solution development stage of the project. Depending on the identified requirements,

the associated user stories will be determined; each requirement identified in the previous stage may contain one or more than one user story. Table 7 presents a sample of the user stories and tasks developed for this project.

Table 7.
User stories and project tasks.

USER STORIES	TASKS
As a user I want to register my email to use the application.	<input type="checkbox"/> Code the application in Kotlin language in Android Studio. <input type="checkbox"/> Generate the user interface. <input type="checkbox"/> Validate the email if the account already exists.
As a user I want to register my phone number to receive notifications.	<input type="checkbox"/> Encode the telephone number record. <input type="checkbox"/> Validate if there is duplication of number. <input type="checkbox"/> Generate registry compliance alert.
As a user I want to enter the driver's section to accept orders.	<input type="checkbox"/> Code the order entry window. <input type="checkbox"/> Validate that the information is complete to place the order.
As a user I want to add an image of the medical prescription for purchase.	<input type="checkbox"/> Allow the app to use the camera to take photos. <input type="checkbox"/> Allow the app to attach the gallery image. <input type="checkbox"/> Validate the image size. <input type="checkbox"/> Generate compliance alert for the record.
As a user I want to know the location of the driver to be aware of his arrival time.	<input type="checkbox"/> Allow the app to use Google Maps to validate the driver's location in real time. <input type="checkbox"/> Validate the information received and display it in the application.
As a user I want to see the orders placed to track them.	<input type="checkbox"/> Generate the report of orders placed. <input type="checkbox"/> Enable the option to request an order already placed. <input type="checkbox"/> Validate the information of the new order. <input type="checkbox"/> View compliance of the new order.

A good way to track the activities to be developed at this stage is to use tools that allow tracking during the development of user stories and tasks. In this case, a good example is through the Scrum board that consists of dividing the board into several Backlog columns, such as: Pending (To Do), In Progress (In Progress), Verify (To Check / To Verify) and Done (due to project affinity they can also be named differently). The rows of the board correspond to the user stories that form the Backlog, used to accumulate operations related to each feature. The cards to be used (post-it type) represent the related tasks, with the activity indicated on it [29]. The task board feature also helps people understand each other's work and helps others about time [30]. There are different software tools that include the Scrum Task Board function. The most used of these software tools are JIRA, Trello and Taiga [31].

The third and last Sprint, which lasts 5 weeks, is the construction of the solution and consists of implementing all the planned elements that have been designed in the previous stage so that they can build the proposed solution and subsequently be used by the user, the client or who requested the service or product that originated the project. Within this activity, the solution is implemented and its completion is subsequently communicated so that users can have access to the benefits developed within the project and thus carry out the corresponding tests for validation. This activity can be carried out both virtually and in person depending on the type of tasks to be carried out and the initial scope of the project. The user must know and identify all the capabilities that will be developed or built in the project to subsequently give their assessment of whether the requested work was completed or not. The Product Owner will receive the finished development and review it to ensure it meets the user story acceptance criteria, which will satisfy the QA process [32]. Figure 3 shows some images of the developed application.

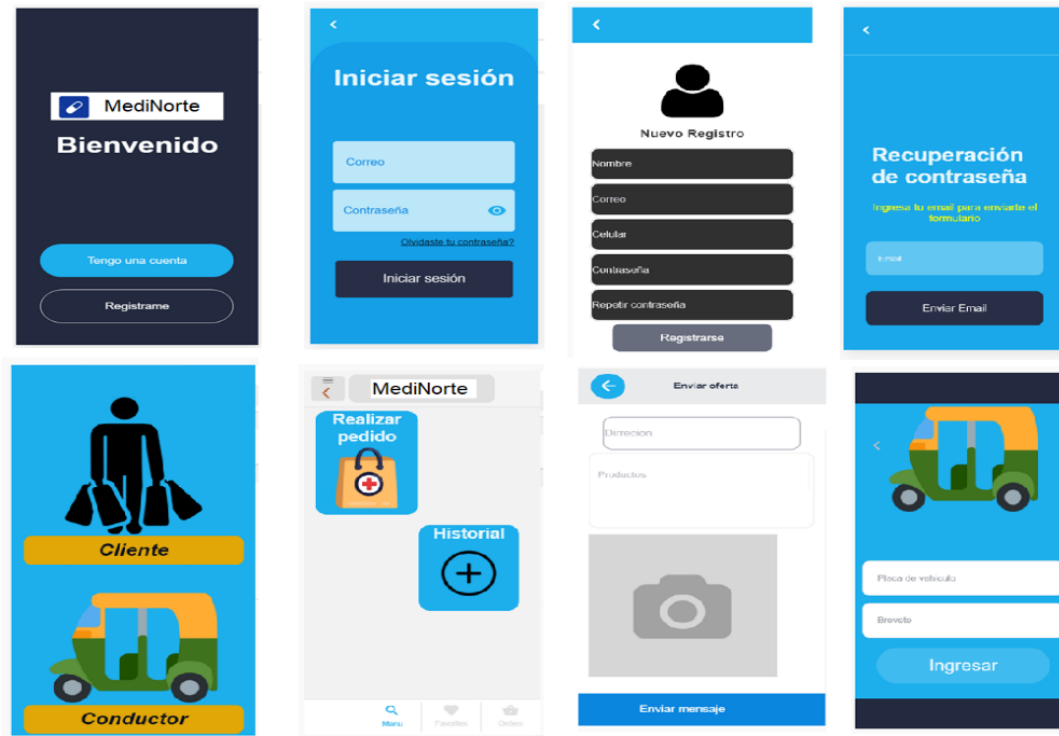


Figure 3. Mobile application developed.

3.4 Final report of the work carried out

The last activity lasts two weeks and is made up of the gathering of the expected results and the closing of activities with the presentation of the final report. In this deliverable, it must be checked whether the expected benefits of the project were achieved in full or in part. In some cases, sometimes due to the nature of the project, more time is required to collect them, however, this will depend on the instructor or teacher. about the purpose of the project by determining the objectives at its initial stage. During this activity, the work team is in charge of validating the results using different techniques or instruments. Then, it prepares the final report, which is mainly made up of the compilation of the information obtained from the previous Sprints, as well as the preparation of complementary information resulting from the results obtained, the benefit and the final structure of the report to be presented. Table 8 outlines the deliverable of the final report, where the defined structure of the work can be visualized, as well as the incorporation of all previous results as parts of the final deliverable for the satisfactory completion of the project.

Table 8.
Outline of the final report.

Report structure	Content
Qualification	Describe the job title in less than 20 words.
Summary	No more than 250 words and must include the objectives, the methodology developed, the results found and the conclusions.
Keywords	Determine the words that represent the work done, maximum 5 words or expressions.
Introduction	It will include the identification of the topic for the study and the previously developed problem statement.
Goals	It will indicate the proposed objectives, both general and specific, previously identified.

Requirements	Add elements from Sprint 1 developed.
Proposed Solution _	Add items from Sprint 2 and 3 developed.
Results	The project implementation and the field test carried out previously will be added.
Conclusions	It must describe whether the proposed objectives were met.
References	Add all project references.
Annexes	Relevant information, tables, images, procedures, development or others, that are part of the project carried out and that complement the report presented.

The entire project is developed during a university academic semester, which consists of an average of 16 weeks, at a rate of 4 hours per week. The evaluation elements and moments are determined at the end of each sprint with the corresponding support. It should also be indicated that the retrospective meeting will be held together with the teacher after each deliverable completed.

4. Discussion

Regalado [33], tells us that there is a need to promote research from the early years by providing spaces and techniques that provide them with the necessary tools to propose solutions to specific problems of the context, which is consistent with the proposal developed that focuses on an agile management environment. of projects in Scrum to develop formative research that can be applied from the first cycles of studies. Carrillo [34] tells us that the evaluation of project-based learning tasks, where evaluations related to research and the search for information, capacity for synthesis, group work and collaboration, planning and management of content and its transfer are developed. , as well as a final product with information collected and organized; It is, therefore, a complex process, which leads to the evaluation of all the tasks carried out, which is a relevant activity and coincides with the present study to maintain adequate monitoring of learning and the proposed objectives, thus allowing , achieve full compliance with the capabilities of the described methodology. In the same way, García [35] tells us that methodological changes in teaching-learning processes are being consolidated in the field of higher education. Teaching strategies are changing towards more active methodologies as a result of these changes. However, they also influence evaluation strategies, increasingly seeking student participation because it has been shown to be a crucial component to improve learning, which is also demonstrated within the study presented that seeks to develop a proposal on ICTs. through the Scrum framework to develop the formative research process.

5. Conclusions

For all the above, it is concluded that the Scrum project management framework allows it to be a referential framework to develop projects in formative research using the scientific method, making use of ICTs during an academic semester, providing the capabilities and activities necessary, so that the student can understand the basic guidelines of research and mobile applications, while, at the same time, know and develop an agile framework to develop projects that can be applied to various needs.

It is necessary to properly identify the Sprints to be developed during the execution of the project; these may vary over time depending on the needs that must be covered by the project to be developed.

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