

## Diseño de una aplicación móvil como apoyo al aprendizaje

*Designing a Mobile Application to Support Learning*

*Design de uma aplicação móvel para apoiar a aprendizagem*

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### Resumen

Los dispositivos móviles admiten el empleo de variadas aplicaciones. En algunos casos son herramientas de apoyo para el aprendizaje que ofrecen a los alumnos flexibilidad con respecto al tiempo y al espacio, por lo que fortalecen la interacción y el conocimiento. Esta modalidad de aprendizaje también suele ser conocida como *m-learning*. Los resultados que se presentan en el siguiente artículo formaron parte de un proyecto en progreso denominado “Desarrollo de una aplicación móvil como estrategia docente”.

El objetivo de este proyecto fue alcanzado una vez que se realizó el análisis y el diseño de una aplicación móvil de anotaciones tanto para los alumnos como para los docentes. En términos generales, dicha *app* contiene las funciones de registrar a un usuario como docente y como alumno, dar acceso a los usuarios registrados, crear dos cursos por

profesor, entrar a uno de estos, eliminarlos, ver las notas, editar y eliminarlas. Y se edificó sobre las metodologías denominadas *investigación basada en diseño (IBD)* y *orientada a objetos*.

**Palabras clave:** aplicación móvil, aprendizaje, diseño, teléfonos inteligentes.

## Abstract

Mobile devices support the use of various applications, in some cases are computing tools to support learning that allow students flexibility with respect to time, space and place, so they strengthen interaction and knowledge, known this way of learning as m-learning. The results described in the following article were part of an ongoing project named Development of a mobile application as a teaching strategy.

The objective of the project was achieved by analyzing and designing of a mobile application for student-teacher annotations, with the functions of: registering a user as a teacher and as a student, giving access to the application to Registered users, create two courses per teacher, enter one of these, delete them, view the notes, edit and delete options, based on the methodologies: Based on Design (IBD) or Design-based Research and Object-Oriented.

**Keywords:** mobile application, learning, design, smartphone.

## Resumo

Dispositivos móveis suportam o uso de vários aplicativos. Em alguns casos, eles são ferramentas de apoio à aprendizagem oferecendo aos estudantes flexibilidade com relação ao tempo e no espaço, de modo que reforçar a interação e conhecimento. Esse modo de aprendizado também é comumente conhecido como m-learning. Os resultados apresentados neste artigo foram parte de um projecto em curso chamado "O desenvolvimento de uma aplicação móvel como estratégia de ensino."

O objetivo deste projeto foi alcançado uma vez que a análise e projeto de um notas de aplicativos móveis para os alunos e para professores foi realizado. De um modo geral, este aplicativo contém funções a registrar um usuário como professor e como um estudante,

proporcionando acceso a utilizadores registrados, criar dois cursos por professor, digite um destes, eliminar, ver notas, editar e excluí-los. E foi construído sobre metodologias chamadas de pesquisa baseada em design (IBD) e orientadas a objetos.

**Palavras-chave:** aplicativo móvel, aprendizagem, design, smartphones.

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## Introduction

In the 21st century, mobile devices are no longer used only to establish easy communication between users, but also allow the use of various applications. In the field of teaching, for example, they have become important tools that favor learning, since they offer students and teachers more flexibility with respect to time and space. In fact, this intrusion of mobile technology has given rise to a new concept, namely m-learning, which designates a learning modality that privileges, among other things, interaction.

According to Aparicio, J., Aguirre, A. and Callejas, E. (2013). He mentions in his article Mobile technology as a support tool in secondary education.

E-learning has been successful. However, it has reached a point where it needs to evolve and mature. From here emerges mobile learning, allowing new possibilities, integrating new technologies and quality in education. It can be defined that mobile learning is the ability to use mobile technology to achieve a learning experience in the student (p 22).

In this regard, Santiago, Trbaldo, Kamijo and Fernández (2017), in their work Mobile learning: new realities in the classroom, mention the following:

What characterizes then the m-learning is that it refers to the learning environments based on mobile technology, aimed at optimizing learning closely related to u-learning (Ubiquitous Learning or ubiquitous learning), a concept that refers to

supported learning in technology and that can be done at any time and from anywhere (p. 5).

The participation of students in the classroom is important. However, sometimes, not everyone can have a direct intervention with the teacher or other students for various reasons: they do not want to interact, they feel inhibited or they have shyness to raise their hands, even though they know the answer of the exercise or practice that is being done. Also because, for reasons of time and dealing regularly with large groups, it is impossible to give more than a few people the opportunity to participate. Taking these reasons into account, the idea of creating an application that allows the active participation of all students of a class group arises, without any factor of the aforementioned can inhibit or prevent their intervention.

For this, first, a qualitative and quantitative study of the use of smartphones was carried out in the Faculty of Information Sciences of the Autonomous University of Carmen. Second, based on an object-oriented methodology, a student-teacher mobile application was designed, which allows, among other functions, to create two courses per teacher, register the teacher and the student, consent to access the course, visualize the teacher's notes, ask participation questions to which the same student can respond to obtain the evaluation with the previous qualification of the teacher.

Within the design are presented the diagrams of scenarios, process monitoring, status, data flow, as well as the structure and interface designs that are part of the applied methodology.

## Method

In accordance with the objectives of the research, the methodology of research based on design (DBR) was used, which is characterized by its interdisciplinary approach of mixed methods research in the field, intended for applied purposes and the construction of theories.

According to De Benito, C. and Salinas, I. (2016). In his article The Research Based on Design in Educational Technology, he mentions the following:

Design-based studies are gaining strength in the field of Technology Educational as they help to understand all the steps of the process of creation, preparation, review, implementation and dissemination, where appropriate, of any program or product related to the introduction of ICT in teaching-learning processes.

Another author such as Wang and Hannafin (2005) define the DBR as a systematic but flexible methodology. One that aims to improve educational practices through analysis, design, development and implementation in an iterative way, based on collaboration between researchers and professionals in real-world environments and leading to context-sensitive design principles and theories. . For this research, the analysis and design stages will be carried out.

The object-oriented methodology was also used, since "it facilitates logical, rapid and detailed methods to create systems [that respond to the needs of users]" (Kendall and Kendall, 2011, p.281).

According to Pressman (2010), the objective of this methodology is to develop a series of models that describe the software of a computer to satisfy a set of requirements defined by the client (p.362). For the design of the application called student-teacher annotations, the following stages were followed:

1. Approach of the problem.
2. Proposal for a solution.
3. Object-oriented analysis.
  - 3.1. Static model: declaration of the scope of the system.
  - 3.2. Dynamic model: this involves scenario diagrams, as well as event tracking. Kendal and Kendall (2011) suggest that they can illustrate a succession of interactions between classes and instances of objects over time (p.294). And, finally, state diagrams are used to examine the different states an object can have (Kendall, 2011, p.309).
4. Functional model: these are the data flow diagrams, which allow the development of functional domain models (Pressman, 2010, p.161).
5. Design

5.1. Architectural design.

5.2. Interface design.

Because this work focuses on the development of the analysis and design stages for a mobile application, corresponding activities were carried out in an organized manner for each stage. In them the techniques, rules and procedures were used to model the application as a result of the problem posed.

### **Problem Statement**

Currently, smartphones have become a productivity tool. In a study conducted by Vázquez, C. Sevillano, G. (2015) presented in his article The smartphone in higher education. A comparative study of educational, social and ubiquitous use in Spanish and Latin American universities. He mentions that:

The educational use of the smartphone is the one with the greatest percentage differences between the two regions. Spanish students use the device in a slightly higher percentage for the exchange of academic information (+ 12.3%) with respect to the average of the other Latin American countries analyzed.

In the case of teachers and students of the Faculty of Information Sciences of the Universidad Autónoma del Carmen, although most have one, since they allow to be always connected and establish communications in real time, it has been observed that They take maximum advantage to facilitate, support and improve the teaching-learning process.

Technological development has changed our ways of life. It has undoubtedly impacted many areas of knowledge. In education, information and communication technologies (ICT) have shown that they can be of great support for teachers and students if they are used in the right way.

According to Cantillo, V. Roura, R. and Sánchez, P. (2012). Those who mention in their article Current trends in the use of mobile devices in education.

The m-Learning is fundamentally based on the use of mobile technologies as the basis of the learning process. Therefore, it is a teaching and learning process that takes place in different contexts (virtual or physical) and / or using mobile technologies (p 4).

That is why the implementation of this mobile application for teaching can be considered as a support tool that will benefit the student to develop both visual and auditory learning strategies.

## **Proposed Solution**

The solution is to present a native mobile application that allows students of the Faculty of Information Sciences of the institution already specified to interact and share information with the teacher, according to the academic activities that have been designed for a specific course.

The student-teacher annotations mobile application has the function of sending and receiving questions and answers among said users in a specific course in order to obtain a greater participation in the class. In addition, it will allow students to expose the doubts or observations that have arisen during a given topic. In this way, all students have the same opportunity to receive a personal evaluation, as well as the same feedback conditions and even the possibility of clarifying doubts by the teacher in real time.

And as Celis says, D., Torres, G. and Pérez, V. (2014). In his work *Mobile telephony in the classroom: digital divide and absence of teaching strategies*.

The teacher is positioned as a key part of the process because, through his understanding of the functionality of the mobile phone as a teaching tool, the design of activities tailored to the needs of his students is made possible, based on the knowledge of both the diversity of functions that a mobile phone provides as well as an analysis of the strategy based on the didactic principles that converge in it (p 12).

The application aims to benefit the student and the teacher in the classroom through the use of smartphones.

## **Object oriented analysis**

Following the object-oriented methodology, according to Kendall and Kendall (2011), for the analysis and design of systems the declaration of the scope of the mobile application was elaborated.

## Static model

### Declaration of the scope of the application

The application will have two modules. One registration: Control of user registration. And another for access: Course control and notes.

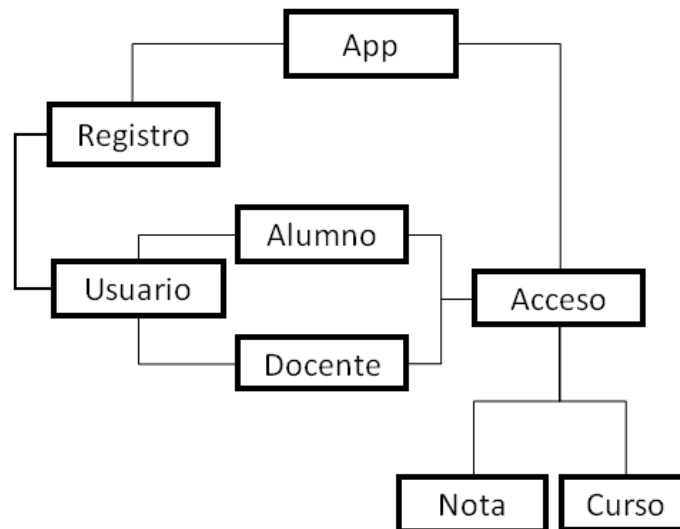
The registration module allows registration of the user, which can be of two types:

- As a student: perform the registration with your data (registration, password and career).
- As a teacher: perform the registration with your data (ID, name and password).
- While in the access module users will have the step to the mobile application and user interface, so they can access as a teacher or as a student.
- Student access will have the following functions:
  - Access: enter the application using the registration and password data.
  - Select course: choose a course from the list of available ones.
  - Shows chosen course: displays annotations made by the teacher.
  - Reply note: you can answer or edit, as well as send a note of the course to the teacher.
  - Exit: to close session.
- The teaching access, on the other hand, will have the following functions:
  - Access: enter the application using the ID and password.
  - Create new course: create a new course with the data: course name, classroom number and schedule.
  - Create note: edit a note, with a title and description.
  - Show notes: shows the list of notes of a course.
  - View note: displays the information contained in the note.
  - Delete note: delete a note, previously selected from the list.
  - Delete course: deletes a course, previously selected from the list.
  - Exit: close session.



As part of the results, several figures that are part of the project were created. Next, in figure 1 the object model is shown:

**Figura 1.** Modelo de objetos



Fuente: Elaboración propia

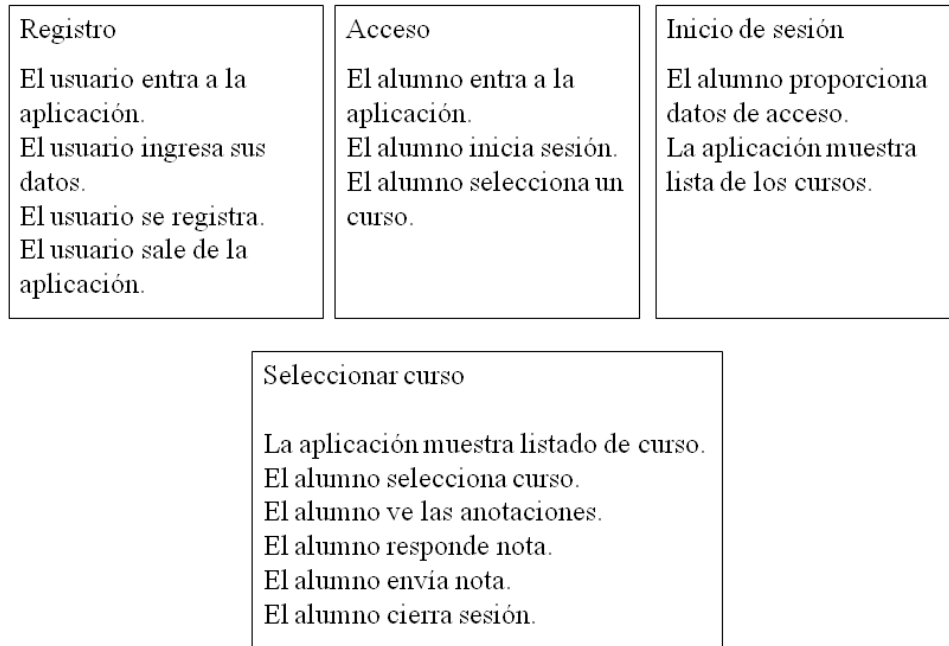
## Dynamic model

The dynamic model is used to specify and implement aspects of system control. It is integrated by the scenario diagrams, used to specify the interaction between the application and the user, and the event tracking diagrams, which are used to track the events of each scenario. In addition to the previous pair, there are also diagrams of states: graphs whose nodes are states and whose arcs are transitions between states caused by events. All these diagrams provide an overview of the functionality of the application and are very useful for the programmer.

## Scenario diagrams

For the mobile application, the scenario diagrams about the user's registration that could be a student or a teacher were prepared, as explained above. Figure 2 shows the scenario at the time of registering a user, as well as the user's access as a student, the start of the session and the selection of a course.

**Figura 2.** Diagrama de escenarios del alumno



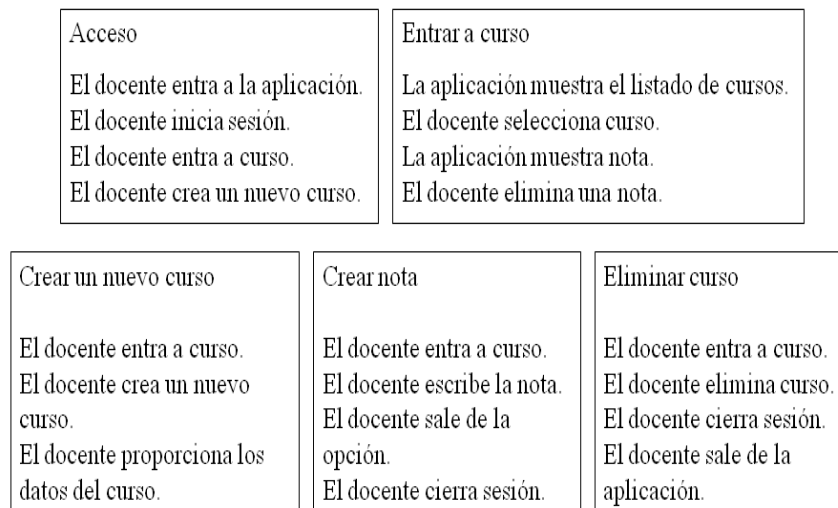
Fuente: Elaboración propia

As part of the application, the student can register, enter, log in, select course, view the notes, in addition to answer, create a new note and send it.

The development of this process is important since sometimes not all students have the same opportunity. Some are afraid of error; others take more time to process information. With the use of the mobile application it will be possible to have a greater participation thanks to the fact that the answers of all the students can be visualized to enrich their learning, to contribute new ideas or points of view.

The teacher is also a user for the application. Figure 3 shows the scenarios of the user as a teacher, whose operations are applicable only to him: have access to the application, create and delete a course and, finally, the scenario of creating a note.

**Figura 3.** Diagrama de escenario del docente



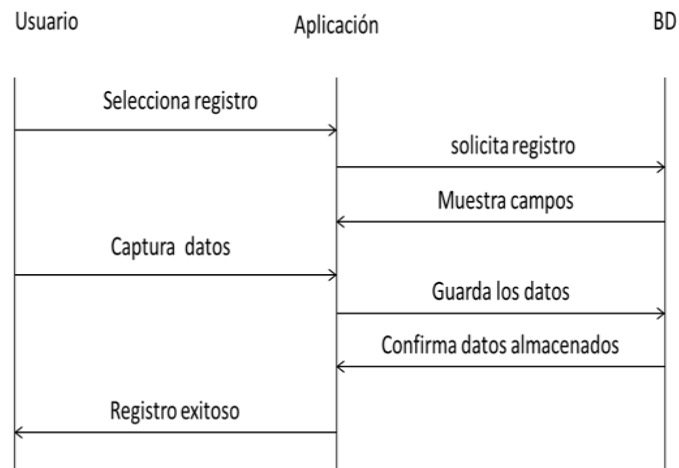
Fuente: Elaboración propia

The teacher can visualize all the participations of the students and give feedback to each one in particular. Also, at the time you consider it necessary, you can delete the notes to start a new participation. And at the end of the semester you can discard the entire course to start a new one.

### Event tracking diagram

These diagrams show the follow-up of the actions that occur in each established scenario. Figure 4 shows the tracking of events when a user registers in the application.

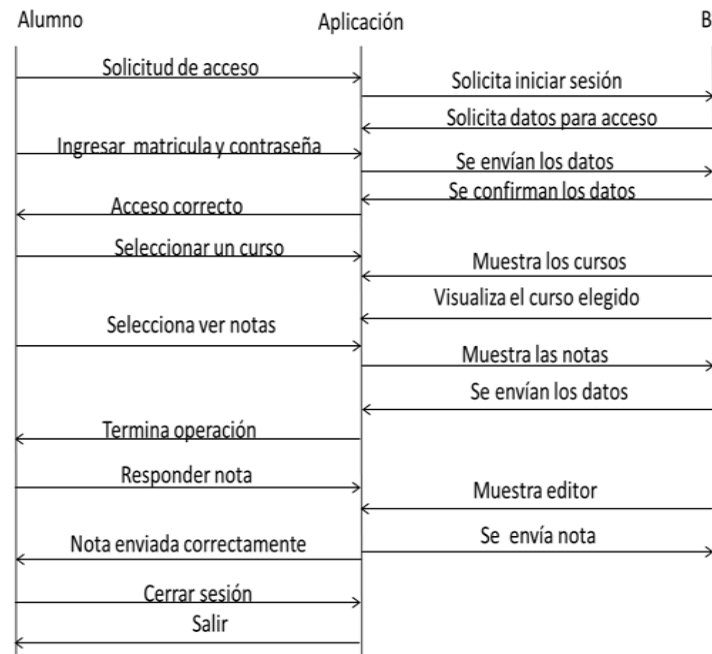
**Figura 4.** Diagrama de seguimiento de sucesos registro de usuario



Fuente: Elaboración propia

Once a user has registered, they can enter the application. In the case of a student user, figure 5 shows the actions that can be performed in the application.

**Figura 5.** Diagrama de seguimiento de sucesos de alumno

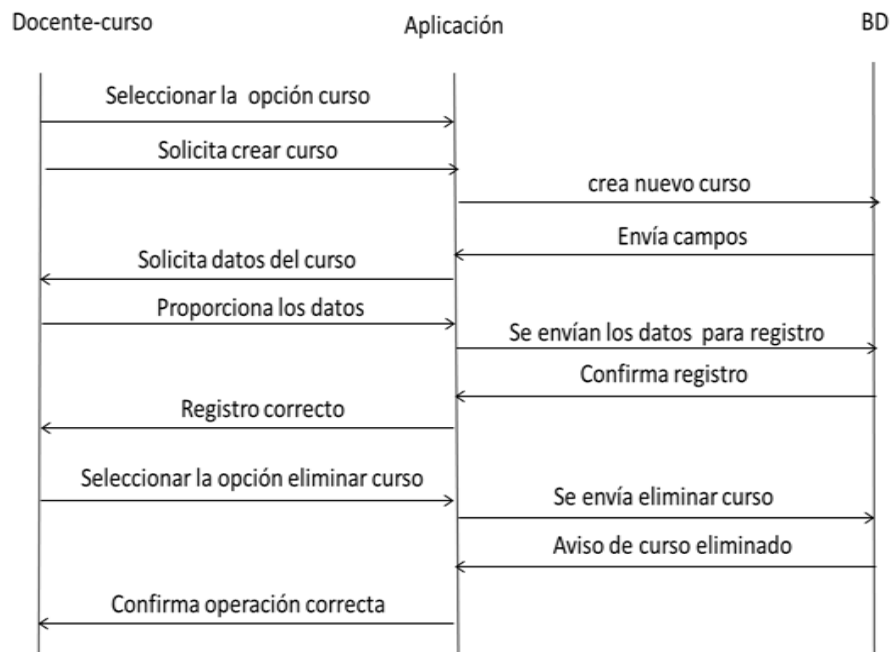


Fuente: Elaboración propia

When entering the application, the student enters the required data, selects a course, sees the notes containing information, questions, answers, comments made by the teacher or other students. He also writes a note and sends it.

When the user is the teacher, he has access to the application when providing his data. Figure 6 shows how the teacher has more options within the application, focused on the follow-up of creating a course.

**Figura 6.** Diagrama de seguimiento de sucesos de curso

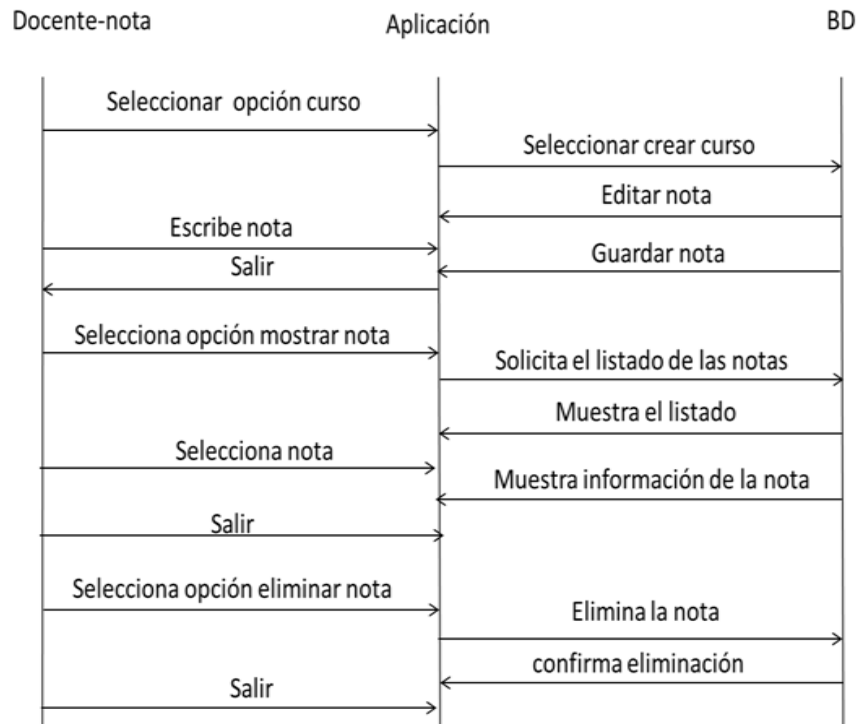


Fuente: Elaboración propia

A teacher has permission to create up to two courses at a time. To create one you must give the required data. You can also delete courses when required.

Another option available to the teacher is to create a note. Thus, when the student selects a course, it will visualize the notes of this one. This follow-up is shown in figure 7 below.

**Figura 7.** Diagrama de seguimiento de sucesos de nota



Fuente: Elaboración propia

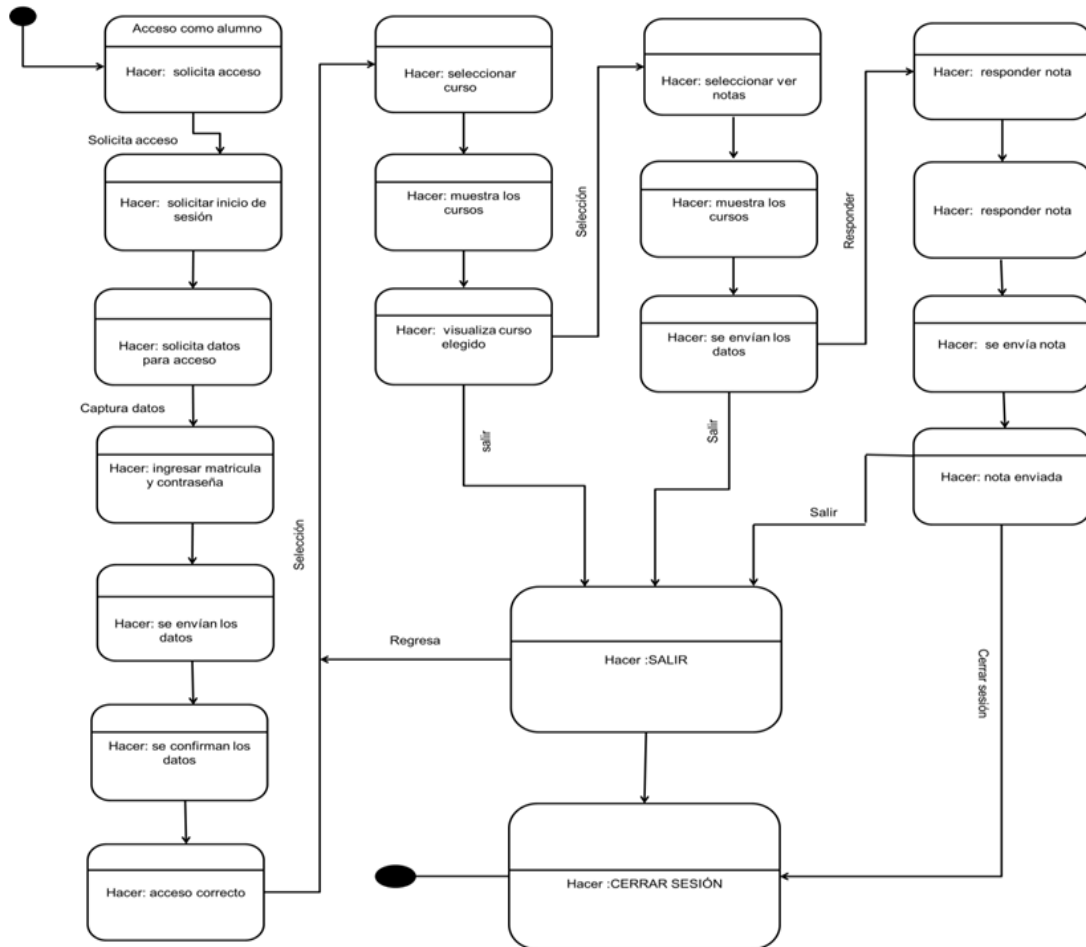
The teacher can create, edit, save and delete a note whenever he needs it; instead, the student does not have permission to delete a note.

In this space the teacher can ask questions of participation, observations and comments; the students can answer the questions and obtain the evaluation of the participation.

### State diagram

The diagrams of states allow to show the behaviors of the application and the routes of the flow of data. In Figure 8 you can see the diagram of the behavior of a student in the application.

**Figura 8.** Diagrama de estados del alumno



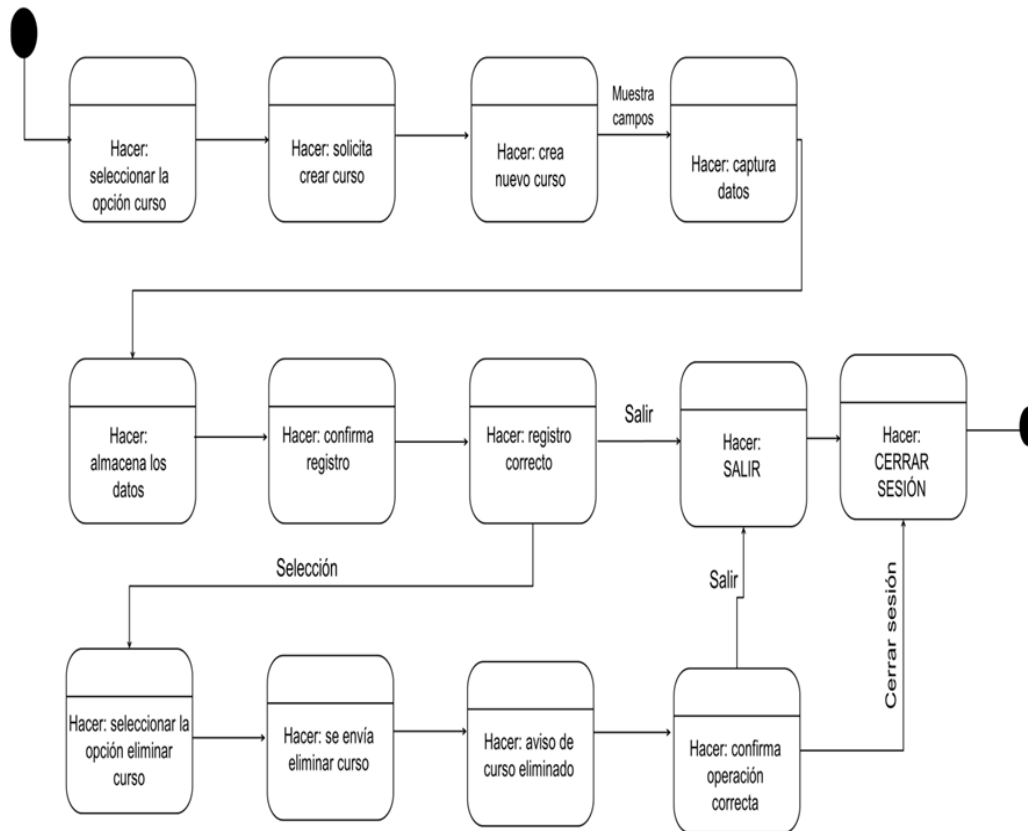
Fuente: Elaboración propia

If we analyze the diagram, a student presents the following behaviors: register your data, access the application, choose a course, view the existing notes, answer a note and exit the application. These actions are carried out each time the teacher indicates it or if he requires it.

For the case of creating a course, the diagram of states that is shown in Figure 9 was drawn up, which indicates the behavior of a teacher at the moment of creating what was said in the application.



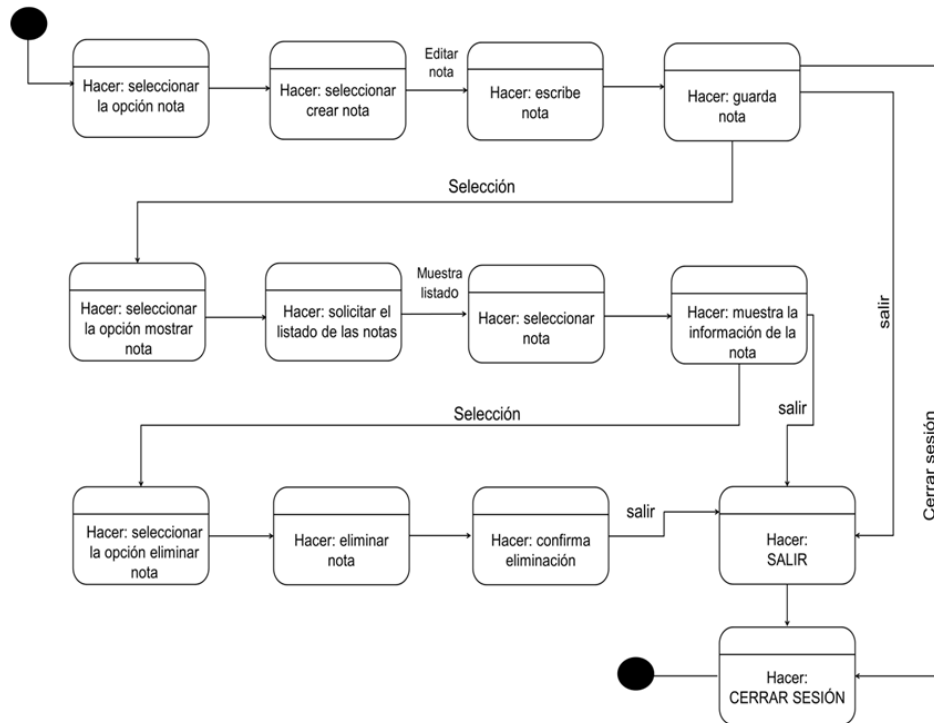
**Figura 9.** Diagrama de estados de curso



Fuente: Elaboración propia

The diagram that is offered in figure 10 shows the creation of a course, the capture of the data, the elimination of a course and the exit of the application.

**Figura 10.** Diagrama de estados de nota



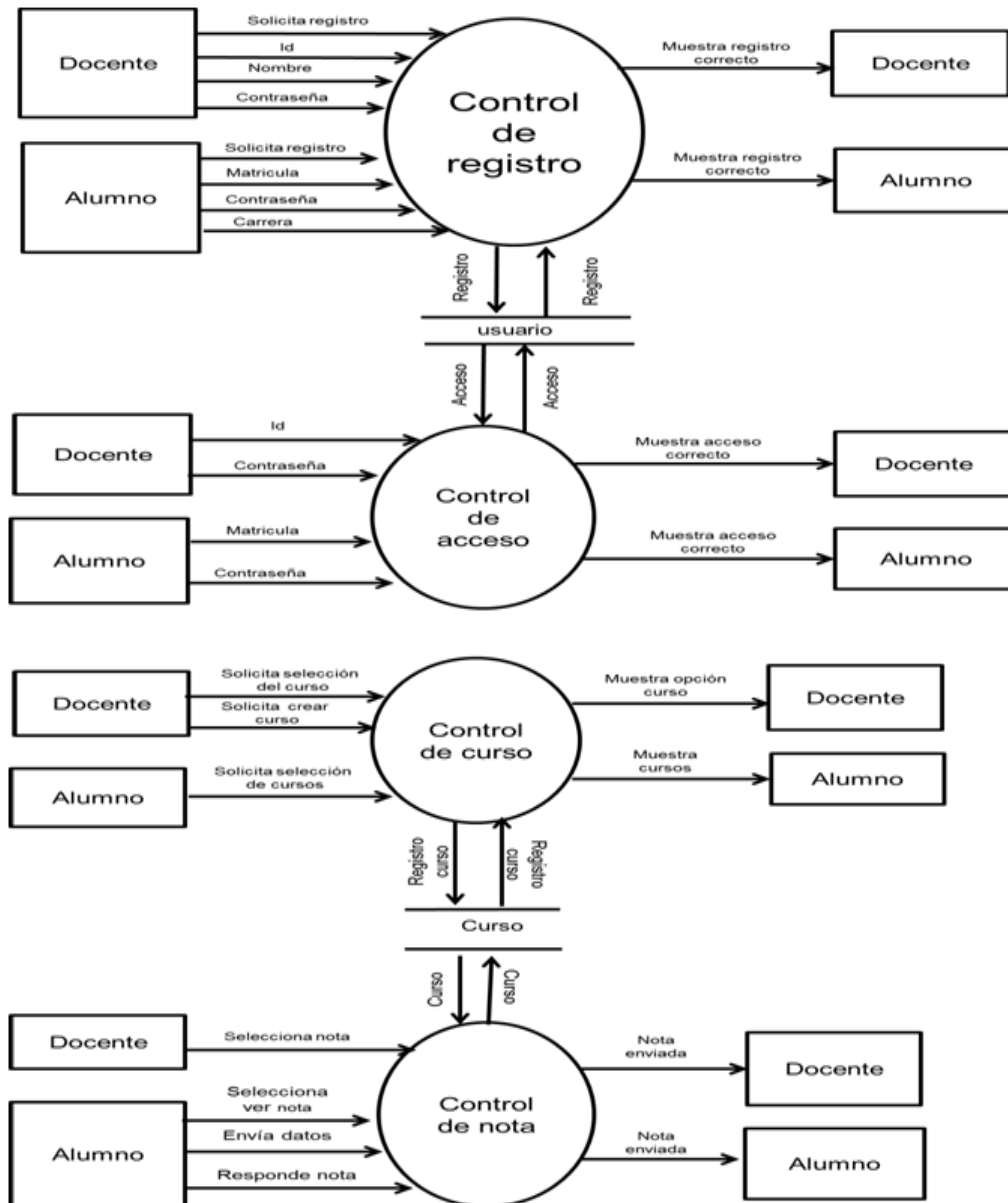
Fuente: Elaboración propia

The note is one of the main parts of the application because it allows the teacher and the students to interact with each other, generating learning according to the teacher's requirements. In this diagram the behaviors of creating a note and saving so that the students visualize it in their device are shown, as well as eliminating the note, action only allows the teacher, as already mentioned above.

### Functional model

The following model is a data flow diagram that allows interpreting the inputs, outputs and operations performed by the application. As can be seen in Figure 11, there are four operations that indicate the functions of the application.

**Figura 11.** Diagrama de flujo de datos de la aplicación



Fuente: Elaboración propia

The functions shown in the diagram are part of the application, which allows keeping track of the registration of the teaching-student users for each course. Access control is only for students who belong to that course, who can interact through the

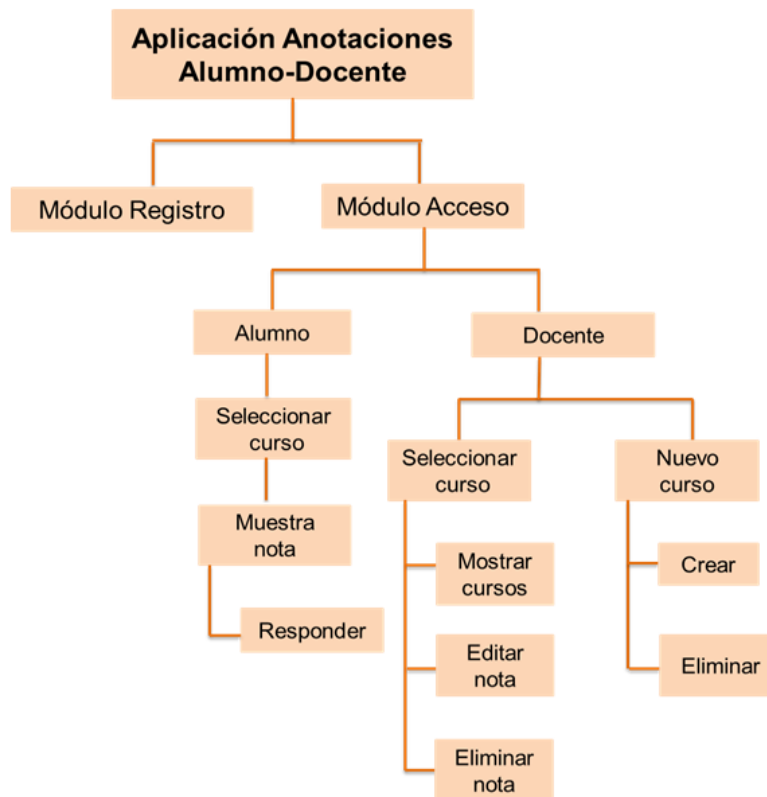
application with the teacher. Course control is for the teacher to create and eliminate the course, according to the needs of each semester. And the note control, for the participation of the students and the feedback of the learning of each activity or topic.

## Application design

As in the analysis, the design phase is important for the developer because it allows to recognize and visualize the structure of the application. In figure 12, for example, the architectural design of the application is presented.

## Architectural design

**Figura 12.** Diseño arquitectónico



Fuente: Elaboración propia

Figure 12 shows how the student-teacher annotations application will be integrated, which will be developed in PHP, HTML5 and Android; in all cases in the PhpDesigner and Android Studio environments.

Another part of the design is the interface, whose intention is to capture an idea of the image that the application would have and that the developer can always improve.

## Interface design

Figure 13 shows the logo of the application, as well as the options for registration and access for the user.

**Figura 13.** Diseño de interfaz aplicación



Fuente: Elaboración propia

Figure 14, on the other hand, shows the data entry interface for the registration and access of a student.

**Figura 14.** Diseño de interfaz alumno: Acceso



Fuente: Elaboración propia

Another interface is the one exemplified in figure 15, whose function is to select a course and enter the notes defined as chat.

**Figura 15.** Diseño de interfaz alumno-curso-nota



Fuente: Elaboración propia

While Figure 16 integrates the design for the teacher's access, when creating the course and the input of this.

**Figura 16.** Diseño de interfaz docente-curso



Fuente: Elaboración propia

In the interface shown in figure 17, finally, the teacher or student can choose a course and enter the chat to write a note, an intervention, a comment, an observation or a warning.

**Figura 17.** Diseño interfaz docente-curso-nota



Fuente: Elaboración propia

## Discussion

The elaboration of the analysis and the design of the student-teacher annotations application allowed identifying other functions that could be included in the application, as well as the improvement of the interface at the time of development, given that said application will be used by the students.

The design of the application was presented to the teachers and the students. Those, after having used it, suggested including the date and time of the entries, in order to know when the students responded, and thus have a record of this information and review the previous answers.

The application is limited to two courses per teacher; therefore, it is suggested to continue the investigation so that in the future the application has the possibility of registering more courses.

## Conclusions

Based on the results obtained, it was possible to perform the analysis and design of a mobile application with the established methodology. In this way, the project is ready to start the next stage of the project.

The design of the application was also presented to the teachers of the Faculty of Information Sciences, who consider it an excellent idea, since they can count on a technological tool that allows greater participation of the students, at no cost. On the other hand, the students of the same faculty think that it is a good option to have an application to be evaluated and share opinions on a topic of the course in an interactive way.

So far, the application is limited to two courses per teacher because, when using a free server, there is little storage space, the same happens when sharing materials.

The next stage of the project will focus on development. We will work to make it available for mobile devices with Android operating system and be used by teachers and students of the Faculty of Information Sciences of the Autonomous University of Carmen, as well as other students and teachers of the university who have the necessary requirements for installation.



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