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# Application for the Academic Management of Supervised Clinical Practicum in Nursing Degree

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**Abstract**—This work focuses on the development of a web application to facilitate the management and evaluation of the practicum training in Nursing Degree at Universidad Autónoma de Madrid. The aim is to streamline processes such as the evaluation of students and the monitoring of their activity at the hospital, and to serve as a support tool for the students in Nursing Degree, all this using efficient scalable technologies and providing a modern and attractive interface. The result is an application that improves the efficiency and experience of the different users involved in the practicum training process (teachers at the university, tutors at the hospitals and students), providing tangible benefits according to a conducted evaluation by an end users group.

**Keywords**—Web application, clinical nursing practice, assessment improvement.

## I. INTRODUCTION

Practical clinical learning is a fundamental aspect of the nursing curriculum. In Spain, in consonance with the framework established by the European Higher Education Area (EHEA), students are required to accumulate a total of 240 European Credits Transfer System (ECTS) credits over four academic years in order to earn a Degree in Nursing. Of these, approximately 90 ECTS credits correspond to pre-professional placements in real clinical settings over the course of 3 years.

During clinical placements, students are expected to acquire a range of competencies essential to providing effective and safe nursing care. They do their clinical training at several health centers and hospitals. The most important are La Paz, Puerta de Hierro Majadahonda, La Princesa and Niño Jesús. There is also a Family Medicine and Primary Care Unit that complements the outpatient element of students' clinical training.

One of the tasks to be carried out by the university lecturers responsible for clinical placements is to grade their assigned students. In order to award these grades, they base on the information provided by the tutors, professionals who host the students during their hospital stay. At the end of the clinical training period, the tutors normally fill in an evaluation questionnaire for each student, which must include the assessment of the acquired competences.

This is not an easy task for these professionals, who, in their day-to-day work, with the hustle and bustle of hospital activity, do not usually record the competences acquired by the students in the different practical activities they perform. Therefore, it is complex to remember all this information afterwards. This is compounded by the fact that students are often with different professionals during a placement period, which makes it even more challenging for tutors to collect all the information on the student's performance.

During clinical placements, student attendance must also be recorded: the start and end time should be recorded, as there is a minimum number of hours to be spent at the hospital. At present, there is no simple and effective way to monitor the student's attendance, since signature sheets (documents recording the presence of each student) can be easily misplaced or manipulated. For this reason, students are sometimes directly trusted to attend the hospital when it is their turn.

In this context, a group of lecturers from the Department of Nursing at Universidad Autónoma de Madrid (UAM) is working on improving the competency assessment questionnaire used to evaluate students, with the aim of proposing more exhaustive questionnaires that will improve student monitoring and evaluation. During the development of this set of questionnaires, this work team considered the possibility of providing digital support for this new assessment format.

In healthcare context, multiple studies consider the use of smartphones as fundamental for communication within the hospital, as well as for searching information in a faster way. However, there is concern about how these devices might cause distractions and errors, affecting the quality of care and patient safety. Most studies agree on the potential of new technologies to improve the performance and quality of care offered in hospitals and agree that the negative effects of mobile use in healthcare settings are not supported by consolidated and reliable data [1, 2]. Indeed, mobile applications have been successfully used in different healthcare contexts [3]: for the safe and effective prescription and administration of drug treatments medication, for consulting articles, cases, and medical news [4, 5]. According to the evaluation and management of clinical practices, different studies have been carried out in the Anglo-Saxon environment, with good results [6], [7]; however, in the Spanish environment, although similar

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tools have been developed in recent years for assessing standard competencies [10], or for managing practice-related issues [9], there are still no papers showing its results.

The main goal of this work is to design and implement a computer application to support the evaluation of clinical practicum carried out by students of Nursing Degree in hospitals or health centers, through a set of questionnaires that can be completed during clinical nursing practise, to confirm the competencies acquired continuously. In addition, recording the students' attendance at the clinical placement through the application would be useful too. On the one hand, it is important to know which professional from the centre is supervising each student at any given moment, in order to have a quick reference in the event of a biological accident in the hospital; on the other hand, it is necessary to know, for each student, which professionals he have spent the most time with, as they will be the ones participating in his evaluation.

The solution presented in this paper makes it possible both to confirm that students have completed the number of hours of clinical training needed to obtain their degree and to ensure that they have acquired the expected competences. This would guarantee that every student finishes his degree having obtained the necessary training provided by these placements. Finally, the application also supports the publication of relevant information for the students by health professionals and university lecturers. This information can be of any kind, such as messages from the university to the students on administrative issues, messages from hospital professionals explaining different techniques, information on how to proceed in case of biological accidents during the internship (e.g., if a student is pricked by a contaminated needle), etc.

## II. ANALYSIS

At the beginning of this work, a first meeting was held between the co-authors from the Nursing Department (hereafter, the experts) and the co-authors from the Computer Science Department. At this meeting, the main needs in this specific context were discussed; the details of the evaluation of clinical practices were analysed; additional functionality was suggested to facilitate and improve the experience for students, university professors and professionals in charge of these students; and a first proposal for a solution to the problem raised was outlined.

In order to better understand the needs to be covered, it is necessary to explain some previous concepts related to the management of clinical practices as well as to the users involved and their tasks in this context.

### A. Definitions

**Unit:** Department of the hospital or health center where the clinical practicum takes place (e.g., Internal medicine, Surgery, or Paediatrics).

**Rotation:** Period during which a student is assigned to a unit. During a rotation, students work under the supervision and guidance of experienced nurses. There are six rotations for students of the Degree in Nursing at UAM. Students must be assessed, on each rotation, by the specialists in their unit who oversee them.

### B. Questionnaires

The questionnaire used to assess student performance currently consists of 48 items organised in 7 blocks (called "dimensions") relating to: adaptation to the practice context; teamwork; clinical decision-making process; integration of ethical principles in care; implementation of nursing interventions; communication with the patient and family; and self-learning management. The tutor must answer each question with "yes", "no" or "not assessable" and must assign a mark to each dimension to assess the acquisition of the competences corresponding to it.

The members of the Department of Nursing co-authoring this paper have recently worked on the creation of a new extended assessment questionnaire with a total of 99 items, organised in the same 7 blocks, in which the number of possible answers for each question increases from 3 to 5, allowing a more precise mark to be assigned to each assessable competence. In this way, the score for each dimension can be calculated from the answers to these questions, providing a more rigorous final assessment to be obtained. This new questionnaire was developed from a literature review. Content validity was established by an expert panel of 12 nursing experts. In this moment, this panel is working on the analysis of reliability and validity of the questionnaire.

### C. Users

**Students:** users who are taking a supervised practice course in the Nursing Degree and, therefore, are doing a clinical rotation in a hospital or health center. They are under the care of an academic tutor, who is accountable to them at the university. In the hospital or health center, they are usually under the supervision of a clinical tutor, although sometimes this is not the case. Each student can be at a clinical unit in the morning shift (from 8:00 to 15:00) or in the afternoon one (from 15:00 to 22:00). The students must attend for a minimum number of hours; otherwise, they must repeat the clinical rotation.

**Academic tutors:** UAM lecturers in charge of a group of students doing clinical practice. Their role is to keep in touch with clinical tutors and correct students' academic works. They need to obtain the students' evaluations at the end of each rotation in order to assign the grades for the corresponding practical subjects.

**Clinical tutors:** nurses that work where the students do their clinical rotation. Every nurse can confirm the attendance of the students, but only clinical tutors can supervise the students' practice and fill in the evaluation reports at the end of the rotation. Occasionally, some students have no clinical tutor associated. In these cases, the professionals from the unit with whom the student has spent most of the time meet, and jointly complete the evaluation report for him.

**Administrators:** they are usually university lecturers responsible for the coordination of clinical practicum for each degree. They manage all the information on users, units, and rotations.

## III. DESIGN

After the first meeting with the experts, a first catalogue of functional and non-functional requirements was drawn up,

which was refined and validated with them in subsequent meetings. The experts were involved throughout all the process. The sub-systems into which the application is divided are:

#### A. Assessment Subsystem

It supports everything related to the assessment of students by the clinical tutors (hospital professionals). They are shown the two evaluation questionnaires. On the one hand, they can access the official questionnaire that is currently used to assign the marks to students, which must be filled in at the end of the practicum. On the other hand, they can access the new questionnaire, which allows for a more comprehensive assessment of the students' competences and to record the acquisition of competences at any time during the practicum, so that students and tutors can keep track of the students' progress. In it, professionals can register comments on the assessment and the final total mark is automatically calculated based on the evaluations recorded in the different dimensions. This second questionnaire is in the process of being officially approved for compulsory use but is already available through the application. Its completion so far is voluntary.

#### B. Attendance Subsystem

It includes all the functionality for managing student attendance at the hospital. Clinical tutors can search for the student in their unit and mark that he is present in the hospital, specifying the check-in time. They can also indicate that a particular student has left. If a clinical tutor forgets to check-out a student, this student appears in a section of the application called "Students pending to check out", and she is allowed to check out at any time. A student can search for a specific clinical tutor in his unit and send her an attendance signature request (e.g., in case she has forgotten to check in); the student inserts the date and time of check-in and check-out, and the clinical tutor can accept, modify, or reject the request. In addition, all users with access to a student's information (administrators, clinical tutors, academic tutor, and the student himself) can view his attendance record.

#### C. Information subsystem

It includes the functionality that allows the publication and visualisation of messages, protocols, and other useful information for students. Clinical or academic tutors can publish information that is organised according to categories previously established (e.g., messages, action protocols, procedure explanations, or any other category they may wish). Administrators can publish information for students in the units and rotations of their choice. Clinical tutors can publish information only for the students associated to their unit. Edition and deletion of published content is also allowed.

#### D. User subsystem

It supports the management of user profiles, access, and permissions. Access is controlled by username and password. The corresponding permissions are granted to each profile, so that administrators can manage users, units and rotations, and the rest of the users can access the functionalities that correspond to each of them. Regarding the permission to fill in a student's evaluation questionnaire, if the student has a clinical tutor, she will be the one to complete it; if he has not been assigned to a clinical tutor, the three professionals in the unit with whom the

student has worked most of the time will be the ones allowed to fill it in.

### IV. THE APPLICATION

#### A. Interaction and interface design

Once all the functional and non-functional requirements of the application had been identified, and the main aspects of the system had been analysed and designed, mock-ups were created to depict the interface and interaction design, as well as to validate it with the experts. The principles and guidelines for interactive interface design were considered [10, 11]. Figma, a free, cloud-based tool widely used by user experience and user interface (UX/UI) designers, was used to develop the mock-ups. This tool is specialised in user interface design and offers very entire functionalities for prototyping.

The strategy followed to validate the interaction and interface design was as follows. A first prototype was developed. Meetings with the experts were held to show them the prototype and obtain their feedback. Thanks to this feedback, it was possible to modify some design details and proceed to implement the application. Fig. 1 shows the mock-up of the attendance tab in which clinical tutors record student attendance.

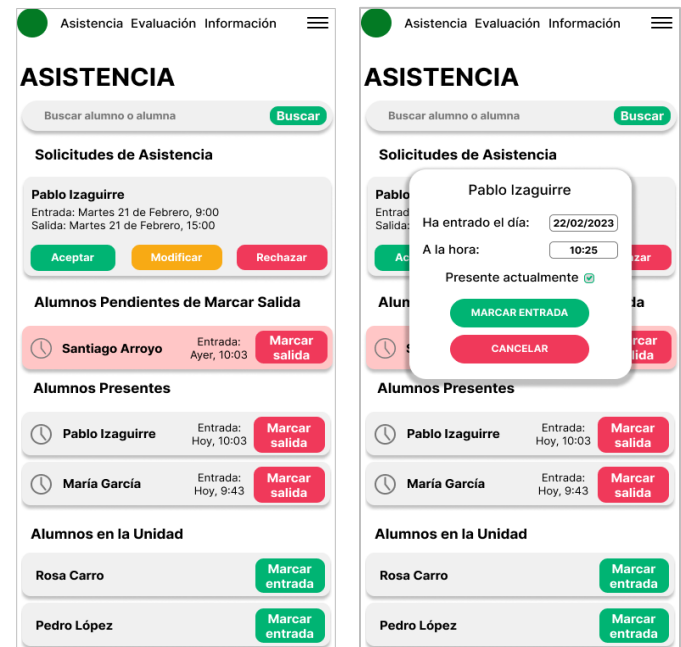


Fig. 1. Mock-up of the tab where attendance is managed

To support the student assessment, several design alternatives were created. They were presented to the experts to discuss with them which one would be more suitable for the clinical tutors. One example of feedback from the experts that caused changes in the interface is the following: in order to visualise the answers to the questionnaires, it was necessary to scroll through the dimensions to see the mark received in each of them; the experts advocated creating an initial screen in which the scores would be summarised, showing the final total score, the score for each dimension and the possibility of accessing the details of each dimension from this main screen (with no need

of navigating between dimensions to find out the score for each of them). The final mock-up for this screen is shown in Fig. 2a.

Regarding the mock-ups developed for inserting and visualising information, they were approved in the validation meetings. Fig. 2b. shows the one for visualisation. As it can be seen, a coherent and common aesthetic has been used throughout the application, based on the use of shaded cards. The predominant colour is the green used when developing UAM institutional resources. Once the design of the application was validated by the experts, the implementation began.

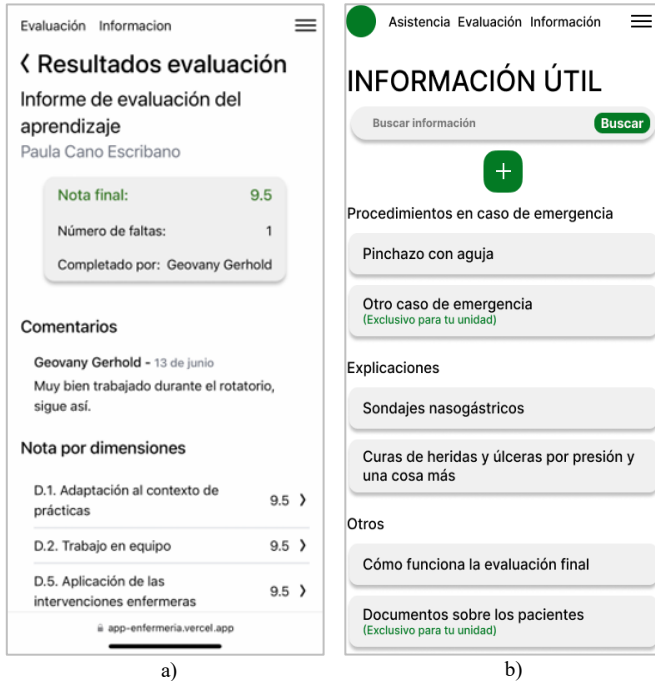


Fig. 2. Mock-ups of assessment and information visualization

## B. Implementation

For the development of the application, the following technologies have been selected, with the aim of allowing efficient development, scalability of the application, ease of code maintenance and agility in both the creation of user interfaces and data management.

For the frontend development of the application, React.js has been used [12]. React is an open-source JavaScript library used to build interactive user interfaces that enables the creation of reusable components, breaking the interface into smaller, more manageable parts, making it easier to build and maintain the code. In addition, it supports efficiently rendering only the components that change, instead of performing a complete UI update, resulting in better performance and a smoother user experience. The primary programming language used in the application is TypeScript [13], a superset of JavaScript that adds static typing features, providing benefits such as compile-time error detection, better code organization, and greater scalability of the application.

For the development of the backend of the application, TypeScript has also been chosen, making use of Node.js as the server-side execution environment, which has numerous

advantages: it is particularly suitable for the creation of efficient and scalable web applications, due to its focus on event handling and its capacity for asynchronous operations, allowing for high performance in high concurrency situations. Thus, if in the future the use of this application is to be extended to other departments of the university, or even to other universities simultaneously, the application will respond efficiently. Other technologies and resources used have been: Next.js [14] as a development framework, Tailwind CSS [15], PostgreSQL [16] as a database manager and Prisma [17] to simplify database access and manipulation.

It is worth mentioning that the application has been implemented using responsive technology to maximise the use of space on mobile devices and to take advantage of larger screens such as those on computers. This type of technology prevents developers from implementing the whole application twice, one for each type of device. Figure 3 shows the different interfaces generated to support the completion of the extended evaluation questionnaire: on the left the version for mobile devices and on the right the one for computers.

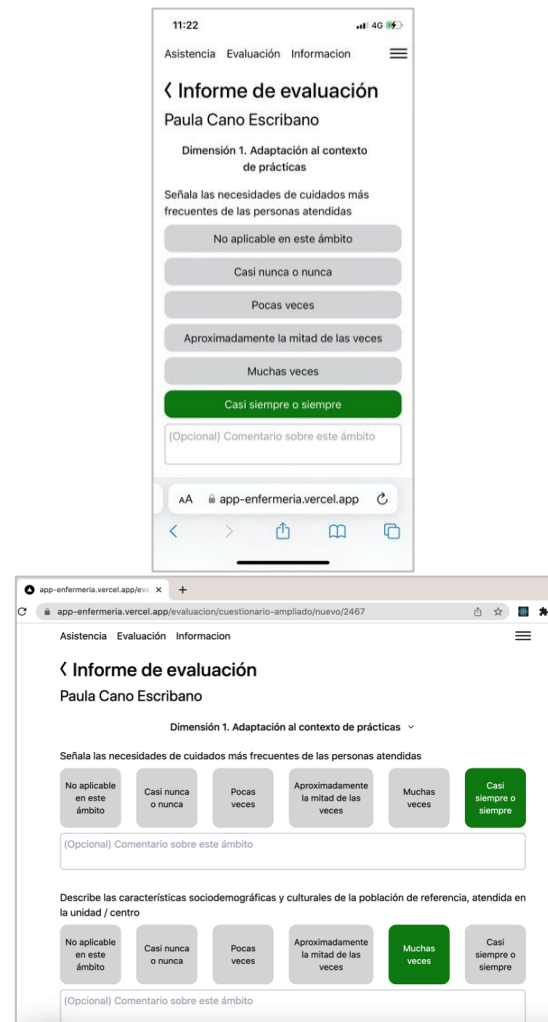


Fig. 3. Screenshots of page to fill in the extended evaluation questionnaire



## V. TESTS AND RESULTS

To evaluate the correct functioning of the application while its different functionalities were being developed, a local environment was configured, where a server was run in development mode. All the tests done during the implementation phase verified the proper functioning and performance of the application and corroborated the appropriate design of the interface to support the corresponding tasks.

On the other hand, tests have been carried out with end users, deploying the application and hosting the database in Vercel. These tests have involved volunteer users of the three profiles: students, academic tutors, and clinical tutors. The objectives of this evaluation have been to assess the usability and potential usefulness of the application and to measure user satisfaction, to check if the application meets their expectations and needs, as well as their satisfaction with the overall experience.

To collect all this information, three questionnaires have been developed, one for each type of user. Each questionnaire sets out a series of specific tasks to be performed by the user and presents questions related both to the performance of these tasks and to the usability of the whole application.

The approach to analysing the user-friendliness of the application has been to present only the statement of the tasks to be accomplished, without any other information or help on how to do it, so that users need to explore the application to perform them. This helps to effectively measure whether the application is simple and intuitive. An example of a task to be performed is the following one, proposed to academic tutors to assess the user-friendliness of the attendance record section:

*"Find your (fictitious) student Paula Cano Escribano and find out which (fictitious) professional she was in hospital with on Wednesday 31 May. See what time she entered the hospital and what time she left".*

For all these tasks, the user was asked whether he/she was able to perform it and whether the interaction was simple and intuitive. In case of answering "no" to any question, the user can write comments in the open text field available next to it, to reflect any difficulties encountered or problems experienced, which provides useful information for future improvements.

On the other hand, to assess the user satisfaction with the different aspects of the application, a set of statements were presented, and a 5-value Likert scale was used to measure the degree of agreement or satisfaction of the user with them. The statements to be assessed deal with specific aspects of the interface (colour contrasts, fonts, organisation of elements shown on the screens, etc.) and interaction (navigation between screens, understanding of buttons and actions that can be performed with them, consistency, ease of use, etc.), and also with other general aspects such as how easy is learning to use the application, user's overall satisfaction with the application, perceived usefulness of the application in the context of nursing practice or whether the user would indeed wish to use it in this context. Special care was taken to ensure that the language used in the questionnaires was not too technical, so that it could be easily understood by all types of users, even those with little familiarity with new technologies.

So far, responses have been collected from 9 users: 5 academic tutors, 1 clinical tutor and 3 students. The results show a very positive evaluation of the application, as it can be seen in the graphs shown in Fig. 4: all users selected "Strongly agree" or "Agree" for statements related to whether they find the application useful and whether they would like to use it.



Fig. 4. User satisfaction: intention of use and application usefulness

In terms of interaction, it was generally well rated. Questions related to the interface were rated very positively too. The lowest rated statements was: *"The contrast of colours makes it possible to see the texts and buttons on the screen well"*: 11% users answered "Neutral", 33% answered "Agree" and 56% answered "Strongly agree", which is not a negative result either.

As for the proposed tasks to be performed by the users, out of the 20 tasks to be performed, only one user was unable to perform one task: *"Visualise which hospital professional a student was with on a certain day"*. This indicates that the design of the interaction for this task should be revised or explained, perhaps by introducing a help button.

The information entered by users in the text fields for comments and suggestions also proved very valuable, such as that proposing to display more feedback messages indicating what actions have been performed (e.g., when posting new information for the students). This will be incorporated into future updates of the application. As the application is web-based, it is very simple to make updates available to users.

## VI. CONCLUSIONS AND FUTURE WORK

We have designed and implemented an application for the automated and efficient digital management of some aspects of the clinical practicum in Nursing Degree at UAM: the student continuous assessment through detailed questionnaires of competence acquisition; the management of student attendance for clinical rotations; and the publication of useful information for the students in a simple way. This is supported with the

intention of providing a better experience for clinical tutors and students during the clinical practise in hospitals or health centers.

This digital assessment provides continuous feedback to students on their performance throughout the practicum, enables clinical tutors to assess the competencies acquired by the students as the rotation progresses, and allows academic tutors to consult all this information at any time. On the other hand, the attendance system developed is intuitive and provides a secure and reliable way to keep track of student attendance. Finally, the publication of useful information for students contributes to their training in this context.

The involvement of the experts in the different phases of development (initial identification of the problem and its scope; requirement analysis; validation of the interface and interaction design through prototyping testing; and final evaluation) has been of great added value.

The guidelines followed for the interface and interaction design, as well as the technology used for its implementation, have resulted in a scalable and robust application, with an attractive user interface that complies with the principles of usability, thus improving the user experience.

According to the comments and suggestions provided by the users who have evaluated the current version of the application, we are considering the possibility of increasing the number of feedback messages, offering help messages to perform some more complex tasks, and increasing the colour contrast in some sections of the application.

On the other hand, it would be interesting if each student could obtain a count of the number of times that they have practised the different nursing techniques. This would be useful, for example, to incorporate this information in their curriculum vitae as a summary, which is common in the healthcare field.

We also plan to support students to enter comments on the techniques performed each day (e.g., notes on something they learned and want to remember, doubts they had and how they were solved, how they felt, how they performed the technique, etc.); they could also note or link information on how to perform those techniques.

Once the new assessment questionnaire is formally approved, it is planned to use the application for the assessment of clinical practice competences in Nursing Degree at UAM. The current version of the application is available at Vercel. The necessary steps for its deployment in a production environment at UAM (which includes hosting it on UAM cloud servers) are currently underway.

Once the application is widely used in this context, its use could be extended to other degrees. In fact, there is interest in using it in the UAM Medicine Degree. The requirements for the development of an additional module for the medical practicum are currently being analysed. In addition, we are exploring the possibility that other universities, with which contact has been established for the psychometric validation of the competence assessment questionnaire, may be interested in using the application. For the time being, the application is available in Spanish. However, it would be interesting to translate it into

other languages for non-Spanish universities to test its effect in different countries.

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