

Design of learning digital tools through a user experience design methodology

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Abstract. The insertion of digital technologies and the widespread use of mobile devices has allowed their use in learning processes. The wide exposure of young people to technology has modified their expectations regarding educational experiences, so it is necessary to propose new ways of learning. However, beyond just proposing new learning tools, it is necessary to think about the learning experience, for this, it is essential to have pedagogical strategies and know in detail the users' specific needs of consultation, study or learning. With this in mind, a project is presented that aims to improve the learning process and application of ergonomics knowledge, in which the design of a digital informal learning tool developed with a student-centered perspective is proposed.

Keywords: m-learning, e-book, user centered design, educational experience, educational digital tools

1 Introduction

Educational tools have constantly evolved at the pace that technology allows, which in turn modifies the expectations of students, their study habits and their practices when doing technological projects. There is a great diversity of digital products oriented to education, we can find, among the most representative, the e-learning, m-learning platforms and e-books. Each of them has specific characteristics and serves particular purposes.

Nowadays the young students grew up with a high influence of digital technologies, so their learning expectations are different [1]. It turns out that educational experiences must be focused precisely on that, on being complete experiences [2]. Reason why the didactic resources have diversified; the books, which were the primary didactic tool have gone to the background. Currently, students of all grades prefer to search for information by "google it", looking for explanatory videos, in articles with short texts; and above all, they seek to have access to information all the time, anywhere.

It is for these reasons that digital tools seem to be the best option to solve the consultation and learning needs of students, however, in the design and development process some issues arise that are worth addressing. Of course, one of them is didactics, it is important to consider that for these tools, to be successful and meet their objectives, they must be designed within a didactic or educational strategy. The development of educational technologies should not be focused on technology per se, but should take into account the pedagogical objective as the main one and consider technology as a means to achieve it [3], only in this way a successful development of digital tools can be achieved. Therefore, the technological and pedagogical component are equally important and both must be studied carefully [4].

On the other hand, there is technology; technological proposals to address educational problems have evolved greatly in the last 40 years, which represents some difficulties. It is necessary to generate reference frameworks that allow guiding the development of educational strategies using each one of the possible digital platforms [5]. This becomes complex when new strategies are rapidly developed. Many times, digital products reach students before they could be evaluated. This fact represents a great challenge. Technology-mediated educational tools changes constantly and new proposals are being developed almost instinctively trying to take advantage of the benefits that new technologies represent.

Finally, there is the experience. Learning must be seen as an experience, that is, a set of interactions between various elements of a system that allow the student to appropriate knowledge [6]. So it is essential to know in depth the students' learning needs, but also their habits of consultation, study and application of knowledge. Only by carrying out a student-centered design process, it is possible to make proposals that could successfully be inserted into the learning process. Digital technologies allow to design solutions very complex and that can cover the entire learning process; however, it is necessary to know in depth the context and needs to make sound decisions and then offer ideal tools [7].

Comentado [PD1]: Falta otra comilla?

Comentado [PD2R1]:

2 Technology mediated education

There are a large number of technological approaches to learning, each one aimed at covering certain objectives. With regard to the design of digital tools for learning, there are three major trends: e-learning that is the initiator of everything, m-learning that has become increasingly important and finally there is a tool that looks like a simple digital product, but it has, in fact, great potential: the e-book.

2.1 E-learning platforms

The e-learning platforms were the first innovative proposal of tools for learning using digital technologies. The arrival of the Internet brought to the table a series of new opportunities for knowledge and social exchange that could now be done at a distance. Since then e-learning platforms have changed enormously, we can now define these platforms as those that make use of digital resources and devices to improve learning

processes [8]. Although this definition seems very broad it is the one that best reflects the objectives of e-learning.

Among the advantages represented by the use of e-learning platforms, we find the fact that it enhances resources for the students, who benefit from multimedia content that represent innovative ways to learn compared to traditional learning models [9]. Another advantage of this type of technologies is that it allows students to learn outside the classroom, giving the possibility of autonomy in learning, the student can choose when and where to learn [10]. It is for this reason that some authors consider e-learning as the evolution of distance learning [8]. Finally, it is also clear that the use of e-learning helps to optimize economic resources, the main reasons for adopting this model are: to improve the quality of learning, to improve access to education and training, to reduce the costs of education and to improve the cost-effectiveness of education [11].

Comentado [PD3]: Se perdió la secuencia?

Comentado [PD4R3]:

2.2 M-learning and ubiquitous learning

With the arrival of mobile phones and their expansion in the market, new technological proposals for learning have been also done using this new tool. At the beginning, it was simple learning games, or interactions through text messages; currently, thanks to the sophistication of mobile phone equipment, m-learning is as complex as e-learning [12].

There are two main differences between the two proposals, the first one is the level of interactivity, the second one, the portability. Smartphones have proposed a whole new digital language through app design. These new digital products allow fast and constant access to content, communication and even interactivity with the environment, so they have become part of everyday life [4]. Being able to propose educational strategies contained in apps has allowed us to take advantage of these benefits to generate clear learning strategies.

On the other hand, the portability offered by mobile solutions allows us to generate a ubiquitous learning environment, that is, the access to content and strategies is available anywhere at any time [13], and could be reached by a thumb. This possibility generates new expectations in students who demand “just enough, just for me, just in time” models [12]. This context has generated students who are impatient, creative, expect results immediately, personalize the things they choose, focus on themselves and trust technology [14].

2.3 Enhanced E-book

An e-book is basically a book in electronic format [15]. From this concept we could think that it is not a new digital learning tool, but a traditional tool in a new format. However, to have this digital resource has allowed us to explore new possibilities in its operation as a tool.

Some studies show that this simple change in format of a book completely modifies the experience of reading and learning through it [16]. Even we can say that reading in digital formats brings some extra benefits, for example, the possibility of being able to use different ways to access the content such as text to speech or being capable to

change the font size [17]. In addition, we must add the fact that being able to read the book on an electronic device increases students' interest in reading.

In addition, digital formats allow new functions to be added to the simple text. We can insert other types of content such as multimedia or generate links to external resources, so it facilitates the process of self-regulating learning and helps to extend the activity to the use of additional resources [16]. Therefore, an e-book can be considered as a new learning tool, as long as it has additional features to improve the learning experience.

3 An educational digital tool design for enhancing ergonomics application

Ergonomics is a fundamental discipline for all the professionals in charge of product design. However, in Mexico there is a lack of interest for learning about this discipline, in addition to this, there are few educational tools that allow informal learning besides textbooks and some web platforms. After an inquiry process it was found that students have a certain curiosity to learn about the subject, but the expectations they have regarding the informal learning experience of a subject are not covered by the textbooks normally used. For this reason, we propose the design of a digital tool, a mobile application, that allows to meet the learning needs of the students at the same time that it is closer to their expectations of learning experience. A user experience design method is used for this purpose.

3.1 User research

With the objective of awakening the interest of university students of engineering and industrial design in ergonomics, a group of professors initiated a research project to identify the areas of opportunity and the deficiencies of the teaching-learning process of ergonomics in Mexico. A diagnostic process was carried out, and as part of it 93 surveys were applied to students (47) and recent graduates (46) of the industrial engineering and design careers of the National Autonomous University of Mexico. In particular, the results of two of the questions are relevant at this stage of the project.

The first question asked respondents to use qualifiers to describe their perception about the content and organization of ergonomics textbooks, the results are shown in Fig 1. The answers with higher percentages allow us to obtain the following conclusions:

- More than a half (56%) of respondents consider books to be interesting. Although it is a majority percentage, it is not so high. It means that half of the participants find no interest in consulting an ergonomics book
- 37% of participants consider the books to be "unclear"
- 30% of respondents think that ergonomics books contain a lot of information, while 26% say they are very extensive
- 30% of participants consider that ergonomics books have insufficient information

The last two points seem contradictory, however, after discussing the issue with ergonomics professors, from their teaching experience, the problem is that students search for information in books, that they can quickly apply to their design or engineering projects. That is why books do not seem to offer enough information at the same time that they are perceived with excess information. Textbooks do not cover the need for students to consult recommendations that allow them to apply ergonomic knowledge to their projects immediately.

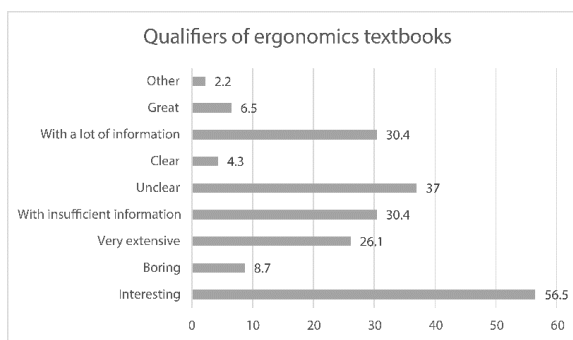


Fig. 1. Qualifiers of ergonomics textbooks in percentage

The second question related to this topic is an open question in which participants were asked to describe the ideal characteristics of a material or tool to learn about ergonomics. A categorization of concepts was carried out based on keywords mentioned by the respondents, and finally a frequency analysis was presented in Fig. 2.

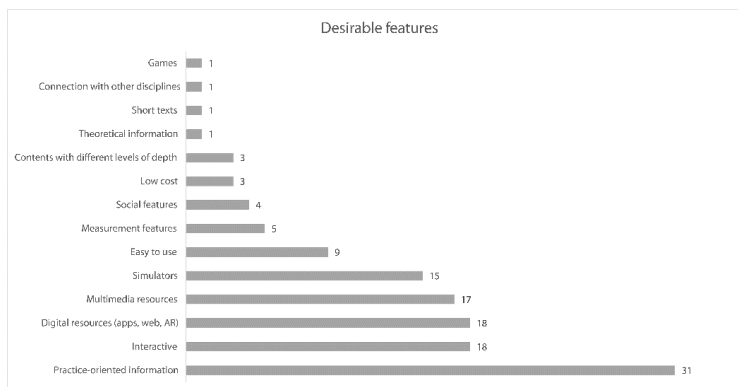


Fig. 2. Simple frequency of desirable features

Based on the participants' responses, a proposal was made to design a new type of teaching material that met the needs of students and professionals to consult information related to ergonomics. The proposal corresponds to a digital tool that is interactive, easy to use and that allows easy access to practice-oriented content, so that users are able to easily apply the information obtained. At the beginning of the project, one of the objectives was to write an e-book, however, after the information collected it is clear that an e-book is not enough, even an enhanced e-book might not be enough, so a deeper analysis of the users' needs was carried out in order to make a more accurate proposal.

3.2 Design features definition

At this stage, an analysis was carried out using the Persona method, it was important to understand how the didactic tool will be used in a real context, how it will be used in class or when carrying out a project. For this stage it was decided to focus the analysis on the students since they are the target user. For the Persona method, three different student profiles were created: outstanding student, who performs learning activities autonomously and has an interest in learning more; average student, who fulfills his tasks and carries out the projects, but is not interested in devoting extra time to his learning; and finally the selfless student, who has difficulty with classes and projects and has also problems understanding when consulting a text. From the analysis of needs and possible solutions in the Persona method, the requirements of the tool were obtained, which are shown in table 1.

Table 1. Functions proposed for each requirement

Feature	Functions
Customization	- Recent contents - Labels to tag specific contents
Immediate Access	- Search tool to easy find an specific topic
Dynamic Visualization	- Two ways of visualization of contents: graphic and text
Interactivity	- Brief texts and use of multimedia - The user decides what to read and in which order - Visual tools to indicate the reading progress
Additional Resources	- To show additional academic resources for each topic

3.3 Interactive handbook of ergonomics

Based on the requirements obtained and the information acquired in the user research stage, the development of a mobile application was proposed, it should allow:

- To access to short contents oriented to its immediate application in a design project

- To access assessment and measurement methods that allow students to apply them with simple resources to solve ergonomic needs
- To access texts that address ergonomics topics categorized according to their field of application, so it will be easier to access them based on the problem they want to solve
- To access textbooks and other online resources categorized by topic of interest
- To self-regulate user learning. It is the users who decide what content they consult, with what depth and in what order. In addition to allowing them to label these contents with the objective of making a classification of them according to the interests of the user
- The application must work disconnected from the internet, this is to make it more accessible and not conditioning its operation to the connection to internet
- The application must be easy to use

Based on the aforementioned requirements, the proposal is defined as an m-learning strategy, although the content seems like an e-book, the interaction needed brings it closer to a mobile application for educational purposes. Probably in the future, the social component of the application could be proposed in order to facilitate discussions and conversations with ergonomics experts. However, at this time it is preferred that the proposal could be low cost and very accessible, so it is preferred without this social component. In order to cover the desirable characteristics, the creation of four types of contents or elements is proposed:

- Checkpoints. Presented in the main menu. These are ergonomic recommendations sorted by thematic categories. Each checkpoint consists of a single sentence and is accompanied by a short text that describes the ergonomic principle from which it is derived and the form of application.
- Methods. Presented in the main menu. The methods are classified thematically and synthetically present the procedure and materials needed to apply an ergonomic inquiry, measurement or evaluation method
- Texts. Presented in a secondary menu. The texts correspond to brief theoretical descriptions of the fundamental themes of ergonomics
- Other resources. Accessible from texts. They correspond to external resources such as books, articles or web pages that address ergonomics in a deeper way

Once the first prototype was developed to visualize the functions and the way of presenting the contents, a focus group session with design students was carried out to evaluate the value of the proposal.

4 Results

During the focus group carried out, the participants talked about their information consultation habits and the problems that exist when they refer to textbooks to find information that allows them to solve ergonomic needs in the design projects. The following conclusions were obtained:

- Students prefer to check websites, videos and other multimedia resources rather than books to learn about a new topic.
- Students prefer books in digital formats due to the portability and flexibility they offer
- They would like to have mobile applications that facilitate the information consultation process
- They require information related to ergonomics that allows them to solve design problems in an agile way

Subsequently, the mobile application proposal “Interactive handbook of ergonomics” was presented and they were asked to explore the prototype. When recovering their impressions in this regard, the following results were obtained:

- The application correctly addresses the need for practical content
- The way of presenting the contents seems friendly and easy to use
- Checkpoints are the type of content students look for when they ask about ergonomics
- The content tagging function seems useful for self-regulating learning
- The methods look interesting but students would like to have associated evaluation tools in other mobile applications. This point is an area of opportunity for the future.
- Being able to have a mobile application for consultation on ergonomics issues can support the application of ergonomic knowledge to design projects

5 Conclusions

The development of digital learning tools has allowed revolutionizing the ways in which new knowledge is acquired, but it also presents new challenges for teachers and developers, who have to find the right ways to propose such tools to be really useful and to support the acquisition of new knowledge. On the other hand, the expectations of the students are focused on having more complete and ubiquitous learning experiences, thus demanding the development of new products for educational purposes. This document presents an example of an educational tool designed from a user experience design method in which students were included in all stages of development, showing that in this way you can have a more detailed understanding of user learning needs; and therefore, to be able to generate a tool that best suits the reality of the students.

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