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Research Article

Educational Software for The Development of Knowledge About Electrocardiogram in Cuban Doctors

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Abstract

Introduction: In recent years, technology has taken computing power to new horizons, driving an unprecedented revolution in information processing. Bioelectric signals are low amplitude and frequency signals coming from the human body, generated by electrochemical reactions of certain types of cells when excited. Some of these signals include the electrocardiogram or electroencephalogram.

Objective: Design a software for the development of knowledge about electrocardiogram in Cuban doctors who work in Venezuela.

Method: An innovative development study was carried out on doctors working in the state of Carabobo in the Republic of Venezuela, in the period from September 5, 2023 to March 20, 2024.

Results: The specialist group was made up of 5 Doctors Specialist in Cardiology and 2 Graduates in Computer Science, which agreed with the design of the software for its implementation. In relation to the types of electrocardiograms, the appropriate indicator before using the software was represented by 52.38% and once the work with the software was finished, this indicator was represented by 90.47%.

Conclusions: The educational software fulfilled the use for which it was created as an educational tool, with principles of didactics, becoming more motivating when incorporating knowledge about electrocardiogram topics to Cardiology resident doctors in service.

Kew Words: educational software; knowledge development; electrocardiogram

Introduction

In recent years, technology has taken computing power to new horizons, driving an unprecedented revolution in information processing. With each new generation, the limits are pushed even further, allowing machines to perform more complex tasks and significantly assist in decision-making for critical problems, such as medical diagnosis.[1].

All of this, added to the popularization of the study and research of algorithms to analyze bioelectric signals, has encouraged the scientific community to develop mathematical models and software that serve as support for health professionals. Bioelectric signals are low amplitude and frequency signals coming from the human body, generated by electrochemical reactions of certain types of cells when excited. Some of these signals include the electrocardiogram (ECG) or the electroencephalogram (EEG). [1]. Specifically, the ECG plays a fundamental role in the study of the cardiac system, since it is probably the most important non-invasive method when detecting and diagnosing heart diseases. To record the behavior of the electric field produced by cardiac

cells, a series of electrodes are placed on the patient's skin, both on the extremities and in specific locations on the thorax.[1]. For some time now, the generalization of the problem-based learning modality has been advocated as a way to encourage learners to use all their potential to achieve the acquisition of the knowledge set by the objectives designed for any training activity. Thus, participatory learning emerges as a necessary procedure to achieve important achievements in the teaching process, integrating theory and practice for the application of the clinical method in problem solving.[2]. To use these learning methods, it is currently advocated to exploit the technological resources within our reach and which are not always remembered in our universities. The use of new information and communication technologies (ICT) has strongly penetrated the university educational field, supporting the rise in the application of teaching methods, which has forced us to reconsider the educational teaching process itself in the new computerized conditions in which society evolves.[2]. The academic tools that have been used for learning and assessment for years are traditional, as are educational strategies. Various research supports the use of digital platforms for learning. Likewise, along the same lines, important studies show the need for the implementation of technology in the study, so that in this way the interest of students in applying these tools increases.[3]. The teaching of electrocardiography during the degree is of great importance since upon graduating from medical schools, and heading towards primary health care, the new doctor has the very high responsibility of responding to medical emergencies when he performs his shifts in which he is. Since this diagnostic means is frequently involved and, in most cases, it means rapid and accurate conduct, this is where the greatest weaknesses arise. Regarding the training of the specialist in Comprehensive General Medicine, its program includes electrocardiography, but as another complement to the study of cardiovascular diseases and not as a specific topic.[2]. In order to continue contributing to the development of knowledge, our objective is to design software for the development of knowledge about electrocardiogram in Cuban doctors who work in Venezuela.

Method

An innovative development study was carried out on doctors working in the state of Carabobo in the Republic of Venezuela, in the period from September 5, 2023 to March 20, 2024. Structured by three stages, where in the first at this stage, bibliographic searches were carried out in indexed databases (PubMed, CUMED, Google Scholar and SCIELO), to find out about didactic means of teaching and learning capable of conveying knowledge to doctors providing services on the electrocardiogram. In the second stage, the teaching methods of the electrocardiogram were determined and a diagnosis was made to know the real state of knowledge in the study subjects. And in the third stage, an educational software was designed (figure 1) through a computer platform that fulfilled didactic elements that make the knowledge to be imparted more accessible, it was validated by an expert group and the results obtained with the application of the proposal.

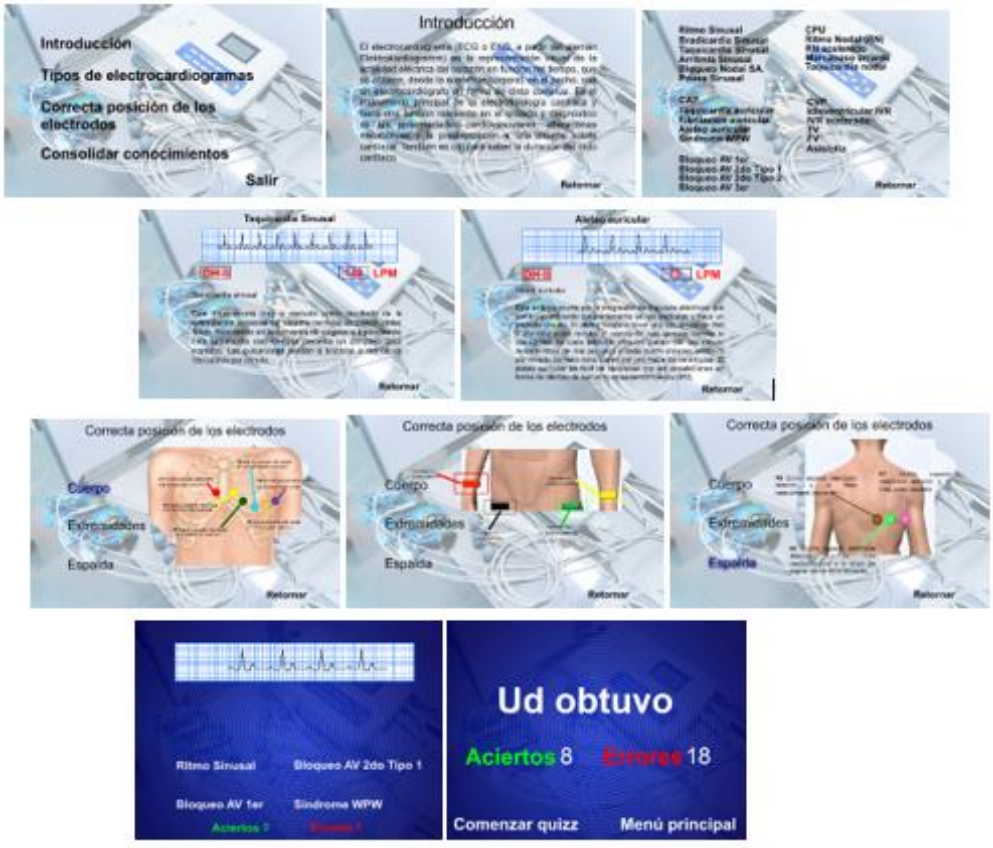

Figure 1. Multimedia for the development of electrocardiogram knowledge

The study sample was made up of 42 Cuban doctors who worked in the state of Carabobo, Republic of Venezuela who gave their consent to participate in the study. A knowledge diagnostic pre-test was applied, the software was designed and validated by a group of specialists, then the software was delivered to the study subjects for their educational interaction and how to work with it was explained, in case of difficulty, computer advice was offered. Finally, a post-test was applied to compile the knowledge acquired after working with the proposed software. The software consists of a presentation, a content menu that reflects different topics related to the electrocardiogram, these topics are related to images and figures for a better understanding of the contents. At the end of the software, you can check what you have learned through a content test and once completed it automatically offers the results obtained. This educational intervention was approved by

the Directorate of the Cuban Medical Brigade in Venezuelan territory by the training personnel and the Science and Technology personnel.

Result

The specialist group was made up of 5 Doctors Specialist in Cardiology and 2 Graduates in Computer Science, who agreed with the design of the software for its implementation in all the parameters analyzed (Table 1).

Software Features	OK		Not agree	
	No.	%	No.	%
Form of content presentation	7	100	0	0
Scientific validity of the topics addressed	7	100	0	0
Language	7	100	0	0
Environmental design	6	85.71	1	14.28
Relevance	7	100	0	0
Representation of a teaching model	5	71.42	2	28.57
Utility for learning	7	100	0	0
Applicability	7	100	0	0
Content	7	100	0	0
Ease	7	100	0	0
Functionality	7	100	0	0
Originality	6	85.71	1	14.28
User interface	7	100	0	0

Source: survey of specialists

Table 1. Assessment by specialist criteria

Within the characteristics of the doctors, the age group between 25 and 30 years (59.52%) and the male sex (66.66%) prevailed (Table 2).

age group	No.	%
From 25 to 30 years	25	59.52
From 31 to 40 years	10	23.80
More than 40 years	7	16.66
Total	42	100
Gender	**No.**	**%**
Female	14	33.33
Male	28	66.66
Total	42	100

Source: survey of doctors

Table 2. Distribution of doctors in the study according to age, sex and state where they work in Venezuela

In the knowledge related to the generalities of the electrocardiogram before the intervention, 80.95% knew that it was the same, a result that changed after the intervention reaching 100% (Table 3).

Level of knowledge about generalities of the electrocardiogram	Before software		After software	
	No.	%	No.	%
Appropriate	3. 4	80.95	42	100
Inappropriate	8	19.04	0	0
Total	42	100	42	100

Source: survey of doctors

Table 3. Doctors according to knowledge about generalities of the electrocardiogram (before and after the intervention with the software)

When analyzing the knowledge that doctors had about the types of electrodes before the intervention with the software, 57.14% responded adequate, this indicator after the intervention was improved since 97.61% identified said electrodes (Table 4).

Level of knowledge about the types of electrodes	Before software		After software	
	No.	%	No.	%
Appropriate	24	57.14	41	97.61
Inappropriate	18	42.85	1	2.38
Total	42	100	42	100

Source: survey of doctors

Table 4. Doctors according to knowledge about types of electrodes (before and after the intervention with the software)

It is shown in the knowledge about the correct position of the electrodes before the intervention with the software, where 69.04% responded to the appropriate indicator, and after the intervention 100% of the doctors responded favorably. In relation to the types of electrocardiograms, the appropriate indicator before using the software was represented by 52.38% and once the work with the software was finished, this indicator was represented by 90.47% (Table 5).

Level of knowledge about correct position of the electrodes	Before software		After software	
	No.	%	No.	%
Appropriate	29	69.04	42	100
Inappropriate	13	30.95	0	0
Total	42	100	42	100
Level of knowledge about types of electrocardiograms in relation to the pathology	**Before software**		**After software**	
	No.	**%**	**No.**	**%**
Appropriate	22	52.38	38	90.47
Inappropriate	twenty	47.61	4	9.52
Total	42	100	42	100

Source: survey of doctors

Table 5: Doctors according to knowledge about correct position of the electrodes, and types of electrocardiograms in relation to the pathology (before and after the intervention with the software)

Discussion

Cuban Medical Education, both in its universities and in the settings where teaching is carried out, has carried out hard work aimed at incorporating ICT in each of the dimensions of graduate training: curricular, university extension and socio- political.[4]. In our study it was observed that the specialists agreed 100% on most of the indicators that characterized the educational software designed. As a characterization of the doctors in the study, the age group between 25 and 30 years (59.52%) and the male sex (66.66%) prevailed. Regarding the generalities of the electrocardiogram before the intervention, 80.95% knew that they were the same, a result that was modified after the interaction with the software, reaching 100% adequate knowledge. All other topics within the software were modified from before to after in relation to types of electrodes used, correct position of these electrodes and types of electrocardiograms in relation to their pathology. These results were similar to other studies such as those that can be mentioned: Rodríguez et al.,[2]. where designed a multimedia on electrocardiography that provides the means for learning for students and health professionals concerning this topic. The evaluation of the multimedia was from excellent to predominance of links, organization and dynamism with 100% and 96.7% respectively, 98.3% considered navigation easy. In general, the software was considered excellent by 93.3% of the users. When checking the level of knowledge, it was inadequate in 90% before using the instrument and rose appropriately to 93.3% after use. of this. Montes de Oca et al.,[5]. created an educational multimedia on clinical electrocardiography applying mnemonics. A validation was carried out using the Delphi method by 30 experts and an evaluation by 351 third-year medical students. 66.67% of the teachers had the teaching assistant category and 46.67% were Doctors in Pedagogical and/or Medical Sciences. For 98.78% of the experts, multimedia was a didactic model that provided complete and updated information on the subject applicable in teaching. 100% of the students expressed that multimedia allowed an adequate understanding of the knowledge and that the level of ease of its use was adequate. Ferrer et al., [6]. created a multimedia on clinical electrocardiography for 120 third-year students and 30 medical sciences teachers. 83.87% of the students were female. Of the teachers, 60% are male. More than 63% of both students and teachers evaluated all dimensions as good. Only poor evaluations were obtained for applicability as a means to facilitate learning and consolidation of knowledge (6.67%) and functionality of the product (6.67%) by teachers. It was concluded that applied multimedia constitutes a useful tool in the educational teaching process for teaching basic electrocardiography, since it serves teachers as an auxiliary means and provides updated information on cardiovascular diseases. Rodríguez and Cacher,[7]. sought to know the degree of knowledge and application of ICT by doctors in the province of Toledo, Spain in learning electrocardiography. 199 questionnaires have been collected. The mean age is 46.6 ± 9.7 years (range: 25-67 years), with 56% being men. 90% of doctors use computers, but they use other media much less frequently. 52% use smartphones. 74% have completed some electrocardiography training, with the majority having a basic level. They have more experience in traditional and individual methods than in ICT. They believe that ICT can be useful, although they value visits to the web and portable applications more than edublogs the use of mobile applications for the development of knowledge has been evidenced as observed in García et al.,[3]. where they showed how the Interactive EKG mobile application for 183 third and fourth semester students of the ESPOCH Medicine degree It is an effective tool to improve learning in electrocardiogram interpretation. 90% of students consider that the use of this application will improve their theoretical-practical learning in relation to the Electrocardiogram.

Conclusions

The educational software fulfilled the use for which it was created as an educational tool, with principles of didactics, becoming more motivating when incorporating knowledge about electrocardiogram topics to Cardiology resident doctors in service.

Conflict of interests

The autors declare that does not exist an interest conflict.

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