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Artículos científicos

Desarrollo de un software educativo para la orientación- aprendizaje de la detección del cáncer cervicouterino

***Development of an Educational Software for the Orientation-Learning of
Cervical Cancer Detection***

***Desenvolvimento de um software educacional para o aprendizado de
orientação na detecção de câncer cervical***

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Resumen

El objetivo de este trabajo fue construir y evaluar la utilidad de un *software* educativo para la orientación-aprendizaje de la detección del cáncer cervicouterino que contempla aspectos psicopedagógicos. Metodológicamente, con la ayuda de especialistas en programación y docencia y con un enfoque cognitivista-constructivista, se desarrollaron varios prototipos evolutivos con refinamientos sucesivos, incluyendo en el *software* información acerca del cáncer cervicouterino, la toma de la muestra de citología cervical y la toma de muestra para la detección del virus del papiloma humano por captura de híbridos. Para la evaluación contextualizada, se presentó el *software* desarrollado a estudiantes de medicina, con un grupo control (A) y dos grupos experimentales (B y C). Al comparar los resultados antes y después de la intervención, se demostró la eficacia del producto en cuanto al logro de aprendizajes significativos.

Palabras clave: cáncer cervicouterino, cérvix, híbridos, software educativo, virus del papiloma humano.

Abstract

The objective of this work was to build and evaluate the usefulness of an educational software for the orientation-learning of cervical cancer detection that considers psycho-pedagogical aspects. Methodologically, with the help of programming and teaching specialists and with a cognitive-constructivist approach, several evolutionary prototypes were developed with successive refinements, including in the software information about cervical cancer, the taking of the cervical cytology sample and the taking of sample for detection of human papillomavirus by capture of hybrids. For contextualized evaluation, the software developed was presented to medical students, with a control group (A) and two experimental groups (B and C). By comparing the results before and after the intervention, the efficacy of the product in terms of achieving significant learning was demonstrated.

Keywords: cervical cancer, cervix, hybrids, educational software, human papillomavirus.

Resumo

O objetivo deste trabalho foi construir e avaliar a utilidade de um software educacional para o aprendizado-orientação da detecção do câncer de colo uterino que considera aspectos psicopedagógicos. Metodologicamente, com a ajuda de especialistas em programação e ensino e com uma abordagem cognitivo-constructivista, vários protótipos evolutivos foram desenvolvidos com aprimoramentos sucessivos, incluindo no software informações sobre câncer de colo uterino, a coleta da amostra de citologia cervical e a coleta de amostra para detecção de papilomavírus humano por captura de híbridos. Para avaliação contextualizada, o software desenvolvido foi apresentado aos estudantes de medicina, com um grupo controle (A) e dois grupos experimentais (B e C). Ao comparar os resultados antes e após a intervenção, foi demonstrada a eficácia do produto em termos de obtenção de aprendizado significativo.

Palavras-chave: câncer cervical, colo do útero, híbridos, software educacional, vírus do papiloma humano.



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Introduction

Pérez (2002) refers that "the generation, application, and integration of computer tools within our daily activities show that we find ourselves within new realities, which we cannot intend to cover analytically and conceptually with propositions from the past" (p. 177). Thus, at this point it is irrefutable that information and communication technologies (ICT) "are creating new environments for teaching and learning" (Pérez, 2002, p. 177). In clinical settings, for example, these new tools, virtual reality among them, have been used with favorable results for training potential users (Montana, Tuena, Serino, Ciproso and Riva, 2019). This new paradigm requires the construction of new educational models, such as the telematics model, which "provides advantages of integration, interactivity, flexibility and overcoming physical distances, which make it the most appropriate means to carry out various pedagogical actions, especially in continuous and distance training" (Pérez, 2002, p. 153).

Educational software is necessary due to the growing use of ICT in today's society, and the potential they have to support training processes. As part of these new paths, the teacher must develop dynamic, interactive curricular materials, with motivating content and easy for students to use (Olivar and Daza, 2007).

According to Peñalosa and Castañeda (2008), a knowledge generation model for learning on the Internet must be based on three main pillars:

- 1) the design of the learning environment and interactivity with the student in mind, as an active entity and protagonist in the process;
- 2) the incorporation of functions to promote the construction of knowledge; and
- 3) the incorporation of functions to promote self-regulated learning skills (p. 252).

Likewise, it is worth mentioning the warning of Pérez (2002), who, although he talks about telematics specifically, here it is extended to the general application of technology in the educational field, he mentions that regardless of the contributions that can be made derive from ICT in favor of educational improvement, as it is relatively new media, some of them still under development, "their implementation must be subject to certain controls that allow

an adequate assessment of not only their overall quality, but also its differential effect on other training options (p. 153).

For Núñez (2008), “new technologies play a fundamental role in the emergence of higher education networks” (p. 168). Romero (2010), for his part, adds that the dynamism that prevails today "requires a high level of competitiveness in terms of efficiency, efficacy and effectiveness" (p. 20).

Taking into account what has been described so far, the objective was to construct and evaluate the usefulness of an educational software for the orientation-learning of cervical cancer detection that includes psychopedagogical aspects. It is about developing a quality product that meets the needs of the user to whom it is directed (García, Vite, Navarrate, García y Torres, 2016).

Method

For the design and development of the software, evolutionary prototypes were made with successive refinements, integrating the classical representation instruments of the cognitivist-constructivist approach, building the educational tool from an integral aspect, with the contribution of different areas of knowledge, considering the pedagogical aspects in the life cycle with the participation of specialists in software design content. From this, it was possible to integrate the design of the contents with cognitive strategies and to properly structure the concepts, with a clear definition of the topic and the objectives so that the student can access knowledge through the proposed activities (Cataldi, 2000) . Thus, the evaluation proposal for each prototype was presented to 13 students of the third cycle of the Medical Surgeon degree (2014-1) of the Academic Division of Health Sciences of the Juárez Autonomous University of Tabasco (UJAT). Subsequently, the plan for incorporating the suggested modifications was followed, based on the assessment questionnaires (considering aspects of the communication interface and the content developed), where the degree of user compliance with an assessment scale was reflected for each item that ranged from one to five: 5 = Excellent, 4 = Very good, 3 = Good, 2 = Fair and 1 = Bad, which allowed obtaining a score of the aspects considered, and formulating or modifying those that have had score less than 2.5 (Cataldi, 2000). In addition, for the external evaluation, the program was presented to nine teachers and professionals related to public health.

For the development and evaluation of the software, an educational context was necessary, the environment for which the program was created, and thus achieve the so-called contextualized evaluation, since this type of evaluation is considered the most representative because it accounts for the reactions of the users. potential users between the program and, therefore, the effectiveness of the product (Cataldi, 2000). To achieve this purpose, the following criteria were considered: communication interface (Prototype v1 [version one]), contents and relevance (Prototype v2 [version two]), usefulness, pedagogical and didactic and technical (Prototype vfinal [final version]) .

At this point, it is worth taking a parenthesis and defining educational software, a task for which Cataldi (2000) is used, who raises it in the following way:

Computer programs made with the purpose of being used as facilitators of the teaching process and consequently of learning, with some particular characteristics such as: ease of use, interactivity and the possibility of customizing the speed of learning (p. 18).

Now, taking up the steps that were taken, the feasibility and life cycle of the software were determined from the perspective of cost-benefit, considering the needs of the educational program, and a model for the program was selected in accordance with the chosen learning theory (Cataldi, 2006). In this case, those responsible for each task were identified and, once this was done, the quality assurance and viability of the software was planned.

Knowing the type of program to be developed, the interface and interactivity requirements were defined, while the software requirements were developed, prioritizing and integrating the educational requirements. Regarding the stage of detailed design of the prototype, defined as the "verified specification of the control structure, the data structure, the interface relationships, the size, the basic algorithms and the assumptions of each component of the program" (Guzmán, Durley and López, 2014, p. 69); At this stage, we said, they were documented, according to Guzmán et al. (2014), "the algorithms that will carry out the function to be performed by each of the modules" (p. 69).

It should be noted that four attributes were taken into account for the software design: 1) the data structure, 2) the software architecture, 3) the procedural detail and 4) the characterization of the interface (Cataldi, 2000, p. 79). In addition to the life cycle stages, the implementation and module integration processes were observed in the final system design. Here the creation

of the test data, creating the source code, generating the object code, creating the operating documentation and planning the integration of the modules were considered (Cataldi, 2000). Likewise, it was considered appropriate to make interactive software with the following technologies: HTML5, JavaScript and jQuery. All of these technologies were used to make open applications. This choice allowed to run the software from a DVD and, at the same time, allowed the information to be migrated to an Internet portal, thanks to which more users could make use of the information (Romero, 2014).

At the end of the development of the educational software for the orientation-learning of cervical cancer detection, it was subjected to an evaluation by potential users, in order to verify the effectiveness of the product in terms of achieving significant learning. For convenience, three groups were selected to validate the understanding of the educational material: a control group, group A (23 students), and two experimental groups, B (25 students) and C (10 students). The participants belonged to the evening shift of the third cycle (2014) of the Medical Surgeon degree of the Academic Division of Health Sciences of the UJAT, Mexico. In group A, one member presented the topic, the others received the information. Some, like the group coordinator (teacher), asked questions and made comments on the topic of cervical cancer. Regarding group B, the class was similar to group A, except that here the teacher delivered the educational software for the orientation-learning of cervical cancer detection, whose list of topics, images and videos served as a study complement for this theme and others. In group C, the group coordinator told the participants to study the cervical cancer issue indicated in the Public Health course syllabus, and also gave them the educational software as an educational supplement.

The main topics of the educational software for the orientation-learning of cervical cancer detection are:

- Overview of cervical cancer.
- Cervical cytology.
- Taking a sample for the detection of human papillomavirus (HPV) by capturing hybrids.

Before and after the intervention, a questionnaire was applied to each group to verify the performance of the students. For the analysis, a comparison was made between variables or pretest and posttest groups. The probability ratio was calculated with its 95% confidence interval and a level of statistical significance of $p < 0.05$. Finally, the Epi-Info version 6.04d

program, developed by the Centers for Disease Control and Prevention in Atlanta, Georgia, was used.

Ethical considerations

For the recording of the video, there were professionals in videofilming, in addition to the volunteer subjects (students [evaluation of prototypes] and health professionals [external evaluation]) to whom the reason for the investigation was explained and they agreed to participate. For the filming of the procedures, taking the cervical cytology sample and taking the sample for the detection of HPV by capture of hybrids, after explanation, the participants were asked for signed written consent. Likewise, for the use of the necessary facilities and equipment, the respective consent was requested from the director of the health unit; in the same way, to the health professional who performed the procedures. The software developed was presented to the Bioethics Commission of the State of Tabasco, Mexico, which approved its relevance and usefulness for users.

Results

Design and development of educational software for the orientation-learning of cervical cancer detection

Evaluation of the communication interface. Prototype v1

For the evaluation of the Prototype v1, the participation of 13 students of the degree of Surgeon of the UJAT was counted on. The quantitative results are shown in table 1. In this prototype only a pre-design of the screen, the drop-down menu and the content tree were presented. Pictures, videos and sound were not uploaded yet.

Tabla 1. Plantilla de evaluación de la interfaz de comunicación de desarrollo del *software* educativo para la orientación-aprendizaje de la detección del cáncer cervicouterino.

Prototipo v1

Requisitos técnicos del <i>software</i> educativo	Estudiantes evaluadores del prototipo													
	1	2	3	4	5	6	7	8	9	10	11	12	13	Promedio
1) ¿Considera adecuado el diseño general de la pantalla?	3	3	4	2	3	3	4	2	2	4	4	3	4	3.2
2) ¿Considera adecuado el uso del menú?	5	5	5	5	5	3	4	3	3	3	5	3	5	4.2
3) ¿Considera adecuado el uso de los módulos?	4	5	5	5	5	3	4	5	4	5	4	4	5	4.5
4) ¿Considera adecuado el uso de los enlaces (hipervínculos)?	4	5	5	5	5	5	5	4	4	5	4	4	5	4.6
5) ¿Considera adecuado el uso de los colores?	4	5	3	5	5	4	4	4	4	4	5	3	5	4.2
6) ¿Considera adecuado el uso de los tipos de letras?	5	5	3	4	3	2	5	2	2	3	4	3	3	3.4
7) ¿Considera que el programa es interactivo?	1	4	4	2	4	2	4	2	1	3	4	2	3	2.8
8) ¿Considera la interfaz amigable?	5	4	5	3	4	4	3	2	2	4	4	4	5	3.8
9) ¿Le da buena información acerca del recorrido?	5	4	5	5	5	4	4	3	5	4	4	4	5	4.4
10) ¿Considera criteriosa la secuenciación de los Módulos?	5	5	4	2	5	3	4	3	3	4	5	4	4	3.9
11) ¿Es de fácil manejo?	5	5	4	4	5	4	4	4	5	4	5	4	5	4.5
12) ¿Ha despertado interés en usted?	4	5	5	4	5	3	4	3	2	3	5	3	5	3.9
13) Sugerencias de cambio (1=Sí, 2=No)	1	1	1	1	1	1	1	1	1	1	1	1	1	
Sugerencias de cambio														
1) Colocar un menú de inicio, y colocar un botón para regresar a menú de inicio.														
2) Anexar foro de preguntas.														
3) Cambiar el tipo de letra y el color para que no se combine con el fondo y resaltar más las letras de los encabezados.														
4) Colocar páginas interactivas, videos o vínculos.														
5) Agregar imágenes al diseño y texto.														
6) Corregir las letras que presentan diéresis.														
7) Incluir un método para seguir las actualizaciones.														
8) La bienvenida debería ser más llamativa (imágenes, video).														
9) Suscripción con correo electrónico.														
10) Es necesario mejor configuración.														
11) El color crema está un poco simple, requiere un poco más de atención.														
12) Pasar el contacto al final.														
13) Colocar idiomas.														
14) Colocar un blog.														

Nota: Calificación del 1 al 5: 5 = Excelente, 4 = Muy bueno, 3 = Bueno, 2 = Regular, 1 = Malo)

Fuente: Elaboración propia

The quantitative results of the screen design appeared adequate. The students asked to improve the colors used and the types of letters (size, color). In addition, the interactivity of the program had to be improved: it was made more dynamic through images and videos. The interface seemed easy to navigate and the sequencing of the screens was generally considered good and user-friendly. In general, there was interest in observing the improvements of the following prototype of the program, with the new functionalities incorporated. The relevant change suggestions were basically to change the font and color so that it does not blend with the background and make the letters in the headers more prominent, improve the start menu, and place a button to return to the start menu, which the program is interactive, with images and videos, contact by email and that the welcome is more attractive.

Evaluation of contents and relevance. Prototype v2

Based on the weighted questions and the suggestions made, the next incremental prototype was passed. The images, some videos and information about cervical cancer, the taking of the cervical cytology sample and the taking of the sample for the detection of HPV by capture of hybrids were included. Now you could have a much closer idea of what the finished program would be like. In this case, the questions about the communication interface were few; Rather, they focused on aspects related to content and its relevance, with a lot of emphasis on its presentation, structuring and adaptation to the needs of the group. Table 2 describes the results obtained with the weights and the students' suggestions. In general terms, they considered the development of this stage of the program very good, referring to the selection of contents. There was positive acceptance regarding the changes suggested in the first prototype: they were satisfied with the interactivity, with the program as a tutorial, with the good resolution of the videos; although, they suggested, it would be even better with the inclusion of sound. Regarding the rest of the suggestions, perhaps the most relevant is that the finished program present images in the texts, improve the introduction of the videos, as well as the hyperlinks in the texts, as necessary.

Tabla 2. Evaluación de contenidos y pertinencia de desarrollo del *software* educativo para la orientación-aprendizaje de la detección del cáncer cervicouterino. Prototipo v2

Contenidos y pertinencia del software educativo	Estudiantes evaluadores del prototipo													
	1	2	3	4	5	6	7	8	9	10	11	12	13	Promedio
1) ¿Considera adecuado la selección de los contenidos?	4	5	5	4	5	5	5	5	5	4	5	4	5	4.7
2) ¿Consideraría adecuado el uso del programa terminado en otros niveles?	5	5	5	5	5	5	4	5	5	4	5	4	4	4.7
3) ¿Los cambios realizados fueron pertinentes?	3	5	5	2	5	4	5	5	5	4	5	3	4	4.2
4) ¿Quisiera que el programa fuera un tutorial?	2	5	5	5	5	5	4	5	5	4	5	4	3	4.4
5) ¿Le facilita la comprensión acerca del tema?	5	5	5	3	5	5	4	5	5	4	5	4	4	4.5
6) ¿Le gustaría que los videos tuvieran sonido?	5	5	5	5	5	5	5	5	4	5	5	5	3	4.8
7) Sugerencias de cambio (1 = Sí, 2 = No)	1	1	1	1	2	1	1	2	1	1	2	1	1	
Sugerencias de cambio														
1) Colocar imágenes en temas. 2) Colocar video en el menú principal. 3) Agregar un efecto a la introducción del video y mejorar la velocidad en la presentación. 4) Mejorar la resolución del video. 5) Mejorar el hipervínculo explicativo de las imágenes. 6) Corregir las faltas ortografía. 7) Incluir resumen. 8) Anexar para impresión. 9) Valorar la inclusión del glosario. 10) Cambiar el color del fondo a otro más atractivo.														

Nota: Calificación del 1 al 5: 5 = Excelente, 4 = Muy bueno, 3 = Bueno, 2 = Regular, 1 = Malo)

Fuente: Elaboración propia

Final Prototype Evaluation

A spreadsheet was prepared with questions relevant to different criteria, based on utility, pedagogical and didactic aspects, as well as technical ones. The questions were weighted as in the previous sections.

Finally, some suggestions were requested from the users through an open item, either for the use of the program or to make any changes that are considered pertinent. The results obtained are observed in table 3. In general, from the evaluation of the program, there was acceptance and agreement regarding the changes produced in the previous stages; The

comments validated the ease of use, the significant improvement in content and navigation, which, in short, motivated users by the current needs of learning the topic in question. Due to the description of the themes, the dynamism and interactivity, it was necessary to move the bars of the software.

Tabla 3. Evaluación de desarrollo del *software* educativo para la orientación-aprendizaje de la detección del cáncer cervicouterino. Prototipo vfinal

	Aspecto	Estudiantes evaluadores del prototipo													
		1	2	3	4	5	6	7	8	9	10	11	12	13	Promedio
Utilidad	1) Facilidad de uso	5	5	5	5	5	4	5	5	5	5	5	5	4	4.8
	2) Grado de adaptación a otros niveles de usuarios	4	5	4	4	5	4	4	5	5	5	5	4	4	4.5
Pedagógicos y didácticos	3) Claridad de contenidos	5	5	5	5	5	4	5	4	5	5	5	5	4	4.8
	4) Nivel de actualización	4	5	5	4	5	5	5	4	5	5	5	5	4	4.7
	5) Interfaz de navegación	5	5	4	5	5	5	5	5	5	5	5	4	5	4.8
	6) Nivel de motivación	4	5	5	5	5	4	4	5	4	5	5	5	5	4.7
	7) ¿Es adecuado para la comprensión del tema?	5	5	5	5	5	5	5	5	5	5	5	5	4	4.9
	8) ¿Es adecuado para el aprendizaje del tema?	5	5	5	5	5	5	5	5	5	5	5	5	5	5.0
Técnico	9) Documentación y ayudas	5	5	5	5	5	4	4	5	4	5	5	4	5	4.7
	10) ¿Son adecuados los recursos que necesita?	4	5	5	5	5	4	4	4	5	5	5	4	5	4.6
Sugerencias	11) Sugerencias de cambio (1 = Sí, 2 = No)	2	2	2	2	2	2	1	2	2	2	2	2	2	
Sugerencias de cambio															
1) Que en la parte de la información no haya necesidad de mover la barra, que sea fija.															

Nota: Calificación del 1 al 5: 5 = Excelente, 4 = Muy bueno, 3 = Bueno, 2 = Regular, 1 = Malo)

Fuente: Elaboración propia

Internal evaluation

Sometimes it is difficult to get out of the traditional when developing this type of program. The group that worked on the development of the program agreed with the changes proposed by the students. In addition, the suggestions received were considered relevant.

External evaluation

The program was presented to nine teachers and professionals linked to public health, who had specialty and master's degrees in the area and who, when exploring the educational software for orientation-learning of cervical cancer detection, considered it a tool interesting to deepen the knowledge about cervical cancer. In addition, participating teachers and professionals were provided with a form similar to the previous ones, with closed and open questions, and were asked to respond based on what was observed in the finished product.

The quantitative results can be seen in table 4. Regarding the recommendations, one suggested improving the sound of the voice, others the need to place more images, videos and less load on the contents, in order to have an even friendlier design , interactive and attractive.

Tabla 4. Evaluación externa del producto final

Requisitos técnicos, utilidad, aspectos pedagógicos y didácticos del software educativo	Docentes y profesionales vinculados con la salud pública									
	1	2	3	4	5	6	7	8	9	Promedio
1) ¿Considera adecuado el diseño general de la pantalla?	4	5	2	3	4	4	1	4	5	3.6
2) ¿Considera adecuado el uso de las ventanas?	5	5	3	3	5	4	2	4	4	3.9
3) ¿Considera adecuado el uso de los botones?	5	5	5	3	4	4	3	4	5	4.2
4) ¿Considera adecuado el uso de los colores?	5	5	4	4	5	4	2	4	4	4.1
5) ¿Considera adecuado el uso de los tipos de letras?	4	5	1	3	5	4	2	4	4	3.6
6) ¿Considera que el programa es interactivo?	5	5	1	3	5	4	2	4	5	3.8
7) ¿Considera la interfaz amigable?	5	5	2	3	5	4	2	4	5	3.9
8) ¿Le da buena información acerca del recorrido?	5	5	5	3	4	4	3	4	4	4.1
9) ¿Considera criteriosa la secuenciación de las pantallas?	4	5	5	3	3	4	2	4	3	3.7
10) ¿Es de fácil manejo?	5	5	4	3	5	5	3	4	5	4.3
11) ¿Considera que el uso de los íconos es correcto?	5	5	2	3	5	5	2	4	5	4.0
12) ¿Considera adecuada la selección de los contenidos?	4	5	4	4	5	5	4	4	5	4.4
13) ¿Consideraría adecuado el uso del programa terminado en otros niveles?	5	5	3	3	4	4	3	3	5	3.9
14) ¿Quisiera que el programa fuera un tutorial?	5	5	3	3	5	5	2	4	5	4.1
15) ¿Le facilita la comprensión acerca del tema?	5	5	5	4	5	5	3	5	5	4.7
16) ¿Le gustaría que los videos tuvieran sonido?	3	5	3	3	4	5	2	3	5	3.7
17) ¿Ha despertado interés en usted?	5	5	3	3	5	5	2	5	5	4.2
18) Sugerencias de cambio (1 = Sí, 2 = No)	1	2	1	1	2	2	1	1	2	
Sugerencias de cambio										
1) El sonido de la voz durante los videos no es muy clara. 2) Está muy plano el diseño. 3) Apoyo con imágenes. 4) Poner más videos. 5) Diseño más amigable, interactivo, atractivo. 6) Menos carga en los contenidos. 7) Mejorar la técnica del Papanicolaou y VPH.										

Nota: Calificación del 1 al 5: 5 = Excelente, 4 = Muy bueno, 3 = Bueno, 2 = Regular, 1 = Malo)

Fuente: Elaboración propia

Contextualized evaluation of educational software for the orientation-learning of cervical cancer detection

Next, the results of the intervention are described, in which the educational software for the orientation-learning of cervical cancer detection was presented to medical students to account for the efficacy of the product in terms of achieving significant learning.

Group A (traditional class)

In this group, one member of the group presented the topic, the others received the information. Some, like the group coordinator (teacher), asked questions and made comments on the topic of cervical cancer.

From the results, regarding the generalities of cervical cancer (Table 5), it is noteworthy that only the item "What is the age group most affected by cervical cancer in Mexico?" In the X² test it gave a value of 5.58, a measure of association strength (OR) of 4.29 (95% CI = 1.25-14.74) and a $p < 0.05$ with a statistically significant difference; In the other items, no statistically significant differences were found. When averaging the proportion of this group of variables, the percentage difference was observed with a slight increase in knowledge (6.38%) after the intervention.

Tabla 5. Determinación de los estudiantes con respuestas correctas de las generalidades del cáncer cervicouterino. Encuesta *pretest* y *postest* clase tradicional

Preguntas del tema. Generalidades	Pretest (n=23)	%	Postest (n=23)	%	X ²	RM	IC 95 %	P	Prueba exacta de Fisher
¿Qué es el cáncer cervicouterino?	13	56.52	14	60.87	0.00	0.98	0.31-3.07	0.971	–
¿Cuál es el principal factor de riesgo del cáncer cervicouterino?	23	100.00	23	100.00	–	–	–	–	–
¿A qué edad comúnmente las mujeres se infectan con el VPH?	16	69.57	16	69.57	0.00	1.00	0.28-3.51	1.000	–
¿Cuál es el grupo de edad más afectado por cáncer cervicouterino en México?	7	30.43	15	65.22	5.58	4.29	1.25-14.74	0.018	–
Dentro de las muertes por neoplasia en mujeres en México, ¿qué lugar ocupa el cáncer cervicouterino?	7	30.43	13	56.52	3.18	2.97	0.88-9.98	0.074	–
¿Qué es la citología cervical?	8	34.78	4	17.39	–	0.39	0.10-1.57	–	0.3140
¿Quién confirma el diagnóstico citológico de una probable lesión cervical?	12	52.17	10	43.48	0.35	0.71	0.22-2.25	0.555	–
En México, ¿cuál es la norma oficial que se refiere a la prevención, detección, diagnóstico, tratamiento, control y vigilancia epidemiológica del cáncer cervicouterino?	8	34.78	5	21.74	0.97	0.52	0.14-1.93	0.326	–
Promedio		51.09		54.35					

Fuente: Elaboración propia

In relation to the determination of students with correct answers on cervical cytology (Table 6), the items in this section with the high association measure resulted: "When is it contraindicated to take cervical cytology?" (an MR of 2.35, not statistically significant) and "If the user is hysterectomized, where will she take the Pap smear?" (with an OR of 5.13 (95% CI = 1.18-22.24) and a p <0.05 with a statistically significant difference. In the other items,

no statistically significant differences were found. When averaging the proportion of this group of variables, the difference was observed percentage with a slight increase in knowledge of 16.67% after the intervention.

Tabla 6. Determinación de los estudiantes con respuestas correctas sobre la citología cervical. Encuesta pretest y postest. Clase tradicional

Preguntas del tema citología cervical	Pretest (n=23)	%	Postest (n=23)	%	X ²	RM	IC 95 %	P	Prueba exacta de Fisher
¿Cuáles son los factores de riesgo del cáncer cervicouterino?	12	52.17	15	65.22	0.3	1.38	0.44-4.32	0.585	–
¿Cuándo está contraindicado tomar la citología cervical?	17	73.91	20	86.96	–	2.35	0.51-10.86	–	0.4590
Para la prueba de Papanicolaou, ¿de dónde se toma la muestra de células?	7	30.43	10	43.48	0.84	1.76	0.52-5.91	0.3594	–
¿En dónde se deben registrar los datos completos de la usuaria para la prueba de Papanicolaou?	15	65.22	14	60.87	0.09	0.83	0.25-2.75	0.760	–
¿Qué datos de identificación se deben anotar en la laminilla?	21	91.30	18	78.26	–	0.34	0.06-1.99	–	0.4140
Si la usuaria está hysterectomizada, ¿de dónde tomará la muestra de Papanicolaou?	3	13.04	10	43.48	–	5.13	1.18-22.24	–	0.0471
¿En qué tiempo se debe realizar la inmersión de la muestra citológica cervical en alcohol de 96°?	15	65.22	18	78.26	0.97	1.92	0.52-7.12	0.3259	–
Promedio		55.90		65.22					

Fuente: Elaboración propia

Regarding the determination of the students with correct answers in the section dedicated to taking the sample for the detection of HPV by capture of hybrids (Table 7), the items in this section did not show statistically significant differences, although the item “¿¿

Where should you insert the brush and at what depth to collect the hybrid capture HPV DNA sample? " it resulted with an MR of 4.59. By averaging the proportion of this group of variables, the percentage difference of 9.19% of increase in knowledge after the intervention was observed.

Tabla 7. Determinación de los estudiantes con respuestas correctas sobre la toma de la muestra para la detección del VPH por captura de híbridos. Encuesta pretest y postest.

Clase tradicional

Preguntas sobre la toma de la muestra para la detección del VPH por captura de híbridos	Pretest (n=23)	%	Postest (n=23)	%	X ²	RM	IC 95 %	P	Prueba exacta de Fisher
¿Cuáles son los requisitos para poder realizar la toma de muestra de detección del ADN del VPH?	16	69.57	16	69.57	0.00	1.00	0.28-3.51	1.000	–
¿En dónde se registran los datos de la usuaria para poder realizar la toma de muestra de detección del ADN del VPH?	16	69.57	16	69.57	0.00	1.00	0.28-3.51	1.000	–
¿En dónde se recolecta la muestra de la detección del ADN del VPH por captura de híbridos?	11	47.83	14	60.87	0.79	1.7	0.53-5.47	0.3745	–
¿En dónde debe insertar el cepillo y a que profundidad para la toma de la muestra de ADN del VPH por captura de híbridos?	16	69.57	21	91.30	–	4.59	0.84-25.17	–	0.1345
¿A qué temperatura deben conservarse el kit con la muestra?	17	73.91	16	69.57	0.11	0.81	0.22-2.92	0.7433	–
Promedio		66.09		72.17					

Fuente: Elaboración propia

In general, in this group, regarding the general aspects of cervical cancer, cervical cytology and taking the sample for the detection of HPV, averaging their proportions resulted in the pretest survey with 56.52% and 62.61% in the posttest survey. When obtaining the percentage difference, a 10.77% increase in knowledge was observed after the intervention.

Group B (traditional class and use of educational software for the orientation-learning of cervical cancer detection)

In this group, one member presented the topic, the others received the information. Some, like the group coordinator (teacher), asked and made some comments in relation to cervical cancer. In addition, the professor gave the students the educational software for the orientation-learning of cervical cancer detection so that they could study and observe the topics, images and videos as a complement to the topic.

Regarding the results of the pretest and posttest survey regarding the general aspects of cervical cancer (Table 8), the item "What is cervical cytology?", In the X² test, yielded a value of 8.01, an MRI of 5.46 (95% CI = 1.63-18.36) and a p <0.05 with a statistically significant difference. "In Mexico, what is the official norm that refers to the prevention, detection, diagnosis, treatment, control and epidemiological surveillance of cervical cancer?", It showed a X² of 5.13, an OR of 3.78 (95% CI = 1.17- 12.19) and a p <0.05 with a statistically significant difference. In the other items, no statistically significant differences were found. When averaging the proportion of this group of variables, the percentage difference of 12.70% increase in knowledge after the intervention was observed.

Tabla 8. Determinación de los estudiantes con respuestas correctas de las generalidades del cáncer cervicouterino. Encuesta pretest y postest. Clase tradicional utilizando la herramienta desarrollada

Preguntas del tema. Generalidades	Pretest (n=25)	%	Postest (n=25)	%	X ²	RM	IC 95 %	P	Prueba exacta de Fisher
¿Qué es el cáncer cervicouterino?	18	72.00	16	64.00	0.37	0.69	0.21-2.29	0.5442	–
¿Cuál es el principal factor de riesgo del cáncer cervicouterino?	24	96.00	25	100.00	–	–	–	–	1.0000
¿A qué edad comúnmente las mujeres se infectan con el VPH?	22	88.00	19	76.00	–	0.43	0.09-1.97	–	0.4634
¿Cuál es el grupo de edad más afectado por cáncer cervicouterino en México?	13	52.00	11	44.00	0.32	0.73	0.24-2.21	0.5713	–
Dentro de las muertes por neoplasia en mujeres en México, ¿qué lugar ocupa el cáncer cervicouterino?	15	60.00	16	64.00	0.08	1.19	0.38-3.72	0.7707	–
¿Qué es la citología cervical?	8	32.00	18	72.00	8.01	5.46	1.63-18.36	0.0046	–
¿Quién confirma el diagnóstico citológico de una probable lesión cervical?	17	68.00	20	80.00	0.94	1.88	0.52-6.84	0.3334	–
En México, ¿cuál es la norma oficial que se refiere a la prevención, detección, diagnóstico, tratamiento, control y vigilancia epidemiológica del cáncer cervicouterino?	9	36.00	17	68.00	5.13	3.78	1.17-12.19	0.0235	–
Promedio		63.00		71.00					

Fuente: Elaboración propia

Regarding the determination of the students with correct answers on cervical cytology (Table 9), the items that were statistically significant are the following: "What are the risk factors for cervical cancer?" It resulted with a X² of 3.95, an OR of 3.19 (95% CI = 1.00-10.17) and a p <0.05 with a statistically significant difference. "For the Papanicolaou test,

where is the cell sample taken from?", The X2 resulted with 6.88, an OR of 5.09 (95% CI = 1.45-17.92) and a $p < 0.05$ with a statistically significant difference. For its part, "Where should the complete data of the user be recorded for the Pap test?", This relationship is statistically significant (Fisher's exact test $p = 0.0046$), an OR of 16.00 (95% CI = 1.86 - 137.98). Regarding the item "If the user has been hysterectomized, where will the Pap smear be taken from?", The Fisher's exact test yielded $p = 0.0374$, an OR of 6.47 (95% CI = 1.23-34.01) with statistically significant difference. In the other items, no statistically significant differences were found. When averaging the proportion of this group of variables, a 53.84% increase in knowledge was observed after the intervention.

Tabla 9. Determinación de los estudiantes con respuestas correctas sobre la citología cervical. Encuesta pretest y postest. Clase tradicional utilizando la herramienta desarrollada

Preguntas del tema citología cervical	Pretest (n=25)	%	Postest (n=25)	%	X ²	RM	IC 95 %	P	Prueba exacta de Fisher
¿Cuáles son los factores de riesgo del cáncer cervicouterino?	10	40.00	17	68.00	3.95	3.19	1.00-10.17	0.0470	—
¿Cuándo está contraindicado tomar la citología cervical?	16	64.00	21	84.00	—	2.95	0.77-11.34	—	0.1963
Para la prueba de Papanicolaou, ¿de dónde se toma la muestra de células?	5	20.00	14	56.00	6.88	5.09	1.45-17.92	0.0087	—
¿En dónde se deben registrar los datos completos de la usuaria para la prueba de Papanicolaou?	15	60.00	24	96.00	—	16.00	1.86-137.98	—	0.0046
¿Qué datos de identificación se deben anotar en la laminilla?	16	64.00	17	68.00	0.09	1.20	0.37-3.86	0.7652	—
Si la usuaria está hysterectomizada, ¿de dónde tomará la muestra de Papanicolaou?	2	8.00	9	36.00	—	6.47	1.23-34.01	—	0.0374
¿En qué tiempo se debe realizar la inmersión de la muestra de citológica cervical en alcohol de 96°?	14	56.00	18	72.00	1.39	2.02	0.62-6.56	0.2385	—
Promedio		44.57		68.57					

Fuente: Elaboración propia

Regarding the determination of the students with correct answers regarding the taking of the sample for the detection of HPV by capture of hybrids (Table 10), in the items of this section no statistically significant differences were found; However, the item "Where is the user's data recorded to be able to take the HPV DNA detection sample?", resulted in an MR

of 2.30. When averaging the proportion of this group of variables, a 13.33% increase in knowledge was observed after the intervention.

Tabla 10. Determinación de los estudiantes con respuestas correctas sobre la toma de la muestra para la detección del VPH por captura de híbridos. Encuesta pretest y postest. Clase tradicional utilizando la herramienta desarrollada.

Preguntas sobre la toma de la muestra para la detección del VPH por captura de híbridos	Pretest (n=25)	%	Postest (n=25)	%	X ²	RM	IC 95 %	P	Prueba exacta de Fisher
¿Cuáles son los requisitos para poder realizar la toma de muestra de detección del ADN del VPH?	11	44.00	15	60.00	1.28	1.91	0.62-5.88	0.2575	—
¿En dónde se registran los datos de la usuaria para poder realizar la toma de muestra de detección del ADN del VPH?	12	48.00	17	68.00	2.05	2.30	0.73-7.27	0.1519	—
¿En dónde se recolecta la muestra de la detección del ADN del VPH por captura de híbridos?	19	76.00	16	64.00	0.86	0.56	0.16-1.92	0.3570	—
¿En dónde debe insertar el cepillo y a qué profundidad para la toma de la muestra de ADN del VPH por captura de híbridos?	19	76.00	21	84.00	—	1.66	0.41-6.79	—	0.7252
¿A qué temperatura deben conservarse los kit con la muestra?	14	56.00	16	64.00	0.33	1.4	0.45-4.35	0.5637	—
Promedio		60.00		68.00					

Fuente: Elaboración propia

In general, when averaging the proportions of this group, the pretest survey resulted with 55.8%, while 69.4% was observed in the posttest survey. As can be seen, there is a percentage difference and a 24.37% increase in knowledge after the intervention.

Group C (use of educational software for orientation-learning of cervical cancer detection)

In this group, the group coordinator told the students to study the topic of cervical cancer indicated in the Public Health course syllabus. In addition, the professor gave them the educational software for the orientation-learning of cervical cancer detection for the study of the subject, so they should review the topics, images, videos, among others, of the software.

The results of the pretest and posttest generalities of cervical cancer of the items with correct answers (table 11) that resulted with considerable association were: "At what age are women commonly infected with HPV?" (RM 1.56), "Among the deaths due to neoplasia in women in Mexico, what place does cervical cancer occupy?" (RM 2.67), "What is cervical cytology?" (RM 9.0), "Who confirms the cytological diagnosis of a probable cervical lesion?" (RM of 1.7) and "In Mexico, what is the official norm that refers to the prevention, detection, diagnosis, treatment, control and epidemiological surveillance of cervical cancer?" (RM of 9.0), which suggests the effectiveness of the software in increasing knowledge, although no item was statistically significant. When averaging the proportion of this group of variables, the percentage difference resulted in a 21.74% increase in knowledge after the intervention.

Tabla 11. Determinación de los estudiantes con respuestas correctas respecto a las generalidades del cáncer cervicouterino. Encuesta pretest y postest. Se utilizó la herramienta desarrollada

Preguntas del tema. Generalidades	Pretest (n=10)	%	Postest (n=10)	%	X ²	RM	IC 95 %	P	Prueba exacta de Fisher
¿Qué es el cáncer cervicouterino?	10	100.00	8	80.00	–	–	–	–	0.4736
¿Cuál es el principal factor de riesgo del cáncer cervicouterino?	10	100.00	10	100.00	–	–	–	–	–
¿A qué edad comúnmente las mujeres se infectan con el VPH?	6	60.00	7	70.00	–	1.56	0.24 - 9.91	–	1.0000
¿Cuál es el grupo de edad más afectado por cáncer cervicouterino en México?	5	50.00	5	50.00	0.00	1.00	0.17 - 5.77	1.0000	–
Dentro de las muertes por neoplasia en mujeres en México, ¿qué lugar ocupa el cáncer cervicouterino?	6	60.00	8	80.00	–	2.67	0.36 - 19.71	–	0.6284
¿Qué es la citología cervical?	1	10.00	5	50.00	–	9.00	0.81 - 100.14	–	0.1408
¿Quién confirma el diagnóstico citológico de una probable lesión cervical?	7	70.00	8	80.00	–	1.71	0.22 - 13.41	–	1.0000
En México, ¿cuál es la norma oficial que se refiere a la prevención, detección, diagnóstico, tratamiento, control y vigilancia epidemiológica del cáncer cervicouterino?	1	10.00	5	50.00	–	9.00	0.81 - 100.14	–	0.1408
Promedio		57.50		70.00					

Fuente: Elaboración propia

In relation to the correct answers on cervical cytology (Table 12), the items that resulted with the measure of strength of association high, but not statistically significant, are the following: "What are the risk factors for cervical cancer?" (RM of 3.50), "For the Pap

test, where is the cell sample taken from" (OR of 2.3), "Where should the complete data of the user be recorded for the Pap test?" (RM 6.0) and "In what time should the cervical cytological sample be immersed in 96o alcohol?" (RM 2.67). When averaging the proportion of this group of variables, the percentage difference of 47.07% increase in knowledge after the intervention was observed.

Tabla 12. Determinación de los estudiantes con respuestas correctas sobre la citología cervical. Encuesta pretest y postest. Se utilizó la herramienta desarrollada

Preguntas del tema de citología cervical	Pretest (n=10)	%	Postest (n=10)	%	X ²	RM	IC 95 %	P	Prueba exacta de Fisher
¿Cuáles son los factores de riesgo del cáncer cervicouterino?	4	40.00	7	70.00	—	3.50	0.55 - 22.30	—	0.3698
¿Cuándo está contraindicado tomar la citología cervical?	7	70.00	10	100.00	—	—	—	—	0.2105
Para la prueba de Papanicolaou, ¿de dónde se toma la muestra de células?	1	10.00	2	20.00	—	2.25	0.17 - 29.77	—	1.0000
¿En dónde se deben registrar los datos completos de la usuaria para la prueba de Papanicolaou?	6	60.00	9	90.00	—	6.00	0.53 - 67.65	—	0.3034
¿Qué datos de identificación se deben anotar en la laminilla?	10	100.00	8	80.00	—	—	—	—	0.4736
Si la usuaria está hysterectomizada, ¿de donde se tomará la muestra de Papanicolaou?	0	0.00	6	60.00	—	—	—	—	0.0108
¿En qué tiempo se debe realizar la inmersión de la muestra citológica cervical en alcohol de 96°?	6	60.00	8	80.00	—	2.67	0.36 - 19.71	—	0.6284
Promedio		48.57		71.43					

Fuente: Elaboración propia

Regarding the determination of the students with correct answers related to the taking of the sample for the detection of HPV by capture of hybrids (Table 13), the items in this section that resulted with the high association measure are the following: “¿ Where should the brush be inserted and at what depth to take the HPV DNA sample by hybrid capture ”(RM of 3.86) and“ At what temperature should the kit with the sample be stored? ” (RM of 3.50),

although no statistically significant differences were found. By averaging the proportion of this group of variables, a percentage difference of 24.13% of increase in knowledge after the intervention was observed.

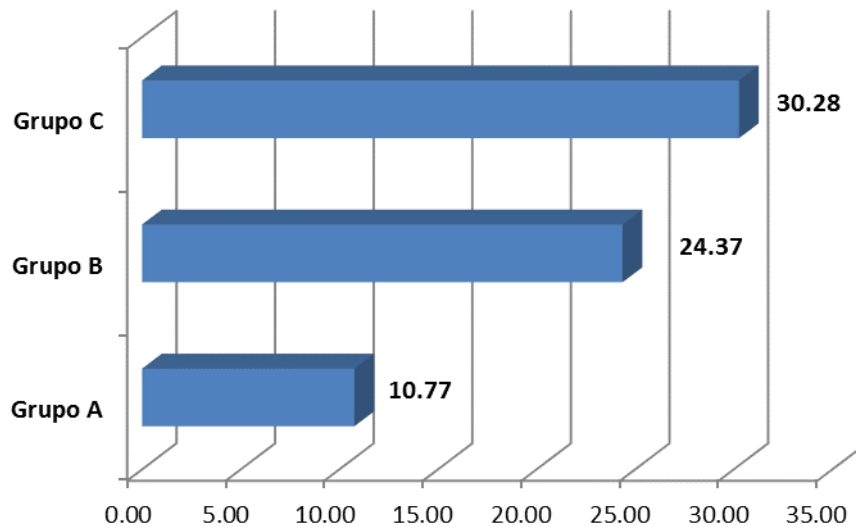
Tabla 13. Determinación de los estudiantes con respuestas correctas respecto a la muestra para la detección del VPH por captura de híbridos. Encuesta pretest y postest clase tradicional. Se utilizó la herramienta desarrollada

Preguntas sobre la toma de la muestra para la detección del VPH por captura de híbridos	Pretest (n=10)	%	Postest (n=10)	%	X ²	RM	IC 95 %	P	Prueba exacta de Fisher
¿Cuáles son los requisitos para poder realizar la toma de muestra de detección del ADN del VPH?	8	80.00	8	80.00	—	1.00	0.11 - 8.95	—	1.4179
¿En dónde se registran los datos de la usuaria para poder realizar la toma de muestra de detección del ADN del VPH?	6	60.00	7	70.00	—	1.56	0.24 - 9.91	—	1.0000
¿En dónde se recolecta la muestra de la detección del ADN del VPH por captura de híbridos?	4	40.00	5	50.00	—	1.50	0.26 - 8.82	—	1.0000
¿En dónde debe insertar el cepillo y a qué profundidad para la toma de la muestra de ADN del VPH por captura de híbridos?	7	70.00	9	90.00	—	3.86	0.33 - 45.57	—	0.5820
¿A qué temperatura deben conservarse el kit con la muestra?	4	40.00	7	70.00	—	3.50	0.55 - 22.30	—	0.3698
Promedio		58.00		72.00					

Fuente: Elaboración propia

In general, in this group, when averaging the total of their proportions, the pretest survey yielded 54.5% and the posttest survey 71%. There was a 30.28% increase in knowledge after the intervention (Figure 1).

Figura 1. Incremento porcentual del conocimiento observado por grupo de estudio, en la encuesta pretest y postest.



Fuente: Elaboración propia

From what is observed in figure 1, the hypothesis is explicitly corroborated, since the number of students in group B obtained a score equal to or greater than 60%, with an OR of 7.88 (95% CI = 2.07-29.94) and a $p < 0.05$ with a statistically significant difference. Similarly, when analyzing students with a score equal to or greater than 70%, an OR of 20.44 was obtained (95% CI = 3.89-107.50) and a $p < 0.05$ with a statistically significant difference (Table 14).

In relation to the statistical analysis of group C, where only the educational software for the orientation-learning of cervical cancer detection was experimented, even better data were obtained in the score of the students with results equal to or greater than 60% , an OR of 9.33 (95% CI = 1.19 - 72.99) and a $p < 0.05$ with a statistically significant difference. Likewise, the students in this group with a score equal to or greater than 70% gave a 0.0162 in Fisher's exact test (table 14).

Regarding group A (control group), only the MRI stood out (2.49), which was not statistically significant in students with a score equal to or greater than 60%; X2 (2.24) in the analysis of this group did not show statistical difference (table 14).

Tabla 14. Determinación de los estudiantes con 60 % y 70 % de puntuación en la evaluación pretest y postest

Grupo A (clase tradicional)	Pretest (n=23)	%	Postest (n=23)	%	X²	RM	IC 95 %	P	Prueba exacta de Fisher
Puntuación ≥ 60%	11	47.83	16	69.57	2.24	2.49	0.75-8.34	0.134	–
Puntuación ≥ 70%	5	21.74	6	26.09	0.12	1.27	0.33-4.95	0.73	–
Grupo B (clase tradicional y utilización de la herramienta desarrollada)	Pretest (n=25)	%	Postest (n=25)	%	X²	RM	IC 95%	P	Prueba exacta de Fisher
Puntuación ≥ 60 %	10	40.00	21	84.00	10.27	7.88	2.07-29.94	0.001	0.0015
Puntuación ≥ 70 %	2	8.00	16	64.00	17.01	20.44	3.89-107.50	0.0000	0.0000
Grupo C (utilización de la herramienta desarrollada)	Pretest (n=10)	%	Postest (n=10)	%	X²	RM	IC 95%	P	Prueba exacta de Fisher
Puntuación ≥ 60 %	3	30.00	8	80.00	5.05	9.33	1.19-72.99	0.0246	0.0348
Puntuación ≥ 70 %	0	0.00	5	50.00	–	–	–	–	0.0162

Fuente: Elaboración propia

Discussion

Educational software carried out methodically and with pedagogical quality criteria is one of the pillars on which the distance education system is sustained (Cataldi, 2006). In addition to being easy to use, it keeps the student interested and motivated; Due to its pedagogical approach, it is of curricular relevance, and an excellent learning material; Due to the organization and structuring of the contents and the fact that it has a cognitivist, constructivist and connectivist approach, it allows students to learn and even assess themselves. Naturally, faced with this last variable, emphasis should be placed on the student's participation in the learning assessment processes (Núñez, 2008). The aforementioned must be incorporated by electronic means, carried out by an interdisciplinary, multidisciplinary team, and thus be able to take students with a certain profile to carry out meaningful learning activities (Beauchemin, 2009).

The relevance of this work revolves around the fact that today we constitute a new social structure where the changes that accompany technological resources prevail. In such terms, the telematic resource and the management of multiple resources are a useful tool for the student to consolidate and achieve new learning in accordance with their expectations. Although, a software or a digital platform is not a substitute for the teacher or the school.

The generation of knowledge using software as a tool for learning cervical cancer was based on the design of the learning environment and interactivity, thinking of the student as an active entity and protagonist in the process; in the incorporation of functions to promote the construction of knowledge and the incorporation of functions to promote self-regulated learning skills; in aiming with due importance towards the pedagogical elements related to computer and telematic elements necessary in the use of ICT as a tool for learning.

The experience of this research makes clear the relevance of collaborative work. In this sense, the ability of the actors involved in the creation of the educational program was crucial (Cataldi, 2000). In addition to linking the areas of knowledge, for this type of educational projects the training and conformation of development teams is essential. The process was not without difficult moments, especially for the teacher knowledgeable in the area at the time guiding professional software developers to create the program and generate a specific pedagogical model according to the requested needs, with solid proposals that generate experiences of meaningful learning in multimedia learning environments (Sandí and Cruz, 2016). The students, when using the educational software for the orientation-learning of the cervical cancer detection that contemplated the pedagogical aspects for its development in an explicit way and with significantly organized content, obtained a superior performance than the traditional didactic intervention used (Cataldi, 2005).

In the comparative analysis of groups A and B, having taken A as a control group, it turned out that group B obtained a better performance in its evaluation thanks to the use of educational software for the orientation-learning of cervical cancer detection as support tool; here, in the exercise of the subject, it was observed that the teachers followed the dynamics of the traditional class. While in group C, where there was no traditional intervention throughout the class, and only educational software was used for the orientation-learning of cervical cancer detection, a better result was observed in the empowerment of the subject. Therefore, we assume that the difference in terms of performance and increase in knowledge is due to the use of educational software, in particular to the methodology applied for its

development, which shows that virtual learning environments created with teaching tools-Appropriate learning increases the user's knowledge (Dominguez, Bautista, Cárdenas, Amorocho & Montoya, 2019). Although it is not necessary to discard the previous knowledge of the subject of the students of each group.

Conclusions

As proposed, an educational software was developed for the orientation-learning of cervical cancer detection where the taking of the cervical cytology sample and the taking of the sample for the detection of HPV by capture of hybrids could be appreciated. As part of its development, it was considered appropriate to make interactive software with the following technologies: HTML5, JavaScript, jQuery, and for the evaluation, several prototypes were developed with increased functionalities.

Considering the importance of some learning theories and their contributions to the theories of instructional design in correspondence with the design of computerized didactic materials, it was possible to build a software that serves as a reference to implement a virtual training system to train subjects, rather than self-taught, autonomous. An important part of the work is the use of hypertext, which cognitively affects a non-linear reading, determined by hyperlinks in the reading, with links or routes to navigate the Internet.

By experimenting with a control group and two experimental groups, and by analyzing the information collected, positive results were obtained: the designed software was capable of generating significant learning and allowed making logical and conceptual connections between the elements. By evaluating the knowledge of the topics contained in the software, these comprehension activities put the new knowledge generated by the students into a dialogue with the previous one.

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