

# Construction and validation of a serious game about human papillomavirus infection

Construção e validação de jogo educativo sobre a infecção pelo papilomavírus humano  
Elaboración y validación de juego educativo sobre la infección por el virus del papiloma humano

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## Abstract

**Objective:** To describe the process of construction and validation of a serious game for the prevention of infection caused by human papillomavirus.

**Methods:** This is a methodological study that followed the steps: conceptualization, pre-production, prototyping, production and expert assessment. For conceptualization and pre-production, an integrative review was developed, which generated demands for knowledge, categorized and used in the prototype production. In an expert assessment, 13 participated for content analysis and seven for design, who answered different instruments. Data were analyzed for the score of Suitability Assessment of Materials and Content Validity Index.

**Results:** A serious game was developed based on gaps in population's knowledge identified in the literature, called electronic roulette. Content experts considered that the technology developed has potential for health education and prevention of forms of illness caused by the human papillomavirus. For assessing appearance, design experts found the understandability and quality of the interface satisfactory.

**Conclusion:** Electronic roulette presented satisfactory evidence of content validity. The recommendations of the experts improved the content and appearance, enabling the mediation of educational activities.

## Resumo

**Objetivo:** Descrever o processo de construção e validação de um jogo educativo para a prevenção da infecção causada pelo papilomavírus humano.

**Métodos:** Estudo metodológico que seguiu as etapas: conceituação, pré-produção, prototipagem, produção e avaliação de especialistas. Para a conceituação e pré-produção desenvolveu-se uma revisão integrativa, que gerou demandas de conhecimento, categorizadas e usadas na produção do protótipo. Na avaliação de especialistas, participaram 13 para análise do conteúdo e sete para *design*, que responderam instrumentos distintos. Os dados foram analisados quanto ao escore do *Suitability Assessment of Materials* e Índice de Validade de Conteúdo.

**Resultados:** Desenvolveu-se um jogo educativo baseado nas lacunas de conhecimento da população identificadas na literatura, denominado roleta digital. Os especialistas de conteúdo consideraram que a tecnologia desenvolvida possui potencial para a educação em saúde e prevenção das formas de adoecimento pelo papilomavírus humano. Na avaliação da aparência, os especialistas de *design* consideraram satisfatórios a compreensibilidade e qualidade da interface.

**Conclusão:** A roleta digital apresentou evidências de validade de conteúdo satisfatórias. As recomendações dos especialistas aprimoraram o conteúdo e aparência, possibilitando a mediação das atividades educativas.

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Conflicts of interest: nothing to declare.

## Resumen

**Objetivo:** Describir el proceso de elaboración y validación de un juego educativo para la prevención de la infección causada por el virus del papiloma humano

**Métodos:** Estudio metodológico que siguió las siguientes etapas: conceptualización, preproducción, creación de prototipo, producción y evaluación de especialistas. Para la conceptualización y preproducción, se llevó a cabo una revisión integradora que generó demandas de conocimiento, que fueron categorizadas y utilizadas en la producción del prototipo. En la evaluación de especialistas, participaron 13 personas para el análisis de contenido y siete para el diseño, que respondieron distintos instrumentos. Los datos fueron analizados respecto a la puntuación del *Suitability Assessment of Materials* y del Índice de Validez de Contenido.

**Resultados:** Se desarrolló un juego educativo denominado ruleta digital, basado en los vacíos de conocimiento de la población identificados en la literatura. Los especialistas de contenido consideraron que la tecnología desarrollada posee potencial para la educación para la salud y la prevención de formas de contraer el virus del papiloma humano. En la evaluación de la apariencia, los especialistas en diseño consideraron satisfactorias la comprensibilidad y calidad de la interfaz.

**Conclusión:** La ruleta digital presentó evidencias de validez de contenido satisfactorias. Las recomendaciones de los especialistas mejoraron el contenido y la apariencia, lo que permitió la mediación de las actividades educativas.

## Introduction

Human papillomavirus (HPV) infection is one of the most prevalent sexually transmitted infections (STIs) in the sexually active population. Due to its association with cervical cancer, it has been a challenge to public health worldwide. An estimated 570,000 new cases worldwide are estimated to be around 3.2% of all cancers, representing an estimated risk of 15.1/100,000 women, with the highest incidence in African countries.<sup>(1)</sup>

In Brazil, cervical cancer is the third most common type among women. The estimated risk, according to statistics from the Brazilian National Cancer Institute (INCA – *Instituto Nacional de Câncer*), is 16.35/100,000 women, being higher in northern, followed by northeastern, center-western, southern, and southeastern Brazil.<sup>(2)</sup> A study demonstrated that some characteristics are related to this type of cancer such as perimenopause, education, parity and screening, in different degrees of association.<sup>(3)</sup>

HPV lodges in the skin or mucous membranes and can infect both men and women, the first being the main spreader. Of the more than 150 HPV types, HPV types 6, 11, 16 and 18 are the most prevalent. Types 6 and 11 are associated with the appearance of genital warts and do not offer oncogenic risks, however types 16 and 18 are more persistent and have a higher risk of developing pre-cancerous cells.<sup>(4)</sup> Given its high worldwide mortality rate, approximately 312,000 women per year,<sup>(1)</sup> has become the focus of numerous public policy of attention.

In Brazil, for 2020, 16,710 new cases were estimated<sup>(2)</sup> and in 2018 6,526 deaths were registered.<sup>(5)</sup> A study revealed that the lack of knowledge about HPV infection and its forms of prevention can be one of the factors for the increase in incidence.<sup>(6)</sup> In view of these data, the investigation of factors that interfere with the low coverage of screening and treatment of cervical cancer has consolidated itself as a Research Priority of the Ministry of Health.<sup>(7)</sup>

The prevention and control of STIs and the reduction of cancer mortality among women are objectives of the Brazilian National Policy for Comprehensive Care for Women's Health (*Política Nacional de Atenção Integral à Saúde da Mulher*),<sup>(8)</sup> for this presupposes organized screening in primary care, with decentralized management, through cytopathological examination and appropriate treatment to percussive lesions.<sup>(9)</sup>

Nurses as members of primary care health teams can contribute in a relevant way to the prevention of HPV infection through educational strategies for the community that strengthens their knowledge.<sup>(10)</sup> A survey of 591 participants over 18 years of age in the countryside of Minas Gerais identified that 59.9% did not know what HPV is, among those who had some knowledge, 47.3% said they had obtained through television and 93.2% recognized the form of transmission; knowledge about HPV is higher among those with higher education.<sup>(6)</sup>

It was observed that knowledge about HPV and its vaccination is unsatisfactory, which favors the risk to health.<sup>(6,11)</sup> Thus, considering the practices

used in contemporary times, educational technologies such as booklets, videos, games and smartphone applications have been standing out as mechanisms for health and well-being promotion, because they are easily accessible and reach a larger population contingent.<sup>(12)</sup>

It is known that educational technologies contribute to health promotion and disease prevention, since, as health education strategies, they favor the clarification of doubts, fill gaps in knowledge, cause behavior changes and stimulate decision-making.<sup>(13)</sup> Among these educational technologies, we highlight the serious games – educational games – which are games developed for educational purposes, and not merely entertainment, to stimulate learning and behavior change in a playful way.<sup>(14)</sup> These games have demonstrated favorable results as a therapeutic and educational aid strategy.<sup>(15-19)</sup>

It is believed that access to information, depending on the conditions of assimilation by the population, is an important strategy of incorporating protective practices into people's daily lives. An integrative review study<sup>(13)</sup> pointed out that the use of educational technologies had a positive impact in terms of health education on HPV and vaccination capture; and showed that no studies were conducted in Brazil addressing the development of technologies for this purpose. Among the technologies developed, the video was the most cited, the others being: internet pages, computer programs, text messages, printed materials and radio soap operas;<sup>(13)</sup> referring to the realization of this study, since it was not identified development of serious games to promote knowledge about HPV.

The realization of this study is consistent with the need to introduce innovative technologies as mediators of the educational process in health by providing reflection and influence on the change in users' behavior, on the epidemiological profile of diseases and in the search for new paradigms for public health, through care planning.<sup>(11,13,18,19)</sup> Considering this context, the objective was to describe the process of construction and validation of a serious game for the prevention of infection caused by human papillomavirus.

## Methods

This is a methodological study that includes strategies for development and assessment of evidence of validity of tools and instruments through specific techniques.<sup>(20)</sup> The educational technology development and analysis process took place between May 2018 and May 2019. For the development of a serious games one should consider the following aspects: mechanics - functioning, aesthetics - audiovisual resources and evoked emotions, narrative - sequencing of events and technology - media employed.<sup>(21)</sup> Followed the following steps: conceptualization, pre-production, prototyping, production and expert assessment.<sup>(22)</sup>

In the initial stage, an integrative literature review was conducted in the databases Medical Literature Analysis and Retrieval System Online (MEDLINE), Latin American and Caribbean Literature on Health Sciences (LILACS) and Nursing Database (BDENF), through the combination of controlled descriptors: knowledge, papillomaviridae, sexually transmitted disease, adolescent and adult, and their correspondents in English and Spanish.

We included studies that portrayed population's knowledge about HPV, published between 2013 and 2018, in English, Portuguese and/or Spanish. The cutout aimed to meet the perspectives of changes in population's knowledge patterns over time, hence the five years prior to data collection. Reports of informal cases, book chapters, dissertations, theses, reports, news, editorials, literature reviews, non-scientific texts and articles without availability of full text online were excluded.

For the development of educational technology, the integrative literature review directed the theoretical content to be addressed, pointing out the gaps in population's knowledge about HPV. The search in the databases returned 1,187 articles, of these 906 did not meet the time frame, obtaining 281 for reading titles and abstracts, which allowed the selection of 28 articles for full reading, after removal of duplicates, 18 articles were obtained, of these five did not meet the scope of this research. At the end, 13 articles

were used to map population's knowledge on the theme under study.

The results of this review contributed to the conceptualization and elaboration of the content to be addressed. The articles were read in full and gaps in population's knowledge about HPV that supported prototype pre-production were identified through thematic content analysis. The 13 articles submitted to analysis were summable and the data were categorized into: meaning of HPV, forms of contagion, signs and symptoms, prevention measures, vaccination and relation of HPV with cancer. The categories were addressed in the prototypical version of electronic roulette.

For the development of the serious game prototype – later called electronic roulette – the Integrated Development Environment (IDE) and the Java Programming language were used, and the information technology professional was assisted.

The initial version was elaborated in the form of a circular geometric figure and divided into eight equal parts (octagon) enumerated. Each part of the roulette – preview page – corresponded to a demand that is in the integrative review, and is arranged in the form of a multiple-choice question with four answer options. Two people are necessary for execution, being oriented to the adult-young population, preferably. Participants, when spinning the roulette - click on spin on the interface - their turning speed will decrease until it stops at one of the numbers, after that, the roulette figure will be deleted and the question indicated by the selected number will be evidenced.

The roulette was colored with varied colors, in order to have participants' attention. In part one, the yellow coloration was used, portraying the meaning of HPV; part two, light blue in color, addressed the forms of transmission; part three with green coloring referred to prevention mechanisms; part four of yellow color portrayed the signs and symptoms of HPV infection; parts five and six of orange-lilac stains referred to vaccination; part seven with blue coloring encompassed the relationships between HPV and cancer; and part eight represented the "pass it" option and was colored red.

Expert assessment aimed to obtain evidence of content validity. For this, two groups of experts were selected: one group assessed the content, language, presentation, stimulation/motivation and cultural adequacy and the other the appearance considering installation/execution errors and the interface quality.

The survey to analyze the eligibility of participants for the role of content expert was initially carried out through the Lattes Platform and the Bank of Theses and Dissertations of the Coordination for the Improvement of Higher Education Personnel (CAPES - *Coordenação de Aperfeiçoamento de Pessoal de Nível Superior*). A system of classification of judges was used for the selection of possible experts.<sup>(23)</sup> This system scores a number of criteria, that is: being a doctor (4 points), being a master (3 points), thesis/dissertation in the area of interest (2 points), publications in the area of interest (2 points), previous experience in validation of educational materials (1 point/work), teaching in the area of interest (1 point/year), professional performance in the area of interest (0.5 point/year) and experience in health education (0.5 point/year).<sup>(23)</sup> Those who scored at least five points were selected, in line with previous studies.<sup>(24,25)</sup>

A group of 13 researchers who met the predetermined criteria was selected, however, there were only three answers. To complement the number of experts, we chose to adopt the snowball sampling technique, in which the selected participant indicates or suggests other participants, the indicated researchers should meet the same criteria initially listed. Regarding the participation of design experts, they were selected by electronic indication (by email) of content experts, as they are researchers with proven experience in the development of educational technologies. It is emphasized that the number of experts from both groups met the literature recommendations.<sup>(26)</sup>

For expert analysis, two validated instruments were adopted.<sup>(27,28)</sup> For content experts, the Suitability Assessment of Materials (SAM) was used, which assesses the difficulty and convenience of educational technologies related to content, writing style, presentation, stimulation/motivation and



cultural adequacy, analyzing the agreement and relevance of each item: 0 – inadequate, 1 - partially adequate and 2 - adequate.<sup>(27)</sup> The instrument for design experts included characteristics that considered the interface quality and its comprehensibility by the target audience, with a Likert-type scale for appearance assessment: 1 – totally disagree, 2 – disagree, 3 – agree and 4 – totally agree.<sup>(28)</sup>

For analysis of content results, the final score was obtained by the sum of the scores of each item divided by the possible sum, and transformed into a percentage. It is emphasized that the possible sum is equivalent to 30 points. The global SAM score was obtained by calculating the arithmetic mean of the sums of each expert ( $\Sigma$ ) divided by the number of experts, and multiplied by 100, to obtain the percentage. Its assessment considered the following values: between 0 and 39% - inadequate; between 40 and 69% - adequate; and between 70 and 100% - higher.<sup>(29)</sup> Values below 60% indicated the need to review the material.<sup>(27)</sup>

Regarding the analysis of results related to design, the systematic logic of Content Validity Index (CVI) was used. The item score was calculated by the sum of agreement the items marked by “3” or “4”, divided by the total number of answers. On the other hand, the score of the instrument was made by summing the CVI of each item, divided by the number of items of the instrument.<sup>(28)</sup> The cut-off point used for CVI was 0.78.<sup>(30)</sup>

The study was approved by the Institutional Review Board (IRB), under Opinion 2,999,641 and CAAE (*Certificado de Apresentação para Apreciação Ética* - Certificate of Presentation for Ethical Consideration) 00921918.5.0000.5210 on November 5, 2018 and met all national and international ethical precepts for research involving human beings.

## Results

The aspects addressed in the literature as gaps in population’s knowledge about HPV were categorized and the main results determined the content to be addressed in the educational game. The studies are identified in alphanumeric codes in chronological order of publication and presented in Chart 1.

After completing the prototypical version of electronic roulette, it was sent for assessment by the expert committee. The final sample of 13 content experts was obtained, with a mean age of 42 ( $\pm 15.75$  years, predominantly female 12 (92.3%). Regarding education, all were nurses, trained more than 10 years ago, with an average of 19 ( $\pm 15.23$ ) years. As for titration, Master’s and PhD degree holders were numerically equivalent, representing 46.41% each. Electronic roulette obtained an overall SAM score of 85.3%. Table 1 presents content

**Chart 1.** Content that is a guide for developing the serious game

Code	Category	Main results
A1, A2, A4, A5, A6, A7, A8, A10, A12, A14	Meaning of HPV	In six studies, it was observed that more than 50% of the interviewees reported not having heard about HPV. And more than 70% of the individuals who reported knowing the infection had poor knowledge about it. Still in this reasoning, two studies showed that just under 30% of individuals had never heard of HPV. Only one article reported good knowledge about the meaning of the virus, where 91.7% said they had heard of it and know what the virus means.
A1, A2, A5, A7	Transmission	In studies that presented the transmission category, it was evidenced that people reported knowing HPV, but more than 60% did not know how to identify the ways in which the virus is transmitted. Women knew more than men about the sexual transmission of the pathogen.
A2, A3, A4, A6, A7, A8, A9, A12, A13.	Prevention	A study revealed that 57% of medical students knew more than two preventive methods and 43% knew only one or no preventive methods. The general population pointed out that they had insufficient knowledge of prevention methods. Still, between female s and males, the population did not know who should receive the HPV vaccine. 90% of women who have sex with women do not use condoms in their sexual experiences. 10% of the interviewees reported that they would not allow their daughters to take the vaccine, because they believed that this would induce the anticipation of the beginning of sexual life. 80% reported having heard about the Pap smear, 40% reported never having done it, 10% reported that they never did it for fear of hurting and not knowing its importance.
A1, A5, A6, A12	Signs and symptoms	In one study, more than 60% of participants could not identify symptoms of HPV infection. Less than 15.5% indicated HPV as a cause of genital warts. Less than 10% indicated that HPV can cause cervical cancer.
A3, A8, A10, A11, A12	Where to find the vaccine	Almost 14% cited the lack of knowledge of the national vaccination campaign. More than 30% had never heard of the vaccine and did not know where to find it and almost 20% were already vaccinated against HPV. A study reported a rate of 20% of respondents who reported that the vaccine is in the testing phase and that it only exists in the private network and that, therefore, its cost is high.
A8, A9, A12	Who can receive the vaccine	Most female and male students did not know who should receive the HPV vaccine and when to be vaccinated. Many felt that these vaccines should be received by people who have already had sex.
A1, A12, A6	Relationship with cancer	The women demonstrated that they had more knowledge about HPV as a cause of genital warts and its relationship with uterine cancer. Women were more concerned than men about HPV-associated penile cancer in the future. 10% of the interviewees pointed to HPV as the cause of cervical cancer.

**Table 1.** Distribution of the results of content, language, presentation, stimulation/motivation, and cultural adequacy assessment (n=13)

Criterion	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13
Content													
Objective is evident facilitating a prompt understanding of the material	2	2	2	2	2	0	2	2	2	2	2	2	0
The content addresses pertinent information related to the prevention of human papillomavirus infection	2	2	2	2	2	2	2	2	2	2	2	1	1
Electronic roulette's proposal is limited to the objectives so that the public can understand	2	1	2	2	2	1	2	2	2	2	2	2	0
Language													
Reading level is adequate for readers' understanding	2	2	1	2	2	2	2	2	2	2	2	2	2
Conversation style makes it easy to understand sentences	1	2	1	2	2	2	2	2	2	2	0	2	1
Information is passed on within a clear context	2	1	1	2	2	1	2	2	2	2	1	2	1
Vocabulary uses common words	2	2	1	2	2	1	2	2	2	2	2	2	2
Understanding is facilitated by topics	2	2	2	2	2	2	2	2	2	2	1	2	1
Presentation													
Material organization is adequate	1	2	2	2	2	2	1	2	2	2	2	2	1
Font size and type promote a nice read	2	2	2	2	2	2	1	2	1	2	2	2	2
Stimulation/motivation													
There is interaction with readers, enabling them to make reflections	2	2	2	2	2	2	0	1	1	2	1	2	0
Prevention methods are well demonstrated	1	2	1	2	2	2	1	2	2	2	1	2	2
There is motivation to identify prevention methods and attitudes to be taken	2	2	1	2	2	1	1	2	1	2	1	2	2
Cultural adaptation													
Material is culturally suited to the target audience's logic, language and experience	2	2	1	2	1	0	2	2	2	2	1	2	2
It presents texts that are easy to understand and culturally appropriate	1	2	1	2	1	1	2	1	2	2	1	2	2
Summation (Σ)	26	28	22	30	28	21	24	28	27	30	21	29	19
SAM score* (%)	86,7	93,3	73,3	100	93,3	70	80	93,3	90	100	70	96,6	63,3

\*SAM - Suitability Assessment of Materials

assessment by experts, demonstrating a value of SAM score higher than the established condition of suitability.

Seven design experts participated, all male. The age group revealed participants, whose ages ranged between 25 and 46 years, with a mean of 37 (± 7.34) years; the mean training time was 11 (± 6.94) years. Design experts' assessment regarding the comprehensibility and quality of the electronic roulette interface revealed CVI values higher than predetermined as adequate. Electronic roulette was considered clear (CVI=0.86), the texts were organized and understandable to the target audience (CVI=0.86), the colors and shapes were adequate (CVI=0.86) and the guidelines were strategically placed, enabling reflection (CVI=0.86). For design experts' assessment, it can contribute to the change of behaviors and attitudes of the target audience (CVI=1.0). In an overall assessment, mean CVI of 0.89 was obtained, considered satisfactory. Experts opined on improvements and adaptations that should be thought of in relation to educational technology, with the primary objective of preventing HPV infection (Chart 2). The identification of experts followed the order of inclusion in the study,

preceded by the letter “C” for content experts and “D” for design experts. At the end of the comments' analysis, the final version of electronic roulette was obtained.

## Discussion

The literature review showed low population's knowledge about HPV. Thus, electronic roulette can be presented as an innovative technology with potential for the prevention of HPV infection to the extent that it provides knowledge about the gaps of population's knowledge on the subject. From this angle, and considering the complexity of population's low knowledge about HPV evidenced in the literature,<sup>(6,11)</sup> health and education professionals are constantly challenged to use educational technologies in order to facilitate the process of health education among professionals and adolescents. Such technologies promote knowledge about the disease, besides motivating self-care.<sup>(10,24)</sup>

The innovations of mobile technology have directed the creation of digital content, particularly in the development of educational materials

**Chart 2.** Recommendations and comments from content and design experts on electronic roulette

ID	Recommendations and Comments	Decision
C01	The item: "What are the ways to transmit HPV?" (" <i>Quais as formas de transmitir o HPV?</i> ") was confusing. I think it is better to say that the route of transmission is through oral, anal and vaginal sex and childbirth. I suggest you put pictures of condoms. Put the pronoun you, making a call to readers to identify with the target audience. For example, in item 3, "You can purchase the condom and vaccine for free at a health center" (" <i>Você pode adquirir a camisinha e vacina gratuitamente no posto de saúde</i> ").	All suggestions have been accepted.
C03	In item 2, I suggest the substitution of "HPV can occur even in the absence of vaginal or anal penetration" (" <i>o HPV pode ocorrer mesmo na ausência de penetração vaginal ou anal</i> ") by "HPV is caught even without contact with the vagina or anus" (" <i>Se pega HPV mesmo sem contato com a vagina ou ânus</i> "). When talking transmission, I also suggest the exchange for "is caught" (" <i>se pega</i> "), because if the roulette is used with a simpler audience the term transmission becomes very technical.	All suggestions have been accepted.
C06	I suggest that at the beginning of roulette, there may be a definition of the goal that it has, as a small introduction to the game and review the agreement, question 4, it is not clear that most do not present symptoms. In question 7, put "which" (" <i>a quais</i> ").	All suggestions have been accepted.
C07	I suggest having a moment or a tab that brings explanations about the rules of this virtual game. I felt the need to score each correct and/or wrong question, or provide some bonus on each number present in roulette for the player.	All suggestions have been accepted.
C09	The dark color of the background can cause disinterest.	The color was kept.
C10	I suggest that in question 6, in the Result, where there are boys from 9 to 16 and girls from 9 to 45 years, insert male and female.	Suggestion have been accepted.
C11	In item 1, how were the response possibilities chosen? I believe that the only alternative that could generate "doubt" (and therefore curiosity) in users is "Hepatitis" since the alternatives have no common point with the acronym HPV. In item 2, why is the word "air" (" <i>ar</i> ") in capital? Still, why do some items appear with the "none of the alternatives" (" <i>nenhuma das alternativas</i> ") option and others don't? On any item would that be the correct answer?	All suggestions have been accepted.
C13	A roulette presentation card in which the participant is invited and instigated to play and know the objective of the game was missing. In my view, there were no topics that could address relevant issues.	All suggestions have been accepted.
D3	Put a brighter color at the bottom of the roulette. Add initial guidance on how to proceed in the game. Put the alternatives in a larger font.	The color was kept. Other suggestions have been accepted.
D4	Put the answer next to the question.	Suggestion have been accepted.
D7	Introduce introductory part explaining how it works and what it is for (the game). Draw up scoring scheme to make it more attractive.	All suggestions have been accepted.

aimed at various purposes, among them, health promotion.<sup>(13,18,19)</sup> These resources are relevant to the change in knowledge, attitudes and beliefs related to the prevention of infections, favoring the dissemination of information that implies a continuing education in order to multiply knowledge about preventive methods and reduce the rate of infected people.<sup>(17)</sup>

In consolidating with the literature used to structure the method,<sup>(22)</sup> the integrative literature review was the theoretical tool for developing the study in its initial stage of conceptualization and pre-production. The review as an initial step in studies of development of educational technologies represents a relevant mechanism to improve and direct production.<sup>(28)</sup> Electronic roulette, in a playful way, proposes the dissemination of several themes related to HPV infection, increasing the activity of healthcare professionals.

Thus, the proposed serious game will be useful for coping with the gap in terms of population's knowledge. A study<sup>(31)</sup> revealed low knowledge of adolescents and guardians about HPV and the vaccine, most of not aware of the causal link with cervical cancer, signs and symptoms of infection, and knowledge regarding the vaccine was limited. Thus, this game may contribute to the increase in

the vaccination rate, considered low in the mentioned study. Vaccination proved to be an economical and accessible strategy,<sup>(32)</sup> therefore, it should be stimulated. A study<sup>(11)</sup> demonstrated that ignorance about HPV and its vaccination leads to the reluctance of parents to vaccinate their children, while the perception of risk from HPV infection was positively associated with vaccination. Thus, investing in health education is essential to face this problem.

The development of educational technologies whether booklets, folders, games or others when for the purpose of health promotion and disease prevention, should focus, however, on population demands,<sup>(24,33)</sup> without disregarding its particularities. This should be considered particularly when the target audience is adolescents. It was perceived by the researchers, for example, that the use of colloquial language would be paramount to achieve the objectives when players finished the serious game. It is reiterated that it is essential that there is an approximation with the daily life of the people to whom the educational technologies in development are intended.<sup>(19,33)</sup>

Another demand has emerged today, with the advent of the internet and state-of-the-art mobile phones, healthcare professionals are less able to compete for the attention of primary care service

users. Thus, intentionally, the researchers chose the development of a type of game, which is more attractive to the target audience, mostly young. When with proven quality this type of game can be a mediator of the health education process, as verified in literature reviews.<sup>(15,34)</sup>

Although electronic roulette was analyzed and considered valid by experts, they left their opinions and suggestions for improvement recorded, in order to ensure quality to educational technology. Expert assessment was of great importance for the development of the serious game, as it was possible to bring together a team formed by several professionals with proficiency and competence in various knowledge related to the subject addressed by the material whose knowledge allows different perspectives on the same focus, attesting the quality of the developed technology.

The professional profile of content experts revealed a great concern of the nursing category with the prevention aspects of STIs. It is noticed that nurses as a member of the primary care health team have the potential to sensitize users by their relational competencies developed during their formative process.<sup>(10,35)</sup>

Assessment by experts in the development of educational technologies is essential to guarantee the tool acceptability by professionals at the end of the healthcare network and the relevance of the content addressed<sup>(19,35)</sup> Another highlight is the importance of assessing the appearance of technologies and their resources by design experts. This group has an important role that makes it possible to improve technology to users' interests,<sup>(24)</sup> using features such as colors and score feedback, making them more attractive.

During the development of electronic roulette, we sought to align the learning objectives with aspects of the game interface – aesthetics – which can provide greater access to the game. Moreover, electronic roulette has proved to be appropriate by both content experts and design experts, as identified in other educational game development studies.<sup>(16,18-19)</sup>

Non-participation of the target audience in the assessment of electronic roulette is an important limitation, thus demanding continuity of assessment for greater effectiveness of its potential as an

educational technology. However, after this study, it was noticed that the proposed objective was achieved and electronic roulette was shown, together with the experts, to have educational and innovative potential. It is important to develop research to refine the proposed technology, which can be useful for coping with HPV-related illness conditions.

## Conclusion

Electronic roulette was considered an appropriate tool by content experts regarding language, presentation, stimulation/motivation and cultural adequacy; and according to design experts an attractive-looking technology. The game developed proved relevant when addressing important content strains for the prevention of hpv disease forms. The results add contributions in the scope of care to be used by healthcare professionals as a mediator of educational activities; the research through continuity of testing and refinement of the product; and teaching either from the perspective of health education or as a resource for the design of the stages in the development of serious games.

## Collaborations

Maciel MPR, Costa LMA, Sousa KHJF, Oliveira ADS, Amorim FCM, Moura LKB, Zeitoune RCG and Almeida CAPL collaborated with study contribution, data analysis and interpretation, writing of the article, relevant critical review of the intellectual content and approval of the final version to be published.

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