

A Clinical Case Simulation Tool for Medical Education

Juliano S. Gaspar^{1,2,3(✉)}, Marcelo R. Santos Jr.¹, and Zilma S.N. Reis^{1,2}

¹ CINS – Centro de Informática em Saúde da Faculdade de Medicina da UFMG, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil
julianogaspar@gmail.com, marrsantosjunior@gmail.com,
zilma.medicina@gmail.com

² Departamento de Ginecologia e Obstetrícia da Faculdade de Medicina da Universidade, Federal de Minas Gerais, Belo Horizonte, Brazil

³ UNIBH – Centro Universitário de Belo Horizonte, Belo Horizonte, Brazil

Abstract. The human being, even if potentially inclined to learn, needs incentives to do it effectively. In these context, the virtual environments could simulate challenges of clinical practice and, at the same time, consider the personal experiences, allows the student's stimulus and also offer additional theoretical content updated and of excellent quality. The purpose of the project is to develop a Clinical Case Simulation Tool (CCST), it's supposed to be a supporter to the acquisition of clinical skills for medical education. This is an experimental study of applied technology for health education. The project is multidisciplinary between health sciences, computing and education. The development of an application to store real clinical cases is the starting point of this study. The structure of the proposed clinical case comprises the description of the case, clinical history, complementary tests, questions and further reading. The access to the application is password protected, composed of access profiles with specific characteristics such as teacher, coordinator, student. All clinical cases are linked to a specific college and discipline. The Clinical Cases simulator platform was created for storage of clinical cases and to provide technological support for preparing courses, workshops and support classroom teaching. This may be considered as an innovative approach, given the use of a digital system that enables the storage of clinical data and laboratory tests, as sounds of cardiac auscultation, pulmonary auscultation, images and videos.

Keywords: Computer simulation · Gamification · Competency-Based education · Clinical diagnosis · Medical education

1 Introduction

The human being, even if potentially inclined to learn, needs incentives to do it effectively [1]. Nowadays, a teacher is supposed to be the driver of a teaching-learning process. In the meantime, the student has much more active role to acquire skills and professional competence. These are considered as the major basic challenges of the current education: learning to know, learning to do and learning to be [2].

Every educational system is built to meet the needs of the society that created it. However, with the recent advancement of technology, the educational system today does not match the educational needs of contemporary society [3].

There is a global challenge to adapt the training of health professionals, facing the limitations of traditional models of education [4]. The competency-based education purposes enhancing of new dimensions and skills for care. In order to prepare more capable health professional, the social issues and the relationships between people matter, as well simulation to lower medical mistakes and teaching strategies of problem-solving [5].

The initial training of medical graduate students demands repetition of specific tasks, controlled behavior and adaptation of an individual time of learning. Fundamental clinical skills domain gathers communication, physical examination, clinical reasoning and proposal of diagnostic measures and therapeutic plan. Despite technological advances, the physical examination of an individual by a doctor is a practice considered, besides cost-effective, extremely important for the diagnosis of diseases, establishment of a diagnosis plan, therapeutic and prognostic, in many situations [6]. However, it takes more than good books to acquire the skills necessary to perform a physical examination. In this context, computer simulation environments can contribute by allowing an ethical repetition of tasks and individualized oriented training in support of learning in real scenario [7].

The virtual environments could simulate challenges of clinical practice and, at the same time, consider the personal experiences, allows the student's stimulus and also offer additional theoretical content updated and of excellent quality.

The simulation consists in using specific computational techniques for the purpose to repeat the process or operation in the real world [8]. It is an important tool to compare and evaluate process changes. The effects of changes in processes is evaluated by measuring performances. As the simulation runs multiple iterations, the performance of students are saved for future performance analysis [9].

In medical education, simulation is the replacement of real patient encounters with either standardized patients or technologies that replicate the clinical scenario [10]. The virtual patient simulations are together education games termed gamified training platforms. Kind of technology applied to medical education, those tools are growing and resulting in a good impact for all levels of medical trainees, providers, and educators [11].

The purpose of the project is to develop a learning virtual environment using clinical cases. The Clinical Case Simulation Tool (CCST) gathering variable complexity and attention level settings is supposed to be a supporter to the acquisition of clinical skills among students of health professional.

2 Methods

This is an experimental study of applied technology for health education. The project is multidisciplinary between health sciences, computing and education. The development of an application to store real clinical cases is the starting point of this study. In a first step, undergraduate medical student and professors are collecting real clinical cases. The professor can register the clinical cases with various complexities, whether based on clinical, ambulatory and hospital care. For real clinical cases, patients will be invited to a voluntary participation.

The present study was approved by the Committee for Research Ethics of Federal University of Minas Gerais under the registration number (Brazil Plataform: 10286913.3.0000.5149) all human research principles respected. Using anonymous presentation, the medical history is composed by clinical examination, laboratory tests, whether in reports or sound, video and image file formats. The medical history library is stored in the Faculty of Medicine of UFMG sever. The content is used exclusively for the training of health professionals. Access is password protected and will be under the responsibility of the project coordinator.

The application makes possible to store the specific characteristics of each type of case: text, images, videos and sound files. A short and objective medical report, clinical images such as ultrasound or magnetic resonance and digital electrocardiogram can be stored in the system, as well as cardiac auscultation sounds. In order to give more realistic sensation during the simulation, cardiac sounds are stored with a digital stethoscope are separated by the aortic, pulmonary, mitral and tricuspid.

During the second step of learning preparation, each clinical case will be reviewed. Professors prepare one or more questions related to the case, theoretical or practical questions focused on diagnosis, prognosis or therapeutic process. Each clinical challenge must be properly explained, following of the correct answer and the other about why they are wrong.

The purpose is offering a virtual clinical challenge and stimulate the students to solve virtual patient cases to support the transfer of learning. In a complementary and final step of the learning process, the system can provide specific explanations about the topic and suggested further reading. All the explanations must be based on published, containing citations and references used.

The application must be ergonomic and self-explanatory, so that teachers can simply document the clinical cases of interest to the improvement of health professionals learning.

3 Results

The structure of the proposed clinical case comprises the description of the case, clinical history, complementary tests, questions and further reading (Fig. 1).

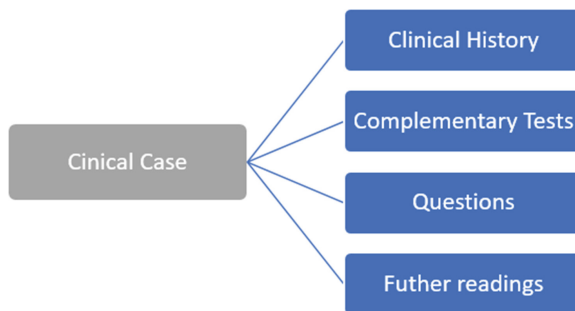


Fig. 1. Structure of clinical cases

In Fig. 2 it can be seen from the CCST database diagram, there are listed the respective tables and fields.

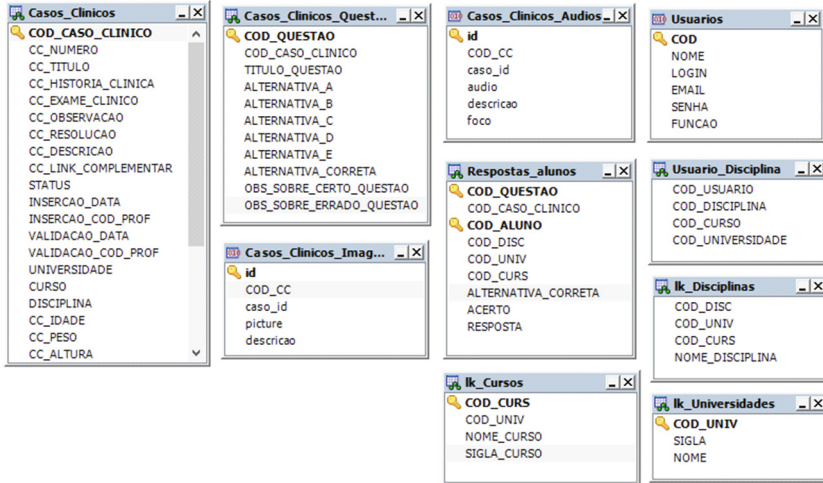


Fig. 2. Data base structure



Fig. 3. Access to clinical cases simulator

Seleção de Casos Clínicos

Faculdade: Curso: Disciplina:

Faculdade	Curso	Disciplina	Numero	Título	Qtd. Questões	Situação	Data Inserção	Usuário	Editar	Excluir
UFMG	Medicina	Internato GOB - Casos clínicos			0	Inserido	2016-04-19 17:38:05	Zilma Reis	<input type="button" value="✎"/>	<input type="button" value="✖"/>
UFMG	Medicina	Internato GOB - Casos Clínicos	1	Exantema em gestante	2	Validado e liberado	2016-04-14 14:16:49	Zilma Reis	<input type="button" value="✎"/>	<input type="button" value="✖"/>

1 de 1

Fig. 4. Access to clinical cases simulator

Fig. 5. Basic components of a clinical case

The access to the application is password protected (Fig. 3), composed of access profiles with specific characteristics such as teacher, coordinator, student.



Fig. 6. Clinical images

Figure 4 shows the list of clinical cases with features to edit or delete an already registered case.

All clinical cases are linked to a specific college and discipline. Should contain a title, the main complaint, the medical history and clinical examination of the patient (Fig. 5).

Some clinical cases may contain static images, or animated by gif, or even videos (Fig. 6).

The clinical cases involving cardiac auscultation (Fig. 7), allow upload 4 foci of heart sounds (aortic, pulmonary, tricuspid, mitral).

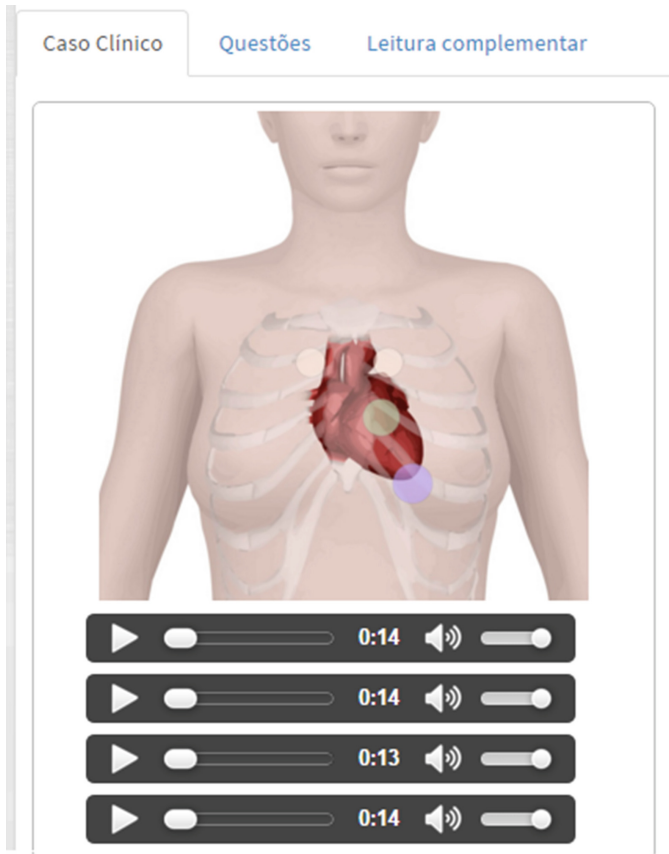


Fig. 7. Auscultation simulator

Each clinical case is composed of one or more questions, containing besides the correct alternative, their explanation of the problems involved (Fig. 8).

Casos Clínicos (1) Validar

Caso Clínico Questões

1) Qual sua principal hipótese diagnóstica?

- A - Farmacodermia
- B - Rubéola
- C - Sífilis secundária
- D - Sarampo

2) Qual exame laboratorial você solicitaria para confirmar sua hipótese diagnóstica?

- A - Hemograma
- B - VDRL
- C - Análise de raspado da lesão
- D - Nenhum, o diagnóstico é estritamente clínico

Fig. 8. Clinical case question example

In addition to the clinical case, after the resolution of the issues, the student has access to further reading about the topic, as well as specific explanations about the case in question (Fig. 9).

Casos Clínicos

Caso Clínico Questões Leitura complementar

Leitura Complementar

<http://www.aids.gov.br/pagina/sifilis-na-gestacao>

Fig. 9. Supplementary reading

The student, through its specific profile, you can view the list with clinical cases already decided, and the list of new cases. Figure 10 shows the display of a case by the student profile.

In closing, the clinical cases simulator presents a history of resolutions, as well as the score of the general or separate students by discipline (Fig. 11).

Casos Clínicos (1)

Caso Clínico Questões

Universidade Federal de Minas Gerais - Curso: Medicina - Disciplina: Internato GOB - Casos Clínicos

Caso clínico: Exantema em gestante

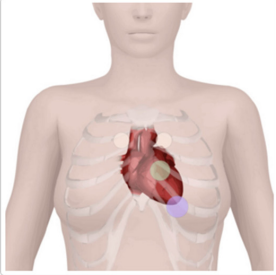
Queixa Principal

História Clínica

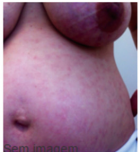
Paciente do sexo Feminino, com idade de 26 anos
 Peso 84 kg, altura de 160 cm, com IMC .
 Pressão arterial 105/70
 Gestante, 26 anos, G2P1A0, casada, dona de casa.
 Procura assistência pré-natal com 24 semanas e 3 dias de gestação.
 Queixa-se de pequenas lesões avermelhadas na pele de início há cerca de três meses que aumentam de tamanho se espalham pelo corpo: braços, dorso, pés e mãos incluindo planta e palma e boca.
 Relata ainda artralgia e fadiga generalizadas.
 Fez uso de Loratadina conforme prescrição médica.
 Relata herpes no início da gravidez tratada com Aciclovir® tópico.

Exame Clínico

Exame geral: afebril, eupneica.
 Pressão arterial: 105/70mmHg.
 Medida do útero: 21cm, batimentos cardíacos fetais: 144/minuto.
 Colo uterino fechado.



Exame (Imagem ou áudio)



sem imagem
 x
 149_1460654416.png

Obsevações sobre o exame

Analise a figura e busque perceba os achados descritos:

Fig. 10. Supplementary reading

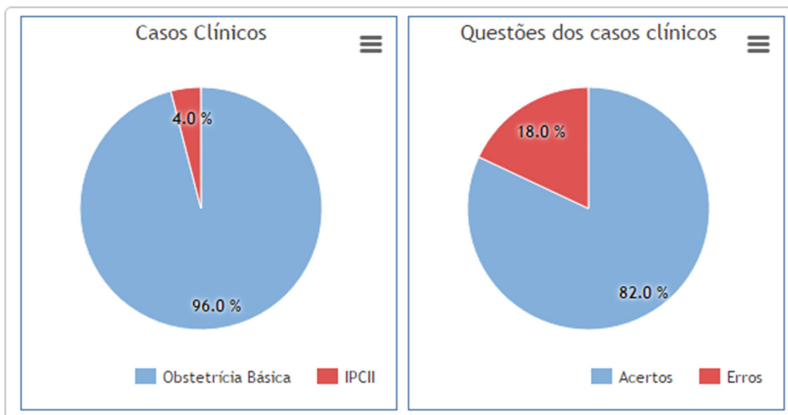


Fig. 11. Student performance

The Clinical Cases Simulator platform can be accessed at the website <http://simulacao.medicina.ufmg.br/> using the login/password = itbam/itbam2016.

4 Discussion

The Clinical Cases simulator platform was created for storage of clinical cases and to provide technological support for preparing courses, workshops and support classroom teaching, managing the access of students and teachers, the content, and the performance evaluation.

This tool assigns to the teacher the driver role of the teaching-learning process, collecting and developing clinical cases, documenting them in the form of text, sound and images, from real scenarios and register them in a virtual environment for later use as a support tool to education in health care. The teacher have also to prepare the sessions of clinical challenges in a virtual environment, in the form of questions/ answers (quiz) with tracks from reports, images, graphs, videos, and specific theoretical content to support the training of health professionals.

The clinical cases simulators in use at Harvard Medical School, is based on a human patient simulator, as they are high-fidelity humans dolls. The clinical cases are made by teachers and solved by the students, with different approaches, according to your level. The negatives of this educational process is the cost of implementation and operation. In addition to this educational procedure is used, it should have a dedicated local and specific equipment for performing simulations [12].

A similar study was conducted in two US residency programs where medical residents were subjected to a competition using a simulator of clinical cases. The competition relied on general issues of residency and issues three medical specialties. The questions were written by teachers and the correct answers had a wide explanation [13].

This study contributes to the interdisciplinary of the sciences as it brought together a multidisciplinary team of doctors of various specialties and professionals in computer science, adapting to the needs of the development of technical skills in building and maintaining the data collection system, analysis of the functionalities of the system and preparation of content within the various areas of health.

This may be considered as an innovative approach, given the use of a digital system that enables the storage of clinical data and laboratory tests, as sounds of cardiac auscultation, pulmonary auscultation, images, videos. Composing a vast digital library of real cases of extreme importance to education in health, whether in classroom courses or distance, which makes the unprecedented application in the literature.

In the future it is intended to measure the effectiveness of learning or acquiring skills of students by comparing performance tests pre and post use of the Clinical Cases Simulator.

The developed digital library, Clinical Cases Simulator, constitutes the starting point for professional training activities and scientific studies. It is expected to contribute in the future to train more qualified health professionals.

Acknowledgements and Support. CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior).

FAPEMIG (PPSUS APQ 3486-13) - Fundação de Amparo a Pesquisa de Minas Gerais.

Departamento de Ginecologia e Obstetrícia da Faculdade de Medicina da Universidade Federal de Minas Gerais, Brasil.

References

1. Zeferino, A.M.B., Passeri, S.: Avaliação da aprendizagem do estudante. *Cadernos da ABEM* **3**, 39–43 (2007)
2. Antunes, C.: *Como desenvolver as competências em sala de aula*. Editora Vozes Limitada (2012). ISBN 853264208X
3. Rădulescu, C., Bucur, C., Ciolan, L., Petrescu, A.: what does the teacher look like nowadays? *CrossCultural Manage. J.* **8**, 123–127 (2015)
4. McLeod, P., Steinert, Y., Chalk, C., Cruess, R., Cruess, S., Meterissian, S., Snell, L.: Which pedagogical principles should clinical teachers know? Teachers and education experts disagree Disagreement on important pedagogical principles. *Med. Teach.* **31**(4), e117–e124 (2009)
5. Cyrino, E.G., Toralles-Pereira, M.L.: Trabalhando com estratégias de ensino-aprendizado por descoberta na área da saúde: a problematização e a aprendizagem baseada em problemas. *Cadernos de Saúde Pública* **20**, 780–788 (2004)
6. Lederle, F.A., Walker, J.M., Reinke, D.B.: Selective screening for abdominal aortic aneurysms with physical examination and ultrasound. *Arch. Int. Med.* **148**(8), 1753–1756 (1988)
7. Troncon, L.E.A.: Utilização de pacientes simulados no ensino e na avaliação de habilidades clínicas. *Medicina (Ribeirão Preto. Online)* **40**(2), 180–191 (2007)
8. Davidsson, P.: Agent based social simulation: A computer science view. *J. Artif. Societies Soc. Simul.* **5**(1), 305–332 (2002)
9. Benneyan, J.C.: An introduction to using computer simulation in healthcare: patient wait case study. *J. Soci. Health Syst.* **5**(3), 1–15 (1997)
10. Okuda, Y., Bryson, E.O., DeMaria, S., Jacobson, L., Quinones, J., Shen, B., Levine, A.I.: The utility of simulation in medical education: what is the evidence? *Mount Sinai J. Med.: A J. Trans. Personalized Med.* **76**(4), 330–343 (2009)
11. McCOY, L., Lewis, J.H., Dalton, D.: Gamification and multimedia for medical education: a landscape review. *J. Am. Osteopath. Assoc.* **116**(1), 22–34 (2016)
12. Gordon, J.A., Oriol, N.E., Cooper, J.B.: Bringing good teaching cases “to life”: a simulator-based medical education service. *Acad. Med.* **79**(1), 23–27 (2004)
13. Nevin, C.R., Westfall, A.O., Rodriguez, J.M., Dempsey, D.M., Cherrington, A., Roy, B., Willig, J. H.: Gamification as a tool for enhancing graduate medical education. *Postgrad. Med. J. Postgradmedj-2013* (2014)