



Serious Game Design with medical students as a Learning Activity for Developing the 4Cs Skills: Communication, Collaboration, Creativity and Critical Thinking: A qualitative research

Conception de jeux sérieux avec des étudiants en médecine comme activité d'apprentissage pour développer les compétences des 4C : communication, collaboration, créativité et pensée critique : Une étude qualitative

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RÉSUMÉ

Introduction : L'impact des nouvelles technologies sur l'éducation a conduit à divers changements dans la manière dont les différentes parties prenantes, comme les étudiants et les enseignants, ils travaillent et interagissent les uns avec les autres. L'utilisation de la conception de jeux sérieux dans des contextes éducatifs a été liée au développement des compétences du 21^{ème} siècle tel que la communication, la collaboration, la créativité et le raisonnement clinique.

Objectif : Analyser un processus de conception de jeux sérieux par des étudiants en troisième année médecine, du point de vue des compétences du 21^{ème} siècle. Les compétences clés décrites sont la communication, la collaboration, la créativité et le raisonnement clinique.

Méthodes : Il s'agit d'une étude qualitative, descriptive et inductive qui suit une approche phénoménologique. Douze étudiants en médecine bénévoles de troisième année ont participé à une activité de conception de jeux sérieux. Cette étude, réalisée lors d'un stage d'été au service de cardiologie de l'hôpital Habib Thameur. Le cours de conception de jeux sérieux avec des étudiants répartis sur 4 semaines avec 10 heures en face à face et 10 heures de travail à distance.

Résultats : Les participants à notre étude étaient douze étudiants en troisième année médecine. Sur ces 12 étudiants, 10 étaient des sexes féminins. La durée de chaque entretien dépend de la capacité de chaque participant. L'analyse des données, basée sur la méthode phénoménologique de Giorgi, a fait ressortir quatre thèmes centraux : thème 1: capacités de raisonnement clinique et de résolution de problèmes, thème 2: communication, thème 3: créativité, thème 4: collaboration. L'essence générale du phénomène réside chez ces étudiants de troisième année médecine qui ont expérimenté la conception de jeux sérieux et ont décrit des compétences clés.

Conclusion : Utiliser l'apprentissage basé sur le développement de jeux sérieux comme méthode d'apprentissage pour transmettre des compétences et des connaissances multidimensionnelles suggère une approche prometteuse pour développer le raisonnement clinique, la créativité, la communication et la collaboration chez les étudiants.

Mot clés: jeux sérieux, communication; collaboration; raisonnement ; créativité

SUMMARY

Introduction: The impact of technology in education has led to various changes in the way that different stakeholders, like students and teachers work and interact with each other. The use of the serious game design in educational contexts has been related to the development of the 21st century skills such as communication, collaboration, creativity and critical thinking.

Aim: To analyze a serious game design process by third –year medical students, from the perspective of the 21st century competencies engaged in the game design process. Those outlined key competencies are communication, collaboration, creativity and critical thinking.

Methods: This is a qualitative, descriptive, and inductive study that follows a phenomenological approach. Twelve volunteer third-year medical students participated in an activity of designing of serious games. This study, carried out during summer internship in the cardiology department of Habib Thameur Hospital. The course of the designing of serious games with students spread over 4 weeks with 10 hours face-to-face and 10 hours of remote work.

Results: The participants in our study were twelve third-year medical students. Of these 12 students, 10 were female. The duration of each interview depends on each participant's ability. The analysis of the data, based on the phenomenological method of Giorgi brought out four central themes: theme 1: Critical thinking skills and problems solving skills, theme 2: Communication, theme 3: Creativity, theme 4: Collaboration. The overall essence of the phenomenon is these third medical students who experienced the serious game design outlined key competencies.

Conclusion: Using serious game development-based learning as a learning method to impart multidimensional skills and knowledge suggests a promising approach for developing clinical reasoning, creativity, communication, and collaboration in students.

Key words: serious game, communication; collaboration; critical thinking; creativity

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INTRODUCTION

The impact of technology in education has led to various changes in the way that different stakeholders, like students and teachers work and interact with each other. Consequently, there is a continuous academic and professional interest around educational technology and its application in learning contexts (1-3). Among the various fields of educational technology, serious game design is a knowledge modeling activity for learners of different ages. It engages the learners in a decision-making process of a complex system which includes the narrative, the characters' representation and their behaviors, and the mechanics allowing the user to reach the game objectives (3,4). The game creation process engages the learners into a meaningful constructivist activity requiring a high level of creativity and collaboration (5-7).

The use of the serious game design in educational contexts has been related to the development of the 21st century skills such the 4Cs (communication, collaboration, creativity and critical thinking) (7).

The aim of this study was to analyze a serious game design process by third –year medical students, from the perspective of the 21st century competencies engaged in the game design process. Those outlined key competencies are communication, collaboration, creativity and critical thinking.

better understand the phenomenon of the present study: the experience of serious game design as experienced by third-year medical students.

Phenomenology is an inductive approach aimed at studying specific experiences as have undergone and described by people. It intends to understand a given phenomenon, and to grasp its nature from the point of view of the people who have experienced it (8).

Inspired by the main stages of any qualitative research, Giorgi's approach (9) consists of five stages: Data collection, reading of interviews, division of data into units of meaning, organization and expression of raw data, and the synthesis of the findings.

Population and location of the study

Twelve volunteer third-year medical students participated in this study carried out during summer internship in the cardiology department of Habib Thameur Hospital.

The course of the educational activity on the designing of serious games with students

The training schedule spread over 4 weeks with 10 hours face-to-face and 10 hours of remote work. The course is structured in five main periods in order to create prototypes (Figure 1).

The first step: Introduction and discovery of Serious Games

Reception of the students by the facilitator with an explanation and introduction of the objectives of the training and the concept of "Serious Game", After this short introduction, we invite the students to discover examples of Serious Games for themselves. The goal

METHODS

Study design

In accordance with the purpose of the research, we opt for a descriptive phenomenological approach in order to

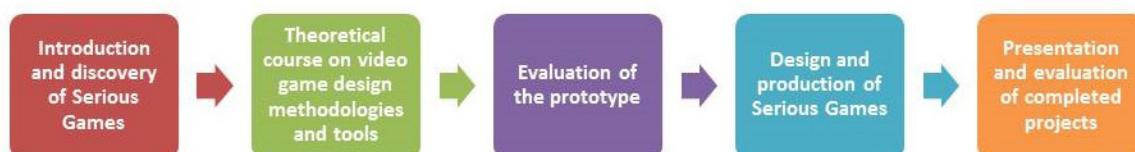


Figure 1 : Prototype of the course on serious game design

of this phase is for students to experience the immense variety of affordable themes through video games.

The second step: Theoretical course on video game design methodologies and tools

We introduce the game modalities, the game and learning mechanics, the evaluation strategy of the learning objectives and the evaluation of the gameplay.

The design elements in a serious game to be assessed are (10): avatars, levels of difficulty of the challenges, performance tables or graphs, a narrative discourse that serves to organise the events of a story in a logical or temporal order, points and the time limit that is allowed for the learner to achieve a specific challenge.

We reveal to our students the theme they will have to deal with through their Serious Game design by setting the learning objectives to be achieved. The themes set for the training were chest pain and dyspnea. The students were divided into two teams and start working on their project. Throughout this phase, the teacher will have to support

and guide the students as to the relevance of their game to the subject.

Each team should improve the prototype and develop a second release defining the type of technologies they consider the best for their game design. The students are not required to engage in the development of the game. They are only required to produce a prototype of the look and feel and interface that could help a third person to understand the game interface and interacts.

The third step: Design and production of Serious Games
As a design tool, we offer them a free version of the “VTS Editor” software with an introductory course in its handling.

The fourth step: Presentation and evaluation of completed projects

Each of the team has completed the game design successfully. The game design process has been evaluated. Some screen casts of a serious game designed by students is represented in figure 2.



Figure 2 : Some screen casts of the serious game

a/ the interface of the game, b/ screencast of the game background consisting in a medical consultation, c/ screencast of level one, d/ a screencast showing a correct answer given by the students

Data collection procedure:

The different methods of data collection used are the interview and the reflective journal. The data collection was done in two complementary steps. First, a socio-demographic questionnaire used to construct the profile of students. A code number was assigned to each student. The second step consisted of semi-structured interviews based on an interview guide.

The semi-structured individual interviews were conducted using close ended questions and multiple choice questions that could lead students to describe his / her experience. They were textually transcribed by two researchers. The data were re-read as many times as necessary.

Data Analysis:

Apart from the collection of verbal data, the other four phases of the phenomenological data analysis process (9) were implemented:

- *Studying interviews:* By reading repeated verbatim and annotating relevant ideas. This stage aims to divide the text into groups of ideas that all reality exist in the discourse. The researcher occurs with the specific aim of discriminating "unit of meaning" each time that a transition in meaning and to extract the significant segments (9).
- *The discrimination of data into units of meaning* relies on a very slow reading. At the end of this step, a series of units of meaning were grouped under several sub-themes, which were voiced through the participants' language (9).
- *Organization and statement of data:* At this stage, the researcher had to use his imagination to express the main ideas implied within the extracts of units of meaning and group them in developing a consistent statement themes and sub-themes (9).
- *Summary of findings:* According to Giorgi (9), this step is the last one in the analysis process. Following the use of imaginative variation, this step consists in looking for the essence of the phenomenon (9).

RESULTS

The participants in our study were twelve third-year medical students. Of these 12 students, 9 were female. The duration of each interview depends on each participant's ability.

The experience of students who participate in the serious game design: after conducting the process of data analysis, four central themes emerge :

- a) « **Critical thinking skills and problems solving skills** » which includes a large sub-theme: Identify the problem, Define the context, enumerate the choices, analyze options, list reasons explicitly and self-correct.
- b) « **Communication** » which includes a large sub-theme: expressing ideas or concepts using appropriate language, conventions or protocols, and demonstrating respect and responsibility when communicating with others.
- c) « **Creativity** » which includes the following sub-themes: Think creatively and Work creatively with others.
- d) « **Collaboration** » which includes the following sub-themes: (1) sharing responsibilities and supporting others to achieve a common goal, (2) demonstrating sensitivity to diverse cultures, audiences or contexts when working with others, (3) exhibiting reciprocity and trust when sharing ideas or roles.

The following verbatim present some of the comments of the participants:

The first central theme is « Critical thinking skills and problems solving skills ». This theme has been demonstrated in these students. The following quote is very revealing about the feeling of our participants:

« ...By designing a serious game, I can identify the learning objectives and the problem »

« ...I can also define the context and analyze options and that my understanding of the topic had become more easier".

The second central theme that can be explored from the experience of the students is « communication ». The sub-themes identified are expressing ideas or concepts using appropriate language, conventions or protocols, and demonstrating respect and responsibility when communicating with others.

"...When I practice this activity, I felt confident to express ideas with the others student »

« ... I learn how to communicate my ideas using appropriate words to the group »

The third central theme that characterizes the experience of designing serious games, is "creativity "which includes the following sub-themes: think creatively and work creatively with Others.

All participants agreed that it is very important to develop creativity.

« ... The fact that i can choose avatars and create a history, let me feel very creative »

The fourth central theme that can be developed from the students' experience is « collaboration ». All students agree that is very important to work together to achieve a project.

« ...I feel very happy to share the responsibility and support the ideas of another student to achieve the serious game »

DISCUSSION

The findings of this study confirm several findings of other studies. The approach to SG design by students certainly featured direct benefits such as the improving of critical thinking and problem solving; creativity; communication and collaboration. The benefit of the students designing and developing the SG is its adaptability to new and enhanced SG contents.

Serious game design as an activity to improve students' critical thinking and problem solving

Our research findings suggest that a serious game design activity context might provide the development of critical thinking and problem solving for medical students. Teaching critical thinking and problem solving effectively for students is essential (11).

Learning critical thinking leads students to develop other skills, such as a higher level of concentration and deeper analytical abilities (12).

According to Snyder and Snyder (13), to produce critical thinking skills, students require training, practice, and patience. The serious game design enables students to think deeply and to solve non familiar problems in different ways (14).

The results of our study are related to the research of Jonassen and Land (15), computers could be cognitive tools that support the knowledge modeling process. The serious game design enables students to reason effectively, to engage in systematic thinking, develops their ability to the make rational judgments and decisions, and enhances their ability to solve problems.

By designing the game, they should inquire, analyze and model the topic and has to structure it as a game, including game and learning objectives, narrative mechanics

(16,17), game mechanics and learning mechanics (18).

Serious game design as an activity to improve students' creativity

The second indicator measured in this study is creativity. The variable indicators of creativity are 'think creatively' and 'work creatively' with others that was adapted from Piirto [5]. From the data above, indicators of think creatively have sub indicators like use a wide range of idea creation techniques (such as brainstorming), create new and temporary ideas (both incremental and radical concepts) and elaborate, refine, analyze and evaluate their own ideas in order to improve and maximize creative efforts. Meanwhile, the indicators of Work creatively with others have sub indicators; develop, implement, and communicate new ideas to others effectively, be open and responsive to new and diverse perspectives; incorporate group input and feedback into the work.

These findings, help teachers to develop this activity of designing SG, that have the ability to develop, implement, and provide new ideas to others, as well as being open and responsive to different new perspectives. Sternberg (19) writes that creativity is the key to discoveries. That means, learners are not only asked to just solve the problems in order to get good grades.

Serious game design as an activity to improve students' communication skills

Communication skills include sharing ideas through oral, written or non-verbal media. Indicator of communication skills is measured from the implementation of classroom learning and scientific articles that are the product of the output of education internship activities. Indicators on this skill include clarifying the purpose or intention of a message in relation to audience, context or culture, considering perspectives, emotions and experiences when seeking shared understanding, decoding and interpreting ideas, expressing ideas or concepts using appropriate language, conventions or protocols, and demonstrating respect and responsibility when communicating with others.

Our findings have been similar to other studies, that serious game design aims to develop an awareness of games as sociocultural objects (20). The serious game design process also values the knowledge, experience of the community members interviewed during the game design process.

In our study, the result of the digital game design is not the goal; instead, we focus on the serious game design process as a participative learning experience as much research in this field (5, 21,22) that is able to engage the game designers with the participants in a powerful knowledge modeling activity (7,22).

Serious game design as an activity to improve students' collaboration

Another skill that must be possessed and applied in the learning process is the skill of collaboration. Indicators of collaboration skills that are measured in this research are sharing responsibilities and supporting others to achieve a common goal, demonstrating sensitivity to diverse audiences when working with others, reciprocity and sharing ideas or roles, valuing accessibility, compromise and the contribution of others to nurture positive working relationships.

The collaboration provides an overview where learners demonstrate their abilities in teamwork and leadership, adapt roles, respect and responsibilities. To grow this character, the learners must be accustomed to work in teams.

Serious game design aims at engaging one or more person in an interactive and collaborative activity (23-26). Our interest in the game design activity like others study, is not focused in the professional process of creating games, but in the game design activity itself as a sociocultural and knowledge modeling activity (7).

Limitations of the study

The educational experience, we report is limited. It only included a small number of students whose selection was not randomized and interested only volunteers third year medical students, no comparison group and no prospective follow-up.

The assessment we report is also very partial and the outcome was subjective. Our results are therefore relatively preliminary. To be better judged, our educational approach should be applied for a longer period and should involve a much larger number of students.

Finally, the educational activity that we report does not allow to specify the place of serious game design in relation to other means of learning.

CONCLUSION

Employing game development-based learning as a method to impart multi-dimensional skills and knowledge on software development suggests being a promising approach from various angles. The students exhibited a high level of dedication and engagement with the project due to the immediate results of their work and the direct application of it. The segmented structure of the SG design and development tasks allowed for attribution of individual performances, which is an often discussed topic on group work assignments.

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