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Schneider Voirol, Marie Paule; Fassier, Thomas

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Large-scale, mobile and technology-enhanced serious game for interprofessional education: pilot study and lessons learnt

Patricia Picchiottino ^a, Adeline Paignon ^a, Liudmyla Hesse^a, Sophie Bos^a, Joanne Wiesner Conti ^a, Marie P. Schneider ^{b,c}, and Thomas Fassier ^d

^aGeneva School of Health Sciences and Centre for Interprofessional Simulation, University of Applied Sciences and Arts of Western Switzerland HES-SO, Geneva, Switzerland; ^bSchool of Pharmaceutical Sciences, University of Geneva, Geneva, Switzerland; ^cInstitute of Pharmaceutical Sciences of Western Switzerland, University of Geneva, Geneva, Switzerland; ^dDivision of Internal Medicine for the Aged, Geneva University Hospitals, University of Geneva Faculty of Medicine and Centre for Interprofessional Simulation, Geneva, Switzerland

ABSTRACT

Recent research suggests that serious gaming is a promising strategy for interprofessional education (IPE). This report describes the design and pilot testing of a large-scale, mobile, technology-enhanced serious game embedded in the IPE curriculum in Geneva, Switzerland. Organized into teams of eight, the students were tasked with finding a young patient who had just escaped from the intensive care unit. Through a series of 10 stations, they explored hospital- and community-based locations of the healthcare system and were engaged in various learning and game activities; they were rewarded with cues to unveil the mystery. A total of 582 undergraduate students from seven disciplines (medicine, midwifery, nursing, nutrition-dietetics, pharmacy, physiotherapy, and technology in medical radiology) took part. Survey results (response rate: 62.8%) suggest that an overall majority of students valued the game, particularly the collaborative experience of actively learning from others in autonomous teams. Qualitative feedback allowed us to identify future areas for improvement: simplifying the adventure storyline and optimizing student flow. Educational institutions across the world facing challenges when creating IPE activities will find in this report ideas and lessons learnt to use mobile technology and serious gaming for large cohorts of students.

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Introduction

Interprofessional education (IPE), namely when at least two different professions learn with, from and about each other, aims to support students to acquire IPE competencies (Hammick et al., 2009). Experts recommend to transcend professional silos early to prepare future healthcare workforce (Frenk et al., 2010). Yet, integrating IPE collaborative activities into shared curricula is a complex educational challenge, especially for large cohorts of students from multiple programs (van Gessel et al., 2018).

Serious games are gaming activities (e.g., board game, puzzle, quiz, physical or virtual simulation, escape, adventure game) designed for educational purposes through entertainment (Olszewski & Wolbrink, 2017). Originally introduced in various, individual healthcare professions, they have a positive impact on learning knowledge and skills (Gorbanev et al., 2018; Maheu-Cadotte et al., 2020). Recent reports of serious games across healthcare professions suggest positive IPE outcomes such as communication, collaboration, and understanding other professions (Friedrich et al., 2019; Fusco et al., 2022; Joseph & Diack, 2015). Designing a serious game is complex: it should be engaging, challenging, and rewarding to increase students' motivation, satisfaction and learning experience (Davis et al., 2022; Olszewski & Wolbrink, 2017; Schwabe &

Göth, 2005). Moreover, designing an IPE serious game is an organizational challenge due to the large number of students trained together in a shared learning space, such as a classroom for board games or a simulation room for escape games (Chan et al., 2020; Friedrich et al., 2019). Technology-enhanced serious games could provide opportunities to increase access to IPE to large numbers of students (Pulman et al., 2009; Samarasekera et al., 2022). Mobile technology may have the additional potential to bring IPE serious games outside classrooms and simulation laboratories to explore large-scale naturalistic learning environments such as the whole university campus (Schwabe & Göth, 2005). This report describes a pilot study of a large-scale, mobile, technology-enhanced serious game embedded in an IPE curriculum.

Background

Setting: the IPE curriculum in Geneva, Switzerland

Since 2013, the University of applied sciences Western Switzerland, the medical school and the pharmacy school of the University of Geneva train together 1,800 students in medicine, midwifery, nursing, nutrition and dietetics, pharmacy, physiotherapy, and technology in medical radiology. This 3-module IPE curriculum is based on the Canadian IPE

competency framework and TeamSTEPPS® (van Gessel et al., 2018). In the first IPE module, pre-clinical Bachelor degree students are involved in workshops, plenary sessions, and discussions in small IPE teams on learning cases, which are the main learning strategies. In 2022, thanks to student feedback, we identified the need for an additional learning strategy to help students achieve the learning goals of this first module: discovering the healthcare system, understanding the roles and responsibilities of other healthcare professionals, and experiencing team collaboration.

A triple challenge: educational, organizational and technological

We designed an IPE serious game and addressed the following triple challenge. *Educational*: we wanted the activity to be engaging and fun for students without prior exposure to clinical teamwork. *Organizational*: we needed a prototype to enable a large cohort of 600 students to familiarize themselves with the Geneva healthcare system in a single day. *Technological*: we intended to test the feasibility, relevance and barriers of using mobile technology as part of an IPE serious game. We hypothesized that technology would facilitate both the educational challenge, by engaging students in learning tasks and gaming, and the organizational challenge, by allowing large-scale participation while saving IPE trainers human resources.

Mobile technology-enhanced IPE serious game: development process

In brief, we went through the following steps (Davis et al., 2022; Olszewski & Wolbrink, 2017). First, our core team of IPE trainers met with a consultant expert in adventure games. We identified key hospital- and community-based locations of the healthcare system, the professionals, and the facets of interprofessional practice we wanted students to explore. We estimated that it would take eight to ten 10-minute game stations to engage the entire cohort, divided into 74 teams each with eight students. Second, the consultant created a narrative story to engage students and connect the stations within an adventure scenario, while the IPE trainers designed the rules of the game (see Table 1). Third, we elaborated with the IPE trainers of the seven professions the learning tasks and game activities for each station (Table 2). Finally, the consultant organized the web-based technology and tools that underpinned the game. Before going live, we piloted each station twice with peer trainers and a patient-as-partner.

Methods

To measure students’ self-perception of their learning experience, we designed an 8-item individual survey with a 4-point anchored scale. The survey was available online. We collected

Table 1. IPE serious game: Storyline, goal, rules, and mechanics of the game.

Narrative hook and goal	Eva, a 22-year old female patient, has just disappeared from the intensive care unit where she was about to die after a tragic accident. Eva is pregnant and diagnosed with gestational diabetes. Students have been called upon to support healthcare teams overwhelmed by the flu pandemic. Their mission: find the missing person and find out what happened.
Rules of the game	Students were given an orientation map showing the location of the 10 stations in the health care network, allegedly the patient’s mobile telephone recent traces in the city. They were expected to work as a team to decide on a strategy for exploring the stations. At each station, they had to scan QR codes with their mobile telephones to access multimedia resources describing the healthcare setting, the tasks and the game instructions (Table 2). At the end of the game, students were instructed to conduct a self-debriefing of their team’s work during the day and to share their key learning points on a virtual dashboard (Padlet®).
Mechanics of the game	Using the map, students were free to self-determine the chronological order of the themed stations they planned to visit, meaning there were a number of ways to find the solution (autonomy). Should they succeed, they were rewarded with cues that gradually unveiled the mystery of the lost patient (cascading information). Their decisions had consequences on their ability to finish the game given the time constraint (branching scenario). Teams had to race against the clock (no competition mechanism).

Table 2. IPE serious game blueprint: Professional and interprofessional focus, station location, learning tasks and gaming activities.

Learn from/about (Who?)	Station location (Where?)	Learning tasks (What?)	Gaming activities (How?)
Dieticians	Youth health service	Calculate the amount of sugar in different ingredients Explore an obesity awareness campaign	Quiz
Medical radiology technicians	Medical imaging center	Name imaging technological devices Rank them according to their irradiation risk	Picture quiz
Midwives	Community birth center	Consult a standard obstetric record Calculate pregnancy due date	Sim. practice (obstetric wheel) Hidden clue game, crossword
Interprofessional (physicians and nurses)	Geriatric emergency room	Practice an ABC primary survey	Sim. practice (manikin) Secret code game
Physicians	Primary care medicine office	Use a self-monitoring blood glucose device Interpret results in a blood glucose record	Simulated practice (glucometer)
Nurses	Community nursing service	Identify fall hazards in the household	Guess the picture quiz
Physiotherapists	Physiotherapy office	Measure the range of motion of different joints	Sim practice (goniometer) Secret code game
Pharmacists	Community pharmacy	Identify the role and practice of pharmacists in the dispensing and use of medicines	“Unlock the box” game Secret code game
Interprofessional (all)	Innovation center (hospital)	Experience cognitive biases and impact of human factors in health care	Visual tests, video demos
Interprofessional (all)	Interprofessional simulation center	Lift and transfer of a physically disabled or unconscious patient	Simulated practice (manikin) Crossword game

Table 3. Student self-assessment of the IPE serious game ($N = 366$, response rate 60.7%).

Survey items	Strongly agree and agree
I learnt more about the healthcare system	67.7%
I better understood the respective roles of healthcare professionals	68.8%
I am more aware of the scope of practice of each health profession	64.6%
Through this experience, I experienced interprofessional teamwork	81.3%
I enjoyed participating in the adventure	75.8%
I was able to take an active part in the progress of our adventure	88.4%
I appreciated that our team was autonomous during the adventure	92.4%
I found this an original way of discovering interprofessional practice	86.8%

anonymous data using *evasys*[®] survey software and performed descriptive statistical analysis with *Microsoft*[®] Excel. Students were invited to provide additional qualitative comments, and students' most illustrative quotations about the educational, organizational, and technological challenges underpinning the game were identified. Key learning points identified by student teams on the virtual dashboard (*Padlet*[®]) were also used as qualitative material for illustrating the educational challenge. According to Swiss law, the Geneva Ethics Committee waived a complete review for this study (Req-2023-01092).

Results

For the first time in January 2023, 582 students participated in the IPE serious game, among the 603 students enrolled in the module (21 absent students due to illness or accident): 172 from nursing, 150 from medicine, 94 from pharmacy, 48 from technology in medical radiology, 45 from physiotherapy, 39 from nutrition and dietetics, and 34 from midwifery. In total, 366 (62.8%) students answered the survey. A large majority valued the game, especially the collaborative experience of actively learning from others in autonomous teams (Table 3). Table 4 displays the quotations illustrative of the triple challenge addressed in designing the game. Participants unanimously illustrated how they perceived the positive learning effects of the game. Students' comments on the organization were contrasted: some valued the immersive and gaming experience, while others complained that its large scale

impaired their experience. Comments on the technology used were mostly suggestions for improvement.

Discussion

In this pilot study, we tested the feasibility, relevance, and barriers of engaging a large cohort of 600 students in interprofessional team learning through a mobile and technology-enhanced serious game. We found this strategy effective to expose pre-clinical students to the essence of IPE: to enjoy the experience of learning from, with and about other professions within a community of practice (Hammick et al., 2009). The positive educational impact is consistent with previous studies that have reported an effect on students' interest and motivation to develop interprofessional competencies (Friedrich et al., 2019; Joseph & Diack, 2015).

The students' comments highlighted the need to better interconnect entertainment and learning. In retrospect, we consider that the interplay between the storyline, the learning tasks, and the gaming activities was too complicated. In line with previous research, we plan to simplify the storyline (Davis et al., 2022) and to improve the feedback and reward mechanisms to increase motivation (Gorbanev et al., 2018; Olszewski & Wolbrink, 2017). In the future, we also plan to use the post-game team debriefing (Friedrich et al., 2019) to further improve the students' ability to reflect on interprofessional competencies and *TeamSTEPPS*[®] strategies. Although we have successfully engaged our large cohort of students in autonomous yet guided learning experiences with a limited

Table 4. Student perception of the IPE serious game: Most illustrative quotations from survey and team debriefing (Online Virtual Dashboard).

Challenge	Illustrative quotes
Educational	I loved this game in the city! It was fun and I discovered places I didn't know about. I learned more about how different settings the health system work. This allowed me to gain a better understanding of the different professions and to work together toward a common goal. This activity was useful to discover teamwork and how to collaborate effectively. These activities quickly generated communication and collaboration between students.
Organizational	The course was immersive and challenging! The puzzles had an adequate level of difficulty, and the quality of the story-telling showed that it was carefully designed. There were bottlenecks in the stations, there were many teams. . . The fact that we were numerous sometimes spoiled the immersive experience: we could hear the other groups too much. At first, it was quite complicated to understand what we had to do. The different activities should have been more interconnected. The links between the story and certain stations were not very clear. We have not necessarily seen clues that were related to the resolution of the adventure.
Technological	The game was very good and modern with QR codes, but we should not do so much reading It was nice to be alone, to make it on our own without asking for help. Be sure to lock the web-pages to avoid spoiling the end of the day! The interface was not user-friendly, it was complex to access the documents again It was difficult to hear the audio content when we were outside . . . needs headphones, like audio guides Too bad we had to use the smartphone all the time, it prevented real communication between us It's a constraint to have a phone with an Internet connection . . . I didn't have one.

number of IPE trainers, the students have stressed that the flow of students needs to be optimized. We therefore plan to engage half of the cohort at a time, with increased starting points. We will also introduce a competition mechanism between teams to stimulate and maintain motivation until the end of the game. The embedded mobile technology had both positive and negative effects. On the one hand, it enabled students to explore the local health system, a true opportunity to use a real environment as a learning context (Schwabe & Göth, 2005). On the other hand, some students reported how the use of individual telephones diminished interpersonal communications and team dynamics.

Limitations

Our pilot study had some limitations. We had no baseline data to compare with, nor did we have a control group. Students in pharmacy and physiotherapy had examinations in the weeks following the event: this potentially altered the students' involvement, response rate and survey results. Future research is needed to demonstrate the added value of the IPE serious game, ideally comparing the results of pre- and post-surveys and with a randomized control group of students exposed to a more traditional educational format.

Conclusion

Educational institutions across the world face educational and organizational challenges when designing and implementing IPE activities for large cohorts of students in limited learning spaces. Based on this pilot study in Geneva, Switzerland, we conclude that a mobile technology-enhanced serious game has the potential to introduce and support interprofessional collaborative learning for a large cohort of students in the naturalistic learning environment of local health care facilities. Key lessons learnt for future improvement include: simplifying the interplay between the adventure storyline, learning tasks, gaming activities, and optimizing student flow.

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Notes on contributors

Patricia Picchiottino (MAS, BSc) is a Senior Lecturer at the University of Applied Sciences and Arts of Western Switzerland HES-SO, Geneva, Switzerland. Deputy Director of the Center for Interprofessional Simulation, she coordinates the interprofessional education curriculum at the Geneva School of Health Sciences HES-SO, Geneva. Midwife by training, she has a special interest in simulation-enhanced interprofessional education.

Adeline Paignon (PhD, MSc, BSc) is a Senior Lecturer at University of Applied Sciences and Arts of Western Switzerland HES-SO, Geneva, Switzerland. She has extensive research experience in social psychology and health professions education, with a special interest in faculty development. She is the coordinator of research at the Centre for Interprofessional Simulation.

Liudmyla Hesse (MSc, BSc) is a Scientific Collaborator at University of Applied Sciences and Arts of Western Switzerland HES-SO, Geneva, Switzerland. Her interests are in interprofessional education and technology-enhanced learning.

Sophie Bos (BSc) is a Teaching Assistant at the University of Applied Sciences and Arts of Western Switzerland HES-SO, Geneva, Switzerland. Technician in medical radiology by training, her interests are in interprofessional education and serious gaming.

Joanne Wiesner Conti (MSc, BSc) is a Senior Lecturer at the University of Applied Sciences and Arts of Western Switzerland HES-SO, Geneva, Switzerland. Master trainer TeamSTEPPS®. She has extensive research experience in psychology and interprofessional education, with a special interest in patients as partners in education.

Marie P. Schneider (PhD, MSc) is an Associate Professor at the University of Geneva. She coordinates the interprofessional education curriculum at the Institute of Pharmaceutical Sciences of Western Switzerland. She has extensive research experience in the areas of medication adherence, communication in health and interprofessional collaboration and practice.

Thomas Fassier (PhD, MD, MHPE, MPH) is a Senior Lecturer at the University of Geneva and Attending Physician at the Geneva University Hospitals. Director of the Center for Interprofessional Simulation, he coordinates the interprofessional education curriculum at the Faculty of Medicine. Physician by training, he has a special interest in simulation-enhanced interprofessional education.

ORCID

Patricia Picchiottino  <http://orcid.org/0000-0001-7110-9220>
 Adeline Paignon  <http://orcid.org/0000-0003-0634-8334>
 Joanne Wiesner Conti  <http://orcid.org/0000-0003-2028-6141>
 Marie P. Schneider  <http://orcid.org/0000-0002-7557-9278>
 Thomas Fassier  <http://orcid.org/0000-0001-5853-8450>

Data availability statement

The data presented in this study are available on request from the corresponding author. The data are not publicly available due to ethical reasons.

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