

# Student–staff Co-creation of Serious Games

## - Lessons Learned

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### Abstract

Few papers have described academic/faculty staff's experiences with co-creation, or partnering with students in cross-disciplinary collaborations. The purpose of this paper is to share challenges and outcomes from two interdisciplinary student–staff co-creations of serious games for use in a Bachelor of Nursing program in Norway. Our experiences are discussed against an evidence-informed model of student–staff co-creation in higher education. Based on the lessons learned from these two projects, we propose ten key points for planning and conducting cross-disciplinary student–staff co-creation of serious games.

### Keywords

Collaboration, design, education, games, interdisciplinary

## 1 INTRODUCTION

Stuckless, Hogan, and Kapralos [1] define a serious game (SG) as “an interactive computer application that (1) has a challenging goal, (2) is fun to play and/or engaging, (3) incorporates some concept of scoring, and (4) impacts to the user a skill, knowledge, or attitude that can be applied to the real world” (p. 146). Serious games used in health care can provide different forms of simulated environments (virtual reality, video, picture, animation), which provide opportunities to practice clinical reasoning and decision-making skills in realistic and safe environments [2]. However, for SGs to enable active, experiential, and problem-based learning, special efforts need to be made in the design and development of SGs [3]. For example, academic/faculty staff need to design the educational content in consideration of the target users, genre/story/context, and learning objectives and ensure evidence-based content. In addition, user–computer interaction design elements must be ensured [3] [4] [5]. Hence, it is important to employ interdisciplinary collaboration which ensure competence within relevant areas and disciplines.

Cross-disciplinary student–staff co-creation of educational tools, such as SGs, may facilitate two dual-value creation dimensions: co-production and value-in-use [6]. Such collaboration and value creation are also in line with the university's vision and strategy for 2021–2024 [7], the White Paper [8], and the United Nations' sustainability goals [9]. Few papers have described academic/faculty staff's experiences with co-creation, or partnering with students in cross-disciplinary collaborations [10] [7]. Mercer-Mapstone et al. [10] call for papers sharing in more detail the challenges and possible negative outcomes of such partnerships. Hence, the purpose of this paper is to share challenges and outcomes from two SG co-creation projects. First, we present the two SGs. Second, we

describe and discuss our experiences against an evidence-informed model of student–staff co-creation in higher education [6], which provides an interdisciplinary view for conceptualizing, designing, implementing, and evaluating co-creation in education. This model considers the following three key elements of co-creation: inputs (individual and environmental considerations), processes (barriers that can arise in co-creation, mechanisms needed to support student–staff co-creation, co-production, and value-in-use), and outputs (benefits for students and staff). Finally, we propose ten key points for planning and conducting cross disciplinary student–staff co-creation of serious games.

## 2 THE TWO GAMES

### 2.1 “I-cannot-breathe”

The single-player SG “I-cannot-breathe” [Jeg-får-ikke-puste] aimed to teach nursing students clinical reasoning and decision-making skills in care for patients with COPD [11]. It was video-based and contained different quiz-based tasks that needed to be solved before continuing the game. The game was linear; users could not direct the nurse in the game or change paths based on their choices. The correct answers were demonstrated by the nurse through the video, and the answers could be viewed on the screen. Figure 1 shows a screenshot from one of four different scenarios.

This game was developed as part of the first author's PhD project connected to the Department of Health and Nursing Science. The PhD candidate collaborated with health personnel and supervisors in developing the educational and evidence-based content. Four students from the Department of Information and Communication Technology chose development software, recorded the videos, assembled video clips and quiz-based tasks, and integrated these with necessary instructions on how to use the SG. The development software chosen by the students

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were Adobe Captivate 8, Adobe Premiere Pro CC, and Adobe Photoshop CS6. HTML5 was chosen for uploading to an internet address. Available platforms were PCs, laptops, and the newest tablets [12].



Figure 1. A screenshot from “I-cannot-breathe”

## 2.2 “Hans and the welfare technology”

The online, single-player SG “Hans and the welfare technology” [Hans og velferdsteknologien] was an interactive, non-linear story; the user’s choices in the quiz-based tasks determined the story. It aimed at teaching students to identify and reflect upon ethical and legal aspects in the use of welfare technology. Figure 2 shows a screenshot from the game, where the elderly man Hans rejects the offer of using a GPS tracker.



Figure 2. A screenshot from the SG “Hans and the welfare technology”.

This SG can be categorized as a visual novel, where a story is told using graphics and text and contains a low level of gameplay [13] [14]. A progress tracker based on points

given for the different choices made in the dialogue and quizzes (yellow line in Figure 2) increased the level of gamification and resulted in automated feedback to the students on their overall achievement. They also received feedback and correct answers in the form of text.

This SG was developed as part of a larger project in connection to the Department of Health and Nursing Science, led by the second author. The second author collaborated with the first author and a nurse from the municipality health care services in developing the educational and evidence-based content.

Four students from the Department of Information and Communication Technology were responsible for the development of the SG—three for programming [13] and one for graphical design [14]. The development/programming software used by the students were JetBrains Rider, JetBrains WebStorm (for JavaScript, CSS, and HTML-elements), Git, Bitbucket, and Overleaf (LaTeX-editor). The design software chosen was Pixel art.

## 3 LESSON LEARNED

The challenges and outcomes of the two projects will now be described and discussed in light of the three key elements of supporting student–staff co-creation: inputs, processes, and outputs [6].

### 3.1 Inputs

Individual and environmental factors, such as individuals’ previous history and experiences with student–staff co-creation, individuals’ motivation, authenticity, and clarity of the activity, constitute the foundations of a co-creation activity before it begins. According to Dollinger and Lodge [7], these inputs are critical to the subsequent processes and outcomes of the experience.

#### 3.1.1 Individual Considerations

In relation to individual experiences, the managers of the two projects (authors) were both nurses with no previous technical experience in SG development. They also had limited experience with student–staff co-creation and project management. The developers of the SG were bachelor students from the Department of Information and Communication Technology with different levels of design and programming experience. The students were recruited through the university’s own website, “Kompetansetorget” [The Competence Square].

The motivations of students and staff were quite different. The students conducted this project with the intention to pass their exam and get a bachelor’s degree. The academic staff aimed to implement the SGs as part of their course, conduct related educational research, and publish the results. As suggested by Dollinger and Lodge [6], motivation and aims should have been addressed at an early stage. Then, the effort for value creation could have been more intertwined.

#### 3.1.2 Environmental Considerations

Important environmental considerations for a co-creation project include clarity of the activities or tasks that should be conducted in the student–staff co-creation process [6]. The most serious pitfall for a project is if one chooses a level of detail in the task description that is either too coarse or too fine [15]. In the first project, a formal agreement

between the two faculties was signed. This specified roles, contributions, and the sharing of resources and costs for development. In the second project, a formal agreement was intended, but only an informal agreement was made. This was due to many involved parties and the lack of a standard procedure for co-creation. In retrospect, the agreements (formal/informal) could have benefited from more details concerning supervisors' roles and responsibilities and the handling of possible risks (3.1.2).

For SG development, it is important to make a detailed specification of the SG in collaboration with the developers [5]. These specifications include, for example, the game engine, database, software applications that fit with planned features in the SG, platform (touch-tablet, laptop, personal computer (PC), smart-phone), and, if desired, compatibility with a Learning and Management System (LMS). In addition, there are many other things that must be considered. What format and user-computer interaction design do we want (videos, graphics/photos, text) and how should users interact with the game (visual/audio, mouse/touch)? Should the SG include different types of questions (e.g., single or multiple answer, drag-and-drop questions), and should it provide the ability for users to choose wrong answers deliberately and view the consequences of their choice? How about in-game assessment? Should users answer questions or complete tasks before they can continue, and do they receive points and a get a final score? What kind of feedback should the user receive during gameplay? And do we want a single- or multiplayer SG?

Depending on whether the game is linear or the user has the option to choose different paths, a storyboard and a decision tree must be developed. One should construct a storyboard for each SG scenario [16] [17]. Each storyboard must contain a detailed description of the SG story, educational content, actions in each video clip or screen with related quiz-based tasks, and questions with answers. Finally, depending on what type of game is developed, one may need special equipment during development (e.g., video cameras and microphones).

In both projects, the description or specifications of the game could have been more detailed, as indicated by the necessity of several adjustments during development.

## 3.2 Processes

### 3.2.1 Barriers

Certain mechanisms are needed to support student-staff co-creation. Some barriers that may arise during the processes of co-creation include role confusion, need for student-staff guidance, inexperience of participants, inclusion of assessment, time, and power imbalance [6].

In relation to organization and roles, the PhD project had a quite simple organization compared to the other project. Here, the SG development team consisted mostly of the PhD candidate and the four recruited students from the bachelor program in Multimedia Technology and Design. The students received supervision from domain experts, who attended the first meetings. After that, most communication with the students' supervisors was through e-mail.

For the second project, the development team consisted of two faculty members (authors) from the Department of Health and Nursing Science, as well as four students and their supervisors from the Department of Information and Communication Technology (one from the bachelor program in Multimedia Technology and Design and three from the bachelor program in Computer Engineering). In addition, one nursing student and a consultant from the ICT department was involved in the co-creation of the SG.

In relation to barriers such as the inexperience of participants, we had no information about the level of experience of each student or how much guidance the students received from their supervisor during the SGs' development. The two teachers (authors) responsible for the SGs' development were nurses, not technicians, and were unaware of all aspects and risks in designing SGs. This caused a power imbalance between the students and academic staff. To carry out the SG development, these two projects were highly dependent on the students and supervisors from the bachelor program in Multimedia Technology and Design.

Dependence on others to be able to carry out a project may be indicative of a high-risk project [11]. Hence, recruiting students with desired skills and motivation, as suggested by Dollinger and Lodge [6], may decrease the risk of project failure. Further, it is important that the students can collaborate as a team. Hence, assistance in recruitment from teachers who knows the individual students may decrease the chances of project failure.

However, even if the right students are chosen, one has no insurance that the project will not be delayed. For example, the game "I-cannot-breathe" was not quite finished when the students submitted their bachelor thesis. The PhD candidate had to cover the expenses when one of the bachelor students finished the game. The consequences of not finishing this SG and the PhD project could have been great. As part of the environmental considerations (3.1.2), there should have been a backup plan for development software and the involvement of the ICT department from day one. Based on experiences from the PhD project, such a backup plan was made for the game "Hans and the welfare technology." Furthermore, a technical solution was chosen that made the clients less dependent on the students' work in relation to adding text.

According to Dollinger and Lodge [6], lack of time and included assessment may cause barriers in the co-creation process. The students in the first project managed to participate in usability testing of the game "I-cannot-breathe" before submitting the bachelor thesis. The testing was beneficial to both the students and the PhD candidate: the students got input from users to improve the game, and the PhD candidate included the usability test as part of her research. In the project "Hans and the welfare technology," a nursing student followed the whole design process and tested the game frequently. Usability testing was planned as part of the project. However, it could not be carried out due to trouble with recruiting nursing students. This was partly due to an overload of other course evaluations at that time and other research requests. In retrospect, we learned that one should plan the recruitment of students for educational research activities at an earlier stage and in better collaboration with leaders. It is important that such

evaluation activities are planned according to the overall education program and course evaluations. In addition, educational research activities in a study program should preferably be aligned to prevent evaluation overload and the consequences of technology from co-creation projects not being formally and scientifically evaluated. The latter may decrease the value of the final co-creation outcome.

### 3.2.2 Co-production

Communication and follow-up are important elements in student-staff co-creation [6], as in project management [11]. In retrospect, we recognize that meetings between the development team members and their supervisors could have been held on a more regular basis to agree on design and to discuss challenges in the design and development process. However, not all supervisors attended the scheduled meetings or contacted the project manager during the development process.

As mentioned in 3.1.2, we experienced that the specification of both games should have been more detailed. In retrospect, the two games could have benefited from earlier involvement of the students and their supervisors in planning the games. Then, some of the technical issues probably could have been avoided. For example, with “I-cannot-breathe,” we experienced that the chosen software did not quite fit with the desired functionalities/features within the SG. For example, there were too few possible options that could be chosen in the quiz-based tasks. In addition, the scoring of the tasks needed to be changed. To fit the desired design, the students had to make changes in the software (scripts). Unfortunately, these changes caused some technical issues. In the “Hans and the welfare technology” project, we tried to prevent similar problems by involving an ICT consultant in the meetings with the students. However, in the end, they still chose solutions that made it difficult to upload the editorial solution to the UiA’s servers. Thus, in retrospect, desired functionalities and options within the SG could have been better communicated to the students. Then, the software could have been chosen based on these needs.

In the “I-cannot-breathe” SG, all text and videos had to be included and assembled by the students. The first author spent much time reviewing the text for errors and the desired user interface design. In retrospect, it could have been advantageous to have used software that enabled the teacher to include and edit text and videos, rendering the teacher less dependent on the students. Hence, for the game “Hans and the welfare technology,” this kind of editorial solution was chosen.

### 3.2.3 Value-in-use

In a university context, value-in-use is related to how students or staff create value for themselves through the co-creation activity. This paper focus on the staff’s point of view. The game “I-cannot-breathe” was uploaded to the university’s database. When the SG was released for use, the number of students that could play the SG at the same time was underestimated. This caused technical glitches, such as sound and video lag when the game was tested by a large group of students for the first time. Fortunately, this was quickly adjusted by the ICT department. Assistance from the ICT department was also necessary when the

game suddenly became unavailable. It turned out that the ICT department had to renew the license.

The game “Hans and the welfare technology” was not integrated into the university’s database but was only made available from an online address paid for by the students. Like the other SG, it suddenly became unavailable due to an unpaid license. However, in this case, all edited text in the game also disappeared and had to be reread.

The responsibility for follow-up for the two games could have been planned and formally handed over to the ICT department earlier. Maybe the risk of unpaid licenses and technical glitches could have been decreased, and the value-in-use increased.

## 3.3 Outcomes

There are a lot of benefits of co-creation of SGs with students [6] [10]. In our two projects, we had never been able to develop these SGs without collaboration with students from the Department of Information and Communication Technology. This was due to the high cost of purchasing consultant services and commercial SG software. Co-creation of SGs also enables teachers to contribute to game development and develop their own pedagogical and technological competences. As for the students, they can apply for real client projects and contribute to developing solutions based on clients’ descriptions. This can facilitate fulfilment of their course learning outcomes, such as the requirement to apply current knowledge and technology to analyses and solve problems for industry and the public sector. It could also be beneficial for students’ future employability. Hence, co-creation can be a win-win-situation across education programs.

However, co-creations of SGs are often low-budget projects that may decrease the options of functionalities. In addition, co-creation with students is a time- and resource-intensive activity with many risks involved. Therefore, the value of the co-creation process and possible risks must be weighed against the possibilities of using available open-source editorial tools or purchasing SG development software. However, for the latter, we need anchoring from our own department when it comes to financial resources, but also supervision from the ICT department to choose and evaluate appropriate tools for each project. It is important to ensure that the chosen software fit with the desired SG functionalities. Then, development and implementation of SGs as pedagogical tools could be a more available option for pedagogical staff. Perhaps, in the future, SGs could become the new slideshows.

The creation or use of open-source editorial software represents the most sustainable solution [9]; these enable faculty to improve or develop new SGs that align with changes in learning objectives and ensuring evidence-based content.

To enhance the outputs and value of co-creation [6], the university may benefit from providing some guidelines, technological infrastructure, and support for similar student-staff co-creation projects.

## 5 CONCLUSION

Based on our experiences of challenges and outcomes from the two co-creation projects, we end this paper by

proposing ten key points for planning and conducting cross-disciplinary student–staff co-creation of SGs:

- Make a decision on what level of fidelity and gamification is feasible in your project according to students' technical skills, available time, and budget.
- If available in your organization, use a project template/handbook for student–staff co-creation projects.
- Create a strong interprofessional team (including the students) with well-defined responsibilities and agreements, preferably led by a person with competence in project management.
- The project should obtain an overview of its uncertainty/risk and how it should be handled.
- Develop comprehensive and detailed specification requirements for the SG in collaboration with the interprofessional team.
- Do not underestimate the time needed for faculty members and other professionals to develop and quality-assure a storyboard and decision tree and the pedagogical academic content in the SG's design.
- Chose a SG editorial software where the educational staff can be less dependent on students and technical consultants concerning adding and adjusting text and other content.
- There should be an established communication pattern in the follow-up; ensure that the responsibility for sustainability is formally handed over to the ICT department.
- Evaluation activities must be planned and anchored early in project development.
- Experience and knowledge from the project should be disseminated to serve as inspiration for similar student–staff co-creation projects.

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