

## Using Multiplayer Digital Games to Support Collaboration in Health Education

Anna Janssen ([anna.janssen@sydney.edu.au](mailto:anna.janssen@sydney.edu.au))<sup>1</sup>, Professor Tim Shaw<sup>2</sup>, Peter Goodyear<sup>3</sup>, B. Price Kerfoot<sup>4</sup>

1. Sydney Medical School, University of Sydney, Sydney, Australia
2. Research in Implementation Science and eHealth Group, Faculty of Health Sciences, University of Sydney, Sydney, Australia
3. Centre for Research on Learning and Innovation, Faculty of Education and Social Work, University of Sydney, Sydney, Australia
4. Surgical Service, Veterans Affairs Boston Healthcare System, Harvard Medical School

**Abstract:** The research described in this article explores the value of a multiplayer game for supporting cooperation and collaboration in health education. The digital game was built using the game platform They Know. This platform was used because it enabled the development of team based strategy games in any subject area. The aim of a They Know game is for small teams of players to take control of the opposing teams home base, in order to win the game. The first team to take control of an opposing teams home base wins the game. To achieve this players have to cooperate within their team to develop strategy and share their knowledge about the subject matter in the game. To design a game in the platform subject matter is distributed across a game map in a network, with each node containing multiple choice questions relating to a specific learning objective or curriculum. In the context of this study the game platform was used for the development of an anatomy revision game, They Know: Anatomy.

**Keywords:** serious game, health education, multiplayer, synchronous learning

### 1 Introduction

Interest in the use of digital games for serious applications has been increasing since the early 2000s. However, there is a significant gap in the research into their use in health education. Although researchers have shown considerable interest in the repurposing of commercial games for enhancing surgical skills training, there are significant gaps in the broader application of games based learning in the health sector [1]. Currently, the literature on the use of digital games in health education has explored a diverse range of areas including their use for educating medical students about the delivery of care for geriatric patients [2], the use of digital games to assess mental preparedness of health professional sin training [3], and a number of studies investigating the impact of exposure to commercial digital games on predicting and enhancing surgical skills [4-5]. Further research is warranted into the effective use of digital games in health education and how they can be used to engage learners. This is particularly evident in regard to the use of multiplayer games to deliver immersive and collaborative learning experiences, as there is currently almost no research into their use in health education.

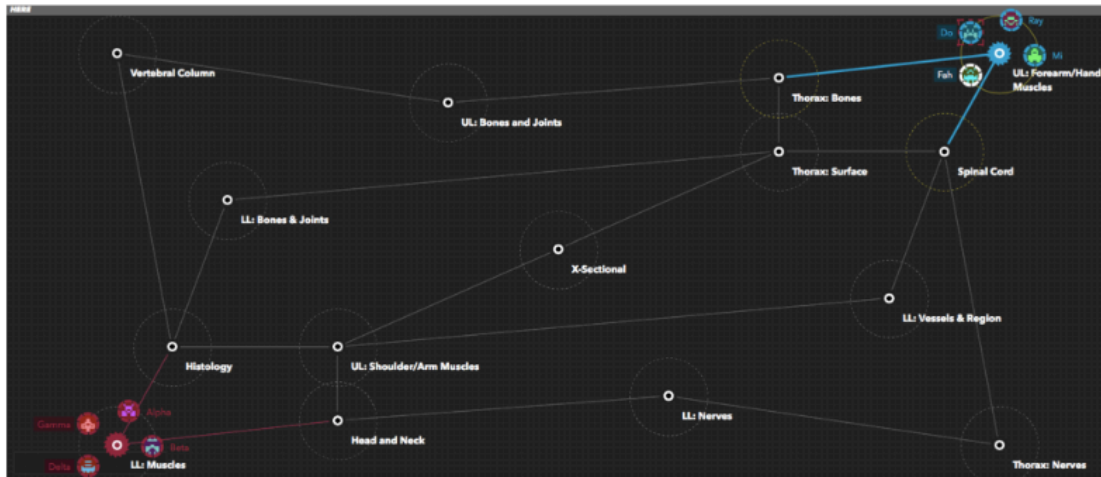
A core component of health education is delivering training around foundational sciences such as anatomy and histology. Although these subjects are integral to health education, they are often challenging subjects for students to learn, due to the breadth of knowledge that has to be internalised [7] and also because of the complexity of the subject matter [6]. Students can also experience other challenges learning anatomy and histology such as a lack of confidence in their understanding of the material, as well as stress and anxiety attempting to internalise core elements [8,9]. As a result of these challenges there is considerable interest in the use of new technologies and tools for the delivery of anatomy and histology education to health students. There are currently two studies that have looked at the use of analogue games to deliver training to this group, a board game developed for medical students [6] and a card game developed for optometry students [10]. Both studies demonstrated the value of the games for improving anatomy knowledge of participants, and also for increasing their engagement with the subject matter.

The aim of this study presented in this article was to explore how multiplayer digital games support student engagement with anatomy and histology subject matter. Although there is some evidence that games can engage health students in anatomy revision, there is currently very little looking specifically at multiplayer digital games.

## **2 Methods**

A mixed methodology was used to evaluate a multiplayer digital game used to support anatomy revision by medical students. Quantitative data collected included game platform metrics such as the number of subject matter nodes encountered by participants, the number of question cards encountered by participants and the number of question cards answered correctly by participants. Qualitative methods included unstructured observations of gameplay sessions, post-match surveys and semi-structured interviews with participants.

The anatomy game used in this study was disseminated using the They Know game platform. This platform was used because it supported multiplayer games, specifically team based strategy games. To win the game players cooperate with their team mates to cross the game map and take control of the opposing teams home base (Refer to Figure 1 for a screenshot of the game used in this study [4]). The game map distributes subject matter across a network of themed nodes relating to a specific learning objective or curriculum area. Each node contains multiple choice questions relating to its learning objective. Players start at their team's home node, which their team controls, and work their way across the network of themed nodes until they reach the opposing teams base. To cross the map players click on a node adjacent to the one they are on and attempt to take control of it for their team. To take control of a node players answer multiple choice questions until enough have been answered correctly to take control of it. A line of control must be created from the player's home base, through the themed nodes to the opposing teams home base in order to take control of it and win the game.



**Fig. 1.** A screenshot of the game *They Know: Anatomy* showing how subject matter nodes are distributed across the game map [4].

In order to develop the questions for the game a team of content developers were identified. The content experts developed a suite of 240 multiple choice questions, which were distributed across 15 subject nodes. The subject nodes covered a breadth of areas including: Upper Limb Muscles – forearm and hand, Lower Limb – nerves, and Head and Neck Anatomy. Once the content had been finalized a member of the research team used graph paper to design multiple maps, one of which would be used for the final game layout. Draft map designs were developed over a series of weeks in order to determine a layout that would encourage players to cooperate with their team mates in order to explore the maximum number of nodes. The successful map design was digitized and used during pilot sessions of the game in 2014.

Second year medical students were recruited in February 2014 to participate in gameplay sessions. During recruitment they were advised that the game was team based and that it had been designed to help them revise anatomy and histology subject matter that they had encountered as first year students. Participants were assigned to a game session, which consisted of at least two matches of the digital game spaced three days apart. Each match in a session was intended to be no longer than 60 minutes in duration. Participants who had expressed interest in participating in a gameplay session were emailed the dates of each session and invited to sign up for one that suited their availability. Up to eight participants could participate in a session, with participants being assigned to one of two teams of four players. All participants in a session played the game synchronously with the other players. Participants on the same team were co-situated in a single computer lab, but each had access to their own desktop computer. They controlled their own player avatar, but could see the movements of all other players across the map. Their team mates had blue avatars and those on the opposing team had red ones.

At the end of each match, participants completed a ranking of their engagement with the game. Once they had completed a session (consisting of multiple matches) participants were invited to participate in semi-structured interviews to explore the gameplay experience of each participant with the game. Each semi-structured interview was transcribed, de-identified and then analysed to identify common themes regarding the gameplay experience. Data collected from a session was analysed prior to the subsequent session being undertaken, so that the research team could iterate on

aspects of the game itself and the gameplay environment, in order to explore different aspects of how multiplayer games supported cooperation and collaboration between participants.

### **3 Results**

A total of three gameplay sessions were conducted during the study. There were eight participants in each session, with a total of 24 participants across all three. The demographic breakdown of the participants across all the sessions was 9 female and 13 male, with two female and six male participants in each of the first two sessions and six female and two male participants in the final session.

During these three sessions 43 post-match engagement rankings were returned by participants. Analysis of the post-match rankings indicated participants experienced a high level of engagement with the digital game, with 83% of participants ranking their experience engaging or very engaging (n=35). The post-match rankings identified competition as a particularly enjoyment aspect of the gameplay experience, with 90% of respondents ranking competition as enjoyable or very enjoyable (n=38). Finally, the majority of participants, 84%, agreed or strongly agreed with the statement that the game was repayable (n=36).

A total of 21 participants agreed to participate in semi-structured interviews to reflect on their experiences with the digital game. Interviews took between 10 minutes and 40 minutes, but most were around 20 minutes duration, and were conducted either over the phone or face to face at the participants' discretion. Thematic analysis of interview data indicated participants found the game beneficial for revising anatomy and histology content. The multiplayer aspect of the game was considered a novel way to support revision of anatomy subject matter that complimented existing autonomous learning approaches. It was identified that multiplayer digital games fostered collaboration through four elements: supporting the development of a team strategy to win the game, facilitating shared decision making to overcome obstacles during the game, working towards a shared goal, and creating a sense of investment in a team. The first element, developing a team strategy, was commented on most frequently by interviewees. It was considered beneficial for identifying the subject matter strengths and weaknesses of individual participants, and inform how the team traversed across the map. However, one interviewee commented that developing a team strategy may also have had made players less willing to expose themselves to subject nodes they felt under confident with, which could limit their exposure to new knowledge. The second element, shared decision making to overcome obstacles during the game, was identified by participants as an unexpectedly rewarding experience. Interviewees found the process of discussing questions and subject matter areas as a team provided them with insight about how well their peers knew the subject matter. This process made individual participants feel closer to their team mates during the game. Additionally, interviewees noted that the process could reduce feelings of social isolation and made them feel that other students were struggling with the same issues they were when learning anatomy and histology. The third element, working towards a shared goal, was identified as a positive attribute of multiplayer serious games by all the interviewees. Interviewees felt they had autonomy throughout the game to progress across the map as individuals, but also felt highly motivated to answer as many questions as possible correctly due to their sense of investment in the team. One interviewee also commented that they found the use of

a multiplayer game were teams worked together to win for revising anatomy and histology subject matter quite novel, which made the overall experience more fun. The final element that that fostered cooperation and collaboration between participants was the structure of the team itself, and the way that encouraged participants to feel invested in their team. This element was not discussed by all the interviewees, but those that did raise it noted that it was a valuable one. Interviewees that discussed this element thought it gave them a sense they had a support system they could draw on if they need it. It was noted that the support provided to students though the support system may be enhance if teams were not randomly assigned, but instead structured to combine students who were stronger and weaker in the subject area.

In addition to reflecting on their own experiences during the gameplay sessions, interviewees discussed how they felt the game might be useful if it was implemented outside the confines of the study. Interviewees were particularly interested in the potential of the game to support user generated content, both in the form of the multiple choice questions themselves and also in the layout of game maps. Although the majority of interviewees raised the possibility of allowing students to create their own questions for future versions of the game, interviewees were divided about how this could be implemented. Some interviewees thought students should be engaged to write questions so that they aligned with their individual revision needs. However, other interviewees felt that students did not know what questions aligned with the anatomy and histology curriculum. To address this problem one interviewee suggested that students should create the questions for future games, and that a content expert should review them for relevance. Another interviewee suggested that some form of question development guidelines could be developed to reduce the likelihood of irrelevant questions being developed. Finally, a third group of interviewees felt that there would be no real benefit of getting students to develop the individual questions in the game, as that should be left to the experts. These interviewees felt it would be interesting if students could design their own game maps and distribute subject matter in a way that was relevant to them.

Finally, interviewees discussed the potential of multilayer games to encourage cooperation and teamwork more broadly in health curriculums. Participants suggested that embedding the multiplayer game early in the academic year could be beneficial for overcoming the challenge of encouraging interaction between students in large units of study. Finally, playing the game allowed participants to identify peers with subject matter knowledge and skills that complimented their own. This information was viewed as useful for making more informed decisions about forming study groups to strengthen self-directed learning and revision.

We acknowledge that this study had some limitations. The primary limitation is that the evaluation used relied heavily on participant reflection on their experiences with the game. Whilst that is a valuable means of exploring feasibility and acceptability of the game for learners, other measures are required to obtain additional insights into how multiplayer digital games foster cooperative learning experiences. Additionally, the demographic used in this study was exclusively medical students which limits the generalizability of our findings to other student populations. It would be interesting to explore the attitudes of other health students to multiplayer digital games in future studies.

#### 4 Conclusion

Multiplayer digital games have the potential to support collaboration in health education and to offer diverse and flexible and immersive experiences to learners. Additionally, they provide new avenues for supporting self-directed learning and encouraging cooperation between large groups of students, such as those in a tertiary unit of study. However, further research is still needed into the degree to which multiplayer games impact learning outcomes and value across a range of educational contexts.

#### 5 References

1. Graafland, M., Schraagen, J. M., & Schijven, M. P. (2012). Systematic review of serious games for medical education and surgical skills training. *British journal of surgery*, 99(10), 1322-1330.
2. Alfarah, Z., et al. (2010). "Educational games in geriatric medicine education: A systematic review." *BMC Geriatrics* 10(1): 1.
3. Lin CC, Li YC, Bai YM, Chen JY, Hsu CY, Wang CH, et al. The evaluation of game-based e-learning for medical education: a preliminary survey. In: AMIA Annual Symposium Proceedings. Bethesda, USA: American Medical Informatics Association; 2005. p. 1032.
4. Plerhoples, T. A., et al. (2011). "Another use of the mobile device: warm-up for laparoscopic surgery."
5. Graafland, M., et al. (2012). "Systematic review of serious games for medical education and surgical skills training." *British Journal of Surgery* 99(10): 1322-1330.
6. Anyanwu EG. Anatomy adventure: a board game for enhancing understanding of anatomy. *Anat Sci Educ*. 2014;7(2):153–60.
7. Ellis H. Teaching in the dissecting room. *Clin Anat*. 2001;14(2):149–51.
8. McKeown PP, Heylings DJA, Stevenson M, McKelvey KJ, Nixon JR, McCluskey D. The impact of curricular change on medical students' knowledge of anatomy. *Med Educ*. 2003;37(11):954–61.
9. Jones DG, Harris RJ. Curriculum developments in Australasian anatomy departments. *Clin Anat*. 1998;11(6):401–9.
10. Choudhury B, Gouldsborough I, Gabriel S. Use of interactive sessions and e-learning in teaching anatomy to first year optometry students. *Anat Sci Educ*. 2010;3(1):39–45.
11. Janssen, A., Shaw, T., Goodyear, P., Kerfoot, B. P., & Bryce, D. (2015). A little healthy competition: using mixed methods to pilot a team-based digital game for boosting medical student engagement with anatomy and histology content. *BMC medical education*, 15(1), 173.