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PRE-SERVICE TEACHERS DESIGNING SERIOUS GAMES FOR 21ST CENTURY CLASSROOMS

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Abstract

Serious games are fun and powerful vehicles for learning, yet initial teacher education courses rarely require pre-service teachers to design serious games they can be used for future teaching and learning. Wanting to disrupt this reality, we designed a course for pre-service teachers at the University of Vienna entitled 'Digital games, simulation and virtual worlds for teaching and learning'. The course required students to first play serious games to experience how deep learning occurs through gameplay. Then they critically reviewed a number of serious games and critiqued them. They came to understand how serious games operationalise playful structures that allow gameplayers to think about their choices, take action and experience the impact of their actions. The final assessment required the pre-service teachers to draw on their gameplay experiences, critiques of serious games and collaboratively design a serious game they could playtest with diverse upper primary school students. We present four serious games designed by pre-service teachers that have successfully mapped educational outcomes into serious game mechanics. We argue that these pre-service teachers' experience of designing and playtesting digital games not only helped them make their teaching relevant to students' lifeworlds, but also helped them understand that pedagogy can be playful.

Keywords: Serious games, teacher education, serious game mechanics, playful pedagogy, game-based learning, gamification

Introduction

The widespread popularity of digital games like *Sim City*, *Civilization*, *Minecraft*, *World of Warcraft* and the *Walking Dead* is no longer questionable. These games now permeate and greatly influence popular culture. They are also extremely successful at teaching gameplayers (students and teachers) complex and higher order thinking skills.

> The success of complex video games demonstrates games can teach higher order thinking skills such as strategic thinking, interpretative analysis, problem solving, plan formulation and execution, and adaptation to rapid change. (Federation of American Scientists, 2006, p. 3).

Because children and young people are already using these digital games, simulations and virtual worlds, it is timely to rethink initial teacher education so that pre-service teachers understand what and how persons (gameplayers) learn through gameplay and what implications this has for teaching and learning across subject areas.

There is a multiplicity of game design courses on offer, yet few are offered or required in initial teacher education programs outside maths and science. Katrin Becker designed and taught a graduate-level course on digital game-based learning in 2005 that was an introduction to digital games and gaming for instruction and learning. Her course required students to either design a game to be used in a learning situation or design a "learning situation or instructional intervention that makes use of a COTS[1] or other existing game, including lead up activities, game play with goals, and debriefing"

[1] Commercial off-the-shelf

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(Becker, 2007, p. 5). The Massachusetts Institute of Technology's (MIT) Scheller Teacher Education Program (STEP) program licenses students to teach mathematics or science in grades 5-12. Future maths and science teachers are required to take an innovative course entitled 'Computer Games and Simulations for Education and Exploration' taught by Eric Klopfer and Jason Haas. In the 2010 course syllabus available online, students are required to complete a 'Literature Review on Games and learning' and 'Documentation and Presentation of an Educational Board Game.' Their course was, in part, an inspiration for our course.

Our course on 'Digital games, simulation and virtual worlds for teaching and learning', however, is different because it is not graduate-level course on digital game-based learning primarily for future maths and science teachers. Rather, our course was offered across disciplines and required pre-service teachers to play, critically evaluate and design digital serious games for a variety of academic subjects. We wanted our students to design playable serious games using a game engine of their choice that was aligned with topics in the Austrian National Curriculum (Österreichischer Lehrplan für allgemeinbildende höhere Schulen), where their gameful learning design was explicitly tied to identified learning outcomes. When we designed the course, we gave the students and option of designing a board game or a digital game. We expected most students would design a board game, but were happily surprised when 25 students in the class opted to design and develop a serious digital game.

Pre-service teachers designing serious games

The course 'Digital games, simulation and virtual worlds for teaching and learning' was held at the Institute for Teacher Education at the University of Vienna (Institut für Lehrer/-innenbildung, Universität Wien) and was embedded in the module 'Theory and Practice of Teaching and Learning' (Theorie und Praxis des Lehrens und Lernens). As teacher educators (not game designers) we are aware of the potentials and frictions of digital games for learning, but troubled that most initial teacher education courses rarely require pre-service teachers to design serious games. Our course required pre-service teacher education students to engage in gameplay, critical academic game reviews, a literature review, game design and development and the playtesting of their serious game prototypes with their peers at university and then in a year 8 classroom. The course followed a blended learning design that aimed to intensified dialogue and sharing of ideas in the online environment. Introducing blended learning as a vehicle for dialogue and sharing of ideas stands contrary to most of the blended learning courses at the University of Vienna (Schmoelz & Payrhuber 2009). Moreover we were aiming to apply the friendship-model of mentoring as suggested by Buell (2004) and further analyzed by Schmoelz & Peterson (2014) for the context of higher education.

The course was supported by Samsung Electronics Austria GmbH who provided our pre-service teachers with professional accounts for Game Maker, Game Salad and Construct 2 that support our students' co-creative gameful learning design (Walsh, Craft, Chappell and Koulouris, 2014). We required students to make their serious games playable on Samsung tablets, because Samsung also provided us with a portable case of 20 tablets and a strong Wi-Fi connection through a portable wireless modem. This allowed students to present and playtest their serious games first in class at the university and then in the classroom at the school. Partnering with an innovative teacher, who was open to the idea of integrating digital games into the curriculum, was also critical to the success of our course. Our pre-service teachers were very fortunate to have the opportunity to playtest their serious games in her new middle school, NMS Schopenhauerstraße and gain intensive practical experience in the classroom and from the feedback sessions with the pupils.

Course learning outcomes

This course was designed so that pre-service teachers can:

- Explore the history of digital games and virtual worlds for teaching and learning;
- Acquire current knowledge of research on digital games, simulation and virtual worlds for teaching and learning;

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- Understand how successfully elements of digital games, simulation and virtual worlds can be leveraged to improve teaching and learning;
- Explore principles for designing, selecting, adapting, or using games, simulation and virtual worlds for classroom practice in any subject;
- Reflect on their digital game play to understand how the learning that occurs is not only relevant to formal educational contexts but also to everyday work, socialisation, and play;
- Recognize James Paul Gee's 13 principles of learning that emerge from video games and consider how they can be adopted for teaching and learning;
- Understand how to leverage games' deeply satisfying properties (e.g. agency, emotion, and immediate feedback) to ensure your future game design is engaging with relevant 'playful experiences';
- Design an educational board game or digital serious game with rules, physical attributes, context of use and rationale that accomplishes an identified learning outcome explicitly tied to the Austrian National Curriculum;
- Playtest the game with peers in class and upper primary students to record feedback for improving and reflecting on your game designs

Course overview

The course explored research around the kinds of thinking, learning and teaching that go into the design of video games, simulations and virtual worlds. Pre-service teachers explored how gameplay might assist children and young people, to understand complex systems within virtual worlds (Walsh, 2010). They also examined the use of digital games, simulations, and virtual worlds as places where 'deep learning' occurs (Aldrich, 2009; Thomson and Brown, 2009). Through playing digital games, participants explored how simulations and virtual worlds operationalize playful structures to allow gameplayers to think about their choices, take action, and experience the impact of their actions. These pre-service teachers also experienced, first-hand through gameplay, games research and critique, what 'good' serious games do. 'Good' serious games draw players in, teach them how to succeed, and keep them engaged with just the right level of challenge. More importantly, by being reflective of what and how they were learning, when playing serious games, pre-service teachers were better placed to answer the question, "*Why* aren't we using serious games in schools?"

Another important question that we wanted the pre-service teachers to be well equipped to answer is: "*How* could we use serious games in schools?" Therefore, we showed students how serious games can be embedded within a wider discourse of what were referred to as playful pedagogies. We presented 'playful pedagogies' as an umbrella term that explores different aspects of play and pedagogy. In the context of pedagogies, it does not mean that learners are just playing games. Rather they explored the idea of gamification and the introduction of game elements such as storytelling, goals and progress indicators, visualisation of characters, problem-solving into educational non-game experiences. Pre-service teachers also viewed gamification as a viable way to improve student in-class participation and engagement (Cronk 2012) as well as increase motivation and self-efficacy (Banfield and Wilkerson 2014).

We realised introducing gamification to teaching and learning might have no relevance in regards to learning outcomes, because "not all students will be equally inclined to take all learning activities seriously enough for their own good in meeting the learning outcome objectives" (Øhrstrøm et al 2013: 422). We also introduced the students to game-based learning, to help them understand that when students are playing games, they can simultaneously learning though gameplay. This was a catalyst to helping them understand that playing serious games in school could potentially help their future students achieving specified learning outcomes within the Austrian National Curriculum. By introducing the pre-service teachers to the notion of playful pedagogies they were able to rethink professional judgments on the ends to which a specific serious game could be deigned and embedded into subject matter curriculum.

Furthermore, we required pre-service teachers to engage in learning activities and game design

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projects directly related to contemporary research in the field of digital games and playful pedagogies, giving them the opportunity to explore the dynamics and principles underlying successful game design. These were grounded in three distinct areas: empowering learners, designing problem-based learning experiences and fostering deep understanding (Gee, 2007). Participants used this knowledge later in the course to collaborate to design a 'playable' digital game (from beginning to end) and playtested their digital game prototypes first at the university with their peers and then in a lower secondary classroom.

Students playtested their serious games with diverse pupils in an urban lower secondary school classroom. In this sense they not only took on the role of game designers who acquired new systems-based literacy practices (Walsh, 2010), but also experienced observing students actually sitting down and playing their game. This experience assisted them in better understanding whether their "game is accessible, usable, and if its mechanics are actually appealing" (St John, 2015, p. 1) to gameplayers and if it achieve the desired learning outcomes. Then for a final assignment, they reflected on the process of playtesting and outlined plans to further develop their games.

Serious games designed by pre-service teachers

Each group of pre-service teachers designed, prototyped, developed and playtested a serious game. The topics covered by our students included bullying (mobbing), teaching English as a second language (TESOL), packaging (environmental sustainability) and politics (history). Students used different game engines for which Samsung Electronics Austria GmbH had generously provided pro-licences. The students were encouraged to use the online manuals of the game engines to learn how to build games. Because we are teacher educators and not game designers, we were unable to assist them in their game design. Students drew heavily on the course readings, assessment tasks, seminar discussions and playtesting in their game design. We present four serious games designed by our pre-service teachers that have successfully mapped educational outcomes into serious game mechanics.

We want to highlight that the students designed all aspects of these serious games' assets and were incredibly creative. The serious games have original art and music scores alongside commentaries of how each game can be operationalised within the classroom. We designed a website to showcase our pre-service teachers' games and the work they completed in the course (Figure 1).

Figure 1: Playful Pedagogy website (**http://www.playful-pedagogy.org/**)

Stop the Mob *by Katharina Luftensteiner, Katharina Pölzl, Markus Resch and Katrin Waldhart*

Stop the Mob is a digital point-and-click game designed for computer and tablet use. The serious game

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introduces players to the timely topic of bullying in schools. It presents gameplayers with situations or scenarios in which their actions can make a positive or negative difference for a bullying victim named Bob. The game was designed primarily for students in lower secondary education. The pre-service teachers designed this serious game to help Austrian students understand bullying and provide them with knowledge and understanding need to identify incidents and actions or inactions as bullying. Students found that a recent study by the Organisation for Economic Cooperation and Development (OECD) shows that, out of all OECD countries, Austria has the highest bullying rate in schools. 21% of Austrian schoolchildren experience bullying during their school years, nearly twice as many as the OECD average. (Nimmervoll 2015). *Stop the Mob* works to raise learners' awareness of mobbing (bullying) in schools and how their actions can make a difference, which is exactly what "Stop the Mob" aims to do.

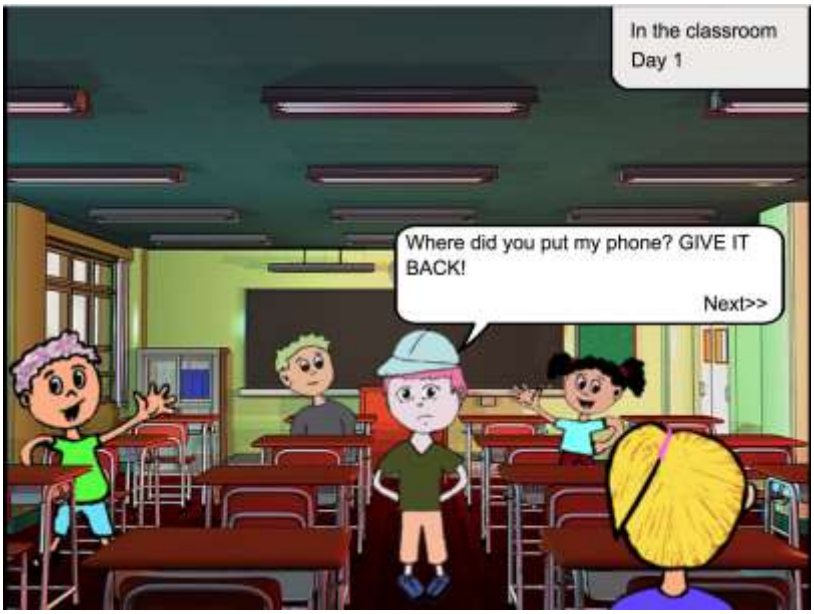

Figure 2: *Stop the Mob*

This scenario in Figure 2. shows how a group of pupils bully a kid by stealing his phone. The girl in the left corner enters the scene and gets to choose from different options to take actions. The kid who is bullied will be more happy or sad, depending on the choice of the young girl. The pre-service teachers describe their game this way:

> In 'Stop the Mob' the player takes on the role of a nameless girl in whose class a certain student called Bob is frequently bullied by his classmates. At the beginning of the game, the player's character has not yet taken a stand on the situation, which leaves the player to decide how to react to Bob's bullying. In five different scenarios the player witnesses the bullying of Bob and can choose from a number of possible responses to the situation that range from joining the mobbing or walking away to taking action and helping Bob. The scenarios correspond to five consecutive school days. On each day, the players find themselves at home after the school scenario and can decide how to spend their afternoon. Apart from doing their homework or enjoying their free time, they always have the option to engage in an activity that may benefit Bob or broaden their understanding of what is happening to him, i.e. their understanding of mobbing." (Luftensteiner et al, 2015).

World of Verbcraft *by Johannes König, Nicole Nedeltschew and Lukas Schnabel*

World of Verbcraft (WoV) is a game designed for the TESOL classroom to teach students regular and irregular verb forms using GameSalad. The pre-service teachers designed their game for student learning English to practice regular and irregular verbs through a fun gameplay experience. WoV is an online game easily accessible via three multiple platforms including computers, tablets and mobile

phones.

In WoV gameplayers are presented with an English verb appearing on a scroll at the top and they need to decide if the verb is a *regular* or *irregular* verb and drag it into the correct cauldron.The pre-service teachers invited a friend to compose the musical score for the game.

Figure 3: *World of Verbcraft*

The screenshot in Figure 3 shows two cauldrons which are labelled with and 'I' for Irregular and an 'R' for Regular. Students can score point by identifying the word on the top e.g. teach as regular or irregular verb form and put it in the correct cauldron. The pre-service teachers describe their game this way:

> The game is set in an enchanting mystical magic world, deep in a spooky forest where dark enormous trees sprawl everywhere as far as the eye can reach nearly covering a small wooden and obscure chalet. Some steps in front of the cottage, two bubbling magic cauldrons are located, the left one having the letter I and the right one having the letter R written on its bulge – and you cannot help but wonder what these cryptic letters might mean…If you listen carefully to the music you can actually hear bats and birds screeching which contributes to an enhanced gameplay experience…You are presented with an English verb appearing on a scroll at the top centre, you read the word out loud and need to decide if the verb is a regular or irregular verb and finally drag it into the left cauldron containing the "irregular-verb-potion" or into the right cauldron containing the "regular-verb-potion." (Nedeltschew, Schnabel & Koenig 2015)

Pack Me![2] *by Bernadette Sophie Auberger, Katarina Nikic and Carina Schneeweiß*

Pack me! is a is a digital drag-and-drop serious game designed for students of Secondary Schools. The serious games was designed to raise students awareness of the amount of packaging waste that originates from different packaging pre-purchase. The game is set in a little grocery store where the gameplayer stands in front of shelves with over 50 products and has to choose 10.

Pack me! has two different game modes: the 'play' and the "learn more". The 'learn more' provides gameplayers detailed information about the categorisation of the products on the grocery

[2] To play Pack Me! Windows Android

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store shelf drawing on the product database www.marktcheck.at by Greenpeace Austria.

Figure 4: Pack me!

As shown in Figure 4, the game is set in a little grocery store where the gameplayer stands in front of shelves with over 50 products. The screenshot shows the main screen for gameplay, in which the players can choose 10 products. The player do not know the rational of the gameplay in the first rounds. After 10 products are chosen, a score appears that shows whether the packaging in the trolley is more or less damaging to the environment. The pre-service teachers describe their game this way:

> At the beginning of the game its true intent is not yet revealed immediately so that the players decide for themselves what they want to buy. The only instruction is to buy ten products by dragging them to the bottom of the trolley in the lower left corner. Once an item is bought, which is indicated by the ringing sound, it cannot be returned to the shelf…After ten products have been selected the purchase is evaluated on the basis of the product database from Greenpeace Austria, which works by assigning each product to one of the three categories: green (good), yellow (critical) or red (bad). Only now it becomes clear that the packaging of the different products is what actually counts… Ideally, in the first round, the players select products, which they like and would buy themselves in a grocery store. Then they get feedback on their choices as well as background knowledge of the game, so that they can try again and avoid critical and bad packaging." (Auberger, Nikic & Schneeweiß 2015)

The Party *by Iris Paur and Philipp Thar*

The Party is a digital serious game that has been designed for implementation in history lessons using the game engine Construct 2. *The Party* aims to illustrate how the media uses manipulation and propaganda to influencing public opinion by putting the gameplayer into the role of a journalist. The journalist needs to make decisions about what to publish to shed a positive light on a fictional political party's morally questionable decisions and the actions of its leader. The gameplayer—as a journalist—needs to decide how to report the news as the gameplayers decision can increase or decrease the party's supports. It's a question of morality as the serious game aims to developing an understanding of the reasons why a journalist might choose to support a regime he/she does not actually advocate, but does not what to lose his/her job.

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Figure 4: *The Party*

This scene shows that the main character of the game is getting a mail. The mail contains a message of an event in which The Party and some of its members are involved. Now, the journalist can choose whether to print the message as such and tell the readers the truth or change the tone and content of the event so that it becomes preferable for The Party and its members. The pre-service teachers describe their game this way:

> After a major economic crisis, a man who calls himself The 'Great Leader' has seized absolute power in your country. Aiming at stopping any criticism of its regime in the bud, his party – The Party – has purchased the newspaper where you work as a journalist and instructed you to present The Party's actions the most favourable way possible. Your cooperation will be generously rewarded! By shedding a 'good' light on The Party, you might soon earn enough money to buy the house with the large garden you and your family have always dreamed of! But will you really be able to publicly lie to your country by covering up The Party's atrocities, just for the sake of accumulating wealth? (Paur & Thar 2015)

Serious game mechanics joining entertainment and pedagogical goals

The serious games designed by our pre-service teachers are pedagogy driven. Each one was designed with a primary pedagogical goal. As the pre-service students collaborated to take on the role of game designers they attempted, and we would argue successfully, to design games with that not only teach, but are also engaging for upper primary students (and others). Their game design is carefully balanced to achieve symbiosis between pedagogy and entertainment (Dror, 2008). There is no doubt that the pre-service teachers were essentially limited in the types of games they could make. This was in part due to the fact that they needed to be playable on tablets and needed to be designed in just one semester as part of a university course. Also we did not provide our students with a model for how to design a serious game, instead we required them to play serious games and critique them according to according to Jasper Juul's (2003) 6 game elements and asked them to consider if serious games be fun and educational at the same time?

The reason why their serious games are 'good' is "because they allow the learner to live through experiences, interact with learning objects and have social interactions with others including teachers and peers" (Arnab et al., 2014). Our students' serious game design matches their desired learning outcomes—that emerge from the National Austrian Curriculum—with typical entertainment game

characteristics. When the students playtested the games within the lower secondary students, the gameplay and classroom discussion afterwards allowed the year 8 students to reflect on and sum up their understandings of the games' (and essentially the pre-service teachers') pedagogical goals on their own terms (de Freitas and Neumann, 2009). These serious games are 'good' because they intrinsically intertwine engagement and learning. Furthermore, the students were able to achieve high-level pedagogical goals (at least for lower secondary students) with low level game mechanics. This highlights the real possibility that these pre-service teachers acquired system-based literacy practices (Walsh, 2010) through their gameplay and game design that allowed them to then understand serious game mechanics and realise them in their gameful designs. This understanding was operationalized in their game design which reflect "their understanding of complex relationships between pedagogy, learning and entertainment/fun and that ultimately they need to merge educational and gaming agendas" (Arnab et al., 2014, p. 6) to design a successful serious game.

Conclusion

We argue these pre-service teachers' experience of designing and trialling digital games not only helped them make their teaching relevant to students' lifeworlds, but also helped them understand that pedagogy can be playful. In this sense these pre-service teachers not only understand—but operationalise—the principles of serious game mechanics by embracing gaming's rich pedagogic heritage while also engaging in an alternative way of thinking about their pre-service teacher education. The pre-service teachers' serious games also won different awards at the Samsung mLearning Contest in Austria. The serious game 'Stop the Mob' was rated won the second prize, which means that 'Stop the Mob' is going to be developed professionally and openly accessible in the near future. We also argue these pre-service teachers' serious games signal the need to rethink aspects of initial teacher education so their education itself requires them to design serious games regularly to transform teaching and learning. A knock on effect would be their future students also designing serious games more regularly to re-represent curricular knowledge across all subject areas.

Acknowledgements

We want to thank the program manager of the Centre for Teacher Education at the University of Vienna, Prof. Dr. Barbara Schneider-Taylor for giving us the opportunity to introduce the potentials of serious games within initial teacher education. We also want to acknowledge the support of Martina Friedl, Corporate Citizen Manger of Samsung Electronics Austria GmbH for providing the necessary technological infrastructure and Andrew Chong for his pro-bono design of the homepage: playful-pedagogies.org. A very special thanks goes to the Head Teacher, Gerda Reissner, and the Head of School, Erika Tiefenbacher, for creating a space in their school for our pre-service teacher to playtest their serious games

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