INFLUENZA: A Board Game Design Experiment on Vaccination

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Abstract

Introduction. Experts on **vaccine hesitancy** recommend tailoring interventions to local contexts, which presents an opportunity for game-based interventions to reflect local demographics and make them central to the experience of the game. **Experimental game design** is a research method that has already been used in **educational games**. Board games are relevant to the topic of vaccination, and present possibilities for game design of openness and flexibility. INFLUENZA was an **experimental game design** with the objectives of designing a vaccination-themed educational **board game** where: an aspect of local context was highly-relevant but also easily modifiable, means of emotional engagement were explored, and openness and flexibility in board game design were explored.

Methods. The **experimental game design** study consisted of finding design solutions for achieving the study objectives in a single game, by analyzing comparable games and using iteration and two stages of live testing with players.

Results. The game reflects national census data in a highly-relevant but also easily modifiable aspect of play (first objective). The game features aspects of personification to foster emotional engagement (second objective). The game is well-suited to changing the number of players, or allowing mediated play (third objective).

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Discussion. INFLUENZA has achieved each of its study objectives from an **experimental game design** perspective. Relevant features of **educational games** are theme, mechanics, and their integration, and the design experimentation in INFLUENZA follows this trend. Future work is running comparative trials of features of INFLUENZA, as well as measuring the impact of different local adaptations of INFLUENZA.

Keywords

board game, educational game, vaccine hesitancy, experimental game design

Introduction

Vaccine hesitancy has been increasing, which threatens the disease-specific high-uptake rates needed for vaccination programs to work (World Health Organization, 2014; Dubé et al., 2015). Vaccine hesitancy "refers to delay in acceptance or refusal of vaccines despite availability of vaccine services" (World Health Organization, 2014, p. 59). Education of young individuals regarding vaccination is an opportunity to help disease protection in the future (Eskola et al., 2015), prompting interventions in school settings, such as ImmunizziAMO (La Torre et al., 2020), which includes small analog games as part of the intervention, and the development of a range of educational digital games on epidemics and vaccine hesitancy (Ohannessian et al., 2016).

Experts on countering vaccine hesitancy stress the need to tailor interventions to local contexts given the intricacy of causes for vaccine hesitancy (Eskola et al., 2015; Dubé et al., 2015). For game-based interventions, this means that an opportunity exists to design games that reflect local demographics and make them central to the experience of the game.

Design-based research is a method which is highly-relevant in the field of education, and consists of creating the first version of a product and its progressive refinement, and using this process to learn about a problem-domain (Collins et al., 2004). Experimental game design is a form of design-based research using game design, and evocative design experiments are a form of experimental game design where the goal is "to explore the design space of game design, by understanding more about the behaviour and experiences that a design choice will evoke in players" (Waern & Back, 2015, p. 344). Experimental game design has been used as stage in research for educational games, such as Bubble Play (Vishkaie & Levy, 2015).

Board games present a number of interesting possibilities for designing games. A board game can have a range and intricacy of collaboration among players not possible in a digital game (Zagal, 2006). The board game implementation of a game for vaccination education has been found to yield significantly better learning outcomes relative to the digital implementation of the same game (Kaufman & Flanagan, 2016). Part of the potential of board games as useful educational technologies is their flexibility and openness over digital games (Greenhalgh et al., 2019), which makes flexibility and openness relevant considerations in the design of new educational board games.

In November 2019, a doctoral candidate at the school of education at Lusófona University in Portugal made a request to the HEI-Lab R&D unit for an original educational board game for use in her research. Eva Vital, a final-year student from the Videogames bachelor's degree was tasked with designing the game under the supervision of professor Filipe Luz and game designer Wilson Almeida. Vaccine hesitancy was deemed an appropriate topic for the game, since vaccine hesitancy and a foreseeable global influenza pandemic were deemed to be two of the ten greatest threats to global health in 2019 (World Health Organization, 2019). The design and development process of this game was used for an experimental game design study. INFLUENZA, the game developed in the study, pertains to other vaccination-preventable diseases besides influenza, which are represented in the game by modelling different outbreak characteristics.

Study Objectives

The purpose of the INFLUENZA experimental game design study was to investigate how a game-based intervention can answer the need for adaptation to local contexts in addressing vaccine hesitancy (Eskola et al., 2015; Dubé et al., 2015), while also exploring two other design objectives. The study objectives were:

- Study Objective 1, to design the game as to make an aspect of the local context of players highly-relevant to the play experience and the design of the game, where this aspect can be easily adapted to other contexts for creating local versions of the game;
- Study Objective 2, to explore means of emotional engagement and of presenting emotional dilemmas to players in a vaccination education game;
- Study Objective 3, to explore ways of designing the game to support openness and flexibility in how it is played, namely in regards to changing the number of players and allowing mediated play, as to make use of these aspects of the usefulness of board games as educational tools.

Methods

The study used design experimentation as a research methodology for games, namely evocative designs, which are experimental game design studies with relatively open research questions (Waern & Back, 2015). This resonates with the research model of designers "making the *right* thing", which, for instance, Zimmerman et al. apply to the field of Human-Computer Interaction (2007, p. 497).

The experimental design study consisted of finding game design solutions that can achieve the study objectives and making them work in an internally consistent, engaging game – as validated through repeated *in-house* testing, by observing live players, gathering feedback, and improving the design.

Comparable Games

The first step in designing INFLUENZA was examining comparable games to see how INFLUENZA could meaningfully differentiate itself, namely in relation to Study Objectives 2 and 3. The reviewed games include Pandemic (Leacock, 2008), Virus! (Cabrero et al., 2015), and POX: Save the People (Flanagan et al., 2011a).

Pandemic is a highly-regarded board game about fighting epidemics – being remarkably well-designed and engendering an understanding of the subject (Sharp, 2011). Pandemic gives players definite roles and uses rigid turn-taking, which creates a design opportunity for these aspects to be more flexible in INFLUENZA (Study Objective 3). The thematic handling in Pandemic is somewhat detached, with players operating at a global scale and individual characters that are victims of epidemics being abstracted. This creates a design opportunity for personifying the victims of epidemics in INFLUENZA, and to more strongly frame the strategic player decisions during play as ethical dilemmas (Study Objectives 1 and 2).

Virus! is a board game about epidemics aimed at children aged 8 and above. This may limit what can be done with the game in terms of complexity, difficulty, and approach to theme, and falls outside the intended use context of INFLUENZA.

POX: Save the People is a board game specifically developed for vaccination education, which has shown results in addressing vaccine hesitancy (Kaufman & Flanagan, 2016). INFLUENZA presents a few design similarities to POX, even though INFLUENZA shows crucial differences in terms of game design, for instance in that directions of disease contagion are handled at the level of characters, and that outbreaks can land anywhere on the board (Appendix 1, 2). More importantly, the decision was made during the design process of POX to standardize and abstract the human characters (Flanagan et al., 2011b). This created an opportunity in the design of INFLUENZA to feature personification of characters (Study Objective 2).

Design Process

INFLUENZA was developed according to a playcentric design process, as argued for instance by Fullerton et al. (2008). This entailed maximizing the number of meaningful iterations on the design with low-fidelity prototypes and live game testing – playtesting, using designated playtesters (Fullerton et al., 2008). The game is only tested more formally – for fine-tuning – in the intended use context after a viable product has been achieved. *Viable* for these purposes means the game communicates well how it is played and what players can do, game-pacing feels appropriate, and decisions feel meaningful (game is engaging and enjoyable), per feedback from playtesters and observation of game sessions.

INFLUENZA was designed around systems thinking relating to vaccination. In INFLUENZA, much like with vaccination in real life, vaccination only provides protection to individuals if surrounding individuals are vaccinated. Understanding vaccination in this way requires systems thinking. Given the goal in the game of fighting epidemics, the mechanics in INFLUENZA for disease resistance, inoculation placement, outbreak

placement, and outbreak spread (Appendix 1, 2) force players to engage in systems thinking regarding vaccination. Systems thinking features heavily in board game use (Berland & Lee, 2011), and is relevant to vaccine hesitancy, as shown by a behavioral study of vaccination decisions using a simulation game by Böhm et al. (2016).

In keeping with the playcentric approach, an initial version of the design for INFLUENZA was assembled with improvised materials, to ease modification. The first stage of iterative design and development for INFLUENZA, which ran between November 2019 and January 2020, consisted of iterating on this version. The playtesters at this stage were the lead game designer and students of the Videogames bachelor's degree at Lusófona University who volunteered. Between three to six playtesters took part in each session for a total of 11 playtesting sessions and 63 playtesters.

Over the course of 11 playtesting sessions in the first stage of development, INFLUENZA was streamlined and design solutions for achieving its study objectives were gradually developed. Iteration led to decisions to remove mechanics and add new ones, changing the model for disease spread, improving how the game communicates (merging mechanics to remove ambiguities), defining clearer turn procedures, refining the card categories (Figure 1), and making challenge in the game more consistent. It was at this point that the idea to pair character biographies on cards with quirky character obituaries (Figure 1) took form, as a means of helping achieve Study Objective 2.

Following playtesting with improvised materials, the state of the INFLUENZA's design had advanced to the point where the visual production and feel of the board game would make a difference in testing. Four low-cost prototypes of INFLUENZA were produced with final artwork printed on manually-cut 120-gram paper (Figures 1 and 2). This was the second stage of iterative development, which ran from January to March 2020, and consisted of five playtesting sessions. This further validated the number of different game elements in how this relates to pacing of the game and clarity.

Results

The goal of INFLUENZA as an experimental design study was simply to try and make design solutions towards the study objectives work in an internally consistent, engaging game. The two stages of experimental testing and iteration carried out internally by the design and development team already validated the consistency and engagement of the game. Whether the achievement of these objectives withstands more observational and analytical methods with the game being played in educational settings is the target of future work.

Regarding Study Objective 1, the cast of character cards in INFLUENZA (Figures 1 and 2) reflects Portuguese demographics from the latest nationwide demographic census (INE, 2012), with respect to the number of people from each age bracket and ethnicity. This gives INFLUENZA a degree of adaptation to the local context. As an experimental design study, INFLUENZA found a way of making the demographic makeup of characters highly-relevant (Appendix 1, 2) to the experience of an educational board game but also relatively easy to modify, in such a way that modification efforts will not interfere with the rest of the game.

Figure 1. Character and Action cards

Figure 2. Setup for a game of INFLUENZA

Regarding Study Objective 2, players face difficult choices in INFLUENZA due to the emergent characteristics of play (see Appendix 2). These choices become ethical choices due to personification – the effort in INFLUENZA's design process of creating original artwork for the characters and writing quirky biographical statements as well as obituaries (Figure 1). This personification is a means of fostering emotional engagement with players. In the course of playing INFLUENZA, players will frequently have to strategically sacrifice a character to save others, or will make mistakes that will cause characters to perish. The personification of characters and victims is a means of preventing play from becoming abstract, thus presenting emotional dilemmas to players in their choices during play.

Regarding Study Objective 3, INFLUENZA allows players to take certain actions outside their turn (see Appendix 2), and does not personify the players or give them definite roles. This encourages players to discuss moves, coordinate moves, and pool resources. Playing time for INFLUENZA is around 30 minutes and recommended for 4-5 players. INFLUENZA is well-suited to mediated play, with the facilitator making all the moves using the game materials, and any number of participants well beyond 5 calling out moves and debating moves among themselves. The possibilities for changing the number of players and for mediated play constitute an exploration of the flexibility and openness of board games as educational tools.

Discussion

INFLUENZA is designed to match other educational board games that answer vaccine hesitancy in terms of modelling the subject and having the potential to change attitudes regarding vaccination. However, the design of INFLUENZA also explores adaptation to local contexts (Figure 2), personification of the human costs of vaccine hesitancy (Figures 1 and 2), and open and flexible play (Appendix 2), all in one game. This was the purpose for game design experimentation as a research method in INFLUENZA: to explore adaptation to local context, personification, and play flexibility – as study objectives 1, 2, and 3, respectively – in a single, internally consistent vaccination education board game. A legitimate goal for an experimental game design study is to simply experiment with achieving design features such as these as part of a working game design that undergoes iteration and refinement. Future work would consist of measuring the impact of the steps. One of the purposes of design experimentation is to open further avenues of research that use different methods.

Theme, mechanics, and their integration are relevant features of educational games, both with regards to their design and their reception (Greenhalgh et al., 2019). Design experimentation in INFLUENZA follows this trend in **educational game** research, since the experimentation pertained to how mechanics can be integrated with theme, namely in fostering design thinking regarding vaccination, and personifying the human costs of vaccine hesitancy.

For future work, randomized experiments with quantitative measurements could evaluate the impact of personification and informal play structure. These features would be subtracted from experimental versions of INFLUENZA, for running

comparative trials with the standard version. Subsequent future work could examine the impact of the demographic makeup of character cards as a feature for local adaptation, comparing between adapted and non-adapted versions of INFLUENZA across different contexts. This could open up a valuable means of adaptation for educational games – how the game reflects real world demographics becoming an important feature of the game experience which is also relatively easy to modify – possibly in uses other than addressing vaccine hesitancy.

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Appendix I – Instruments

Character Cards:

- Character cards (Figure 1) show the character's portrait, biography, Disease Resistance score, a mark for whether they refuse vaccinations, and arrows for direction of spread;
- the Disease Resistance score ranges from 1-4, and increases by 1 point for each inoculation, and shows up as *X* when immune;
- characters with a black circle around their resistance score refuse vaccination;
- the white arrows show which adjacent characters will suffer contagion whenever this character becomes infected;
- characters become immune when they receive inoculations or survive an outbreak;
- characters die (get their card flipped) on the last turn of an outbreak if their Disease Resistance score is below the strength score of an Outbreak.

Outbreak Cards:

- Outbreak Cards (Figure 1) show the outbreak's strength score and how many turns the outbreak will keep on spreading;
- outbreak strength ranges from 1-4;
- outbreaks will infect unvaccinated characters, or inoculated characters whose Disease Resistance score is lower than the outbreak's strength score;
- every turn an Outbreak is active, infection tokens are placed on top of the cards for infected characters;
- on the first turn of an outbreak, a number of turn markers corresponding to that outbreak's duration is placed on the Outbreak card, and one marker is removed every turn thereafter;
- when the outbreak runs its course, infected characters either gain immunity or die.

Action Cards:

- Inoculation cards (*Vacina* in Figure 1) give the player on the current turn an extra Immunization token;
- Cure cards (*Cura* in Figure 1) let a player on the current turn select an infected character to remove all infection (or hold on to the cure for later use);
- Eradication cards (*Erradica* in Figure 1) let a player on the current turn heal all characters infected by a given outbreak (or hold on to the eradication for later use);
- Swap cards (*Troca* in Figure 1) let a player on the current turn exchange the grid positions of two uninfected characters (or hold on to the swap for later use);
- Disease +1 or +2 cards (*Doença* in Figure 1) make the current turn's outbreak gain in strength by one or two points – Players can use any accumulated cure, eradication, or swap cards at any time, regardless of whether or not it's their turn.

Immunization/Infection tokens:

- each token is worth +1 Immunization/Infection;
- players can accumulate 3 immunization tokens to use as a cure;
- players can use any stored cures whenever they want.

Appendix 2 – Process

Turns:

1. one player gets can Immunization token and draws an Action card;
2. players make their moves –
 - a. they can inoculate any character that will accept inoculation (place an Immunization token over that character's card),
 - b. they can cure an infected character using a Cure card or three Immunization tokens (discard an Outbreak card or remove Infection tokens and place Immunization tokens on that character's card),
 - c. they can cure all characters infected by one outbreak using an Eradication card (remove all Infection tokens and place Immunization tokens on afflicted characters)
 - d. players can swap two alive and uninfected characters,
 - e. players can choose to do nothing;
3. Player rolls two dice (one die for horizontal card position on the grid and the other for vertical position) to determine where the new outbreak will hit (Figure 2) –
 - a. if the dice find an immune character, then the outbreak fails to take hold,
 - b. if the dice find a non-immune character (those who *Can be Vaccinated*, and *Cannot be Vaccinated*) the Outbreak Card goes on top of that character's card, and the outbreak begins (turn 0 of outbreak),
 - c. if the dice find a character that is already infected, the outbreak is overwritten if the new outbreak's strength score is higher – otherwise the outbreak is ignored;
 - d. adjacent characters are infected according to contagion arrows,
 - e. place however many turn-markers over the Outbreak card match the listed number of turns;
4. Spread for any other ongoing outbreaks is tallied –
 - a. place Infection tokens on any newly-infected characters,
 - b. remove one turn-marker from the outbreak,
 - c. if the outbreak is on its last turn (last turn-marker gets removed), tally which characters live and which characters die,

- i. any afflicted characters whose Disease Resistance score is higher than the outbreak's strength score or matches that score live and become Immune (place Immunization tokens on character cards),
- ii. any afflicted characters whose Disease Resistance score is lower than the outbreak's strength score die, and their cards are flipped;

Start the next turn (turn +1).

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