Super Mario Maker 2 as a Tool for Educational Game Design

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Abstract: This paper describes the setup of a case study to test how to use a platform game for a hands-on learning experience that extends traditional methodologies. More precisely, it concerns the use of the level editor of a popular off-the-shelf commercial game, *Super Mario Maker 2*, as a co-design tool with chemical engineers and chemical engineering students. Participants use the editor to make platform game levels that represent chemical processes. Data is collected to identify patterns on how to effectively align chemical engineering content with platform game mechanics with a view towards later creating a custom-made game editor. The study is expected to show the efficacy of participatory game design, commercial games and platformers in engineering education.

Keywords: co-design, participatory game design, platform game, commercial game, learning, education, chemical engineering

1. Conceptual background and related work

Constructivist educational theories focus on learners driving their own learning activities, whereas teachers play the role of a guide orienting students rather than an instructor providing knowledge. Adopting video game creation as a learning methodology can facilitate a constructivist experience, defended by theorists like Jean Piaget, to foster critical thinking and creativity. In addition to that, I believe game creation can extend theoretical learning methodologies by providing a hands-on set where participants need to abstract the content, and, therefore have a clear understanding of it, in order to project it effectively in a game. Their creations can be played by other peers, which means not only that knowledge transfer is encouraged, but also that an interpretation of the projected content is requested, which mirrors a learning process.

However, game development is a complex process that involves specialised technical skills, particularly in programming and game design, and so represents a challenge for learners without a background in computer science, game design or game development. Seymour Pappert led one of the first initiatives to use computers as educational tools when he created the *LOGO* programming language for children in 1967. Further to Pappert's and other related work such as Mitchel Resnick's *Scratch*, I aim to develop a game editor through which chemical engineering students can create platform game levels intuitively, with no need for programming skills.

This study pays special attention to how to align chemical engineering content with the game experience, e.g. game items, mechanics, obstacles, etc, effectively. For that purpose, a case study is set up that facilitates the intrinsic integration of the learning content (Habgood & Ainsworth, 2011) in a platform game.

2. The study setup

2.1 *Super Mario Maker 2* as a co-design tool

During the case study, a total of roughly 20 participants are organised in teams of two to four people comprised of experienced chemical engineers and students with the objective to design levels of a platform game that represent chemical processes. 'Platformers' or 'platform games' are mainly games with a character controlled by the player that runs and jumps to avoid obstacles and/or to defeat enemies (Minkkinen, 2016).

Thus, access to *Super Mario Maker 2* (*SMM2*), a popular platform game maker for the Nintendo Switch console, is offered so that participants can employ their subject-specific expertise to co-design game levels with this digital tool.

2.2 Participants' guidelines

Participants will encounter two different challenges: how to use their expertise to align chemical engineering with their creations and how to design game levels. Therefore, some initial help is provided to guide participants through the process. These guidelines, even though may seem opposed to constructivist theories, are just compromising the learners' agency over the learning content, which is regarded essential to adequately reach the event's purpose.

2.2.1 Example level

To get the creative process started, participants are presented with a part of an example level (Figure 1).

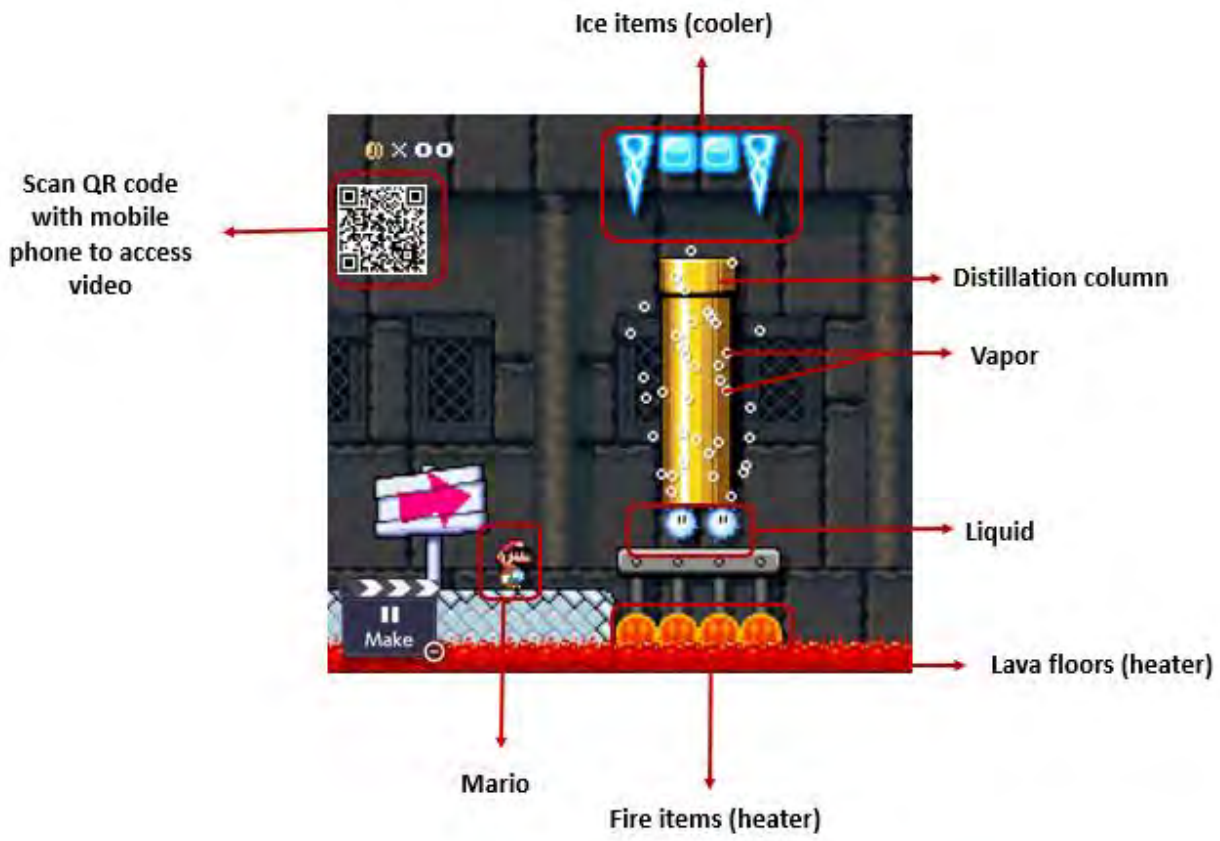

Figure 1: Improvised representation of a distillation column in a *Super Mario Maker 2* game level.

This part of the game level represents a distillation column with ice items on the top which stand in for the column's cooler, fire items on the bottom and lava floors for the heater, and two drops representing the liquid that evaporates.

In *SMM2*, players cannot create new game items from scratch; but there are a number of items that users can copy, paste and erase at their convenience. The game items available in *SMM2* are divided into four categories shown in Table 1.

Table 1: Game items categories in *SMM2*.

GAME ITEMS - CATEGORIES				
	TERRAIN	ITEMS	ENEMIES	GIZMOS
EXAMPLES				
				
				
				

How these game items are placed in the level defines the game play and the obstacles that Mario, controlled by the player, must get pass in each level. The main objective is that Mario reaches the end of each level without dying (too often). In the level shown in Figure 1, for instance, Mario must keep clear of the stalactite-shaped artefacts because they are deadly and fall to the floor after a lapse of time. Mario needs to jump on the top of the column, with the help of the jump booster in the vapour, at the right moment to avoid collision with the falling iced stalactite.

2.2.2 Game design workshop

Participants are offered a basic workshop about game level design in platform games. Successful game design should provide an enjoyable playing experience and, in the case of platform games, rhythm, as in a musical composition, is key (Compton & Mateas 2006). For example, knocking down a moving enemy is only effective if Mario jumps at the right moment to land squarely on the enemy's head without being hit.

I propose that designers in these game jams focus on three main elements when considering the structural design of a game. The first element to consider is the *action* in a game. The game needs to be engaging, requiring a player's full concentration in order to progress to the next level. The second element to consider is the need for *rest* in a game, during which players can pause, think, and plan their next moves. The third and final element to consider when designing a game is *exploration*, where players are allowed to explore their surroundings and are posed with puzzles to solve. Along with the inclusion of these three elements is the need for logic flow so players experience a smooth play experience.

2.3 Familiarisation, creation and presentation

Next, teams decide which chemical process they want to work on and design the draft of the game level or levels. This part also acts as a familiarisation process, during which participants can use and explore the game. Once the first draft is completed, each team is assigned a time slot to access the console and build their levels because there is only one Nintendo Switch console available. The creations are finally shared and explained during the last part of the study.

2.4 Evaluation

The assessment of this study is carried out using three methods. Firstly, anonymous questionnaires about the game items and mechanics are filled out by participants at the end of the event, requesting information such as gender, chemical engineering expertise level and video game habits. Secondly, video recording of some parts of the study, particularly the final presentations to record an explanation of each level creation. Finally, the resulting game levels that participants save in the game.

The data gathered from these methods are reviewed and assessed in order to understand how to integrate the content in the custom-made editor. The assessment process pays special attention to identifying crucial game items and mechanics that facilitate the representation of chemical processes in

a platform game. Some game items, such as pipes, have a straightforward relation to a chemical plant, but it is expected that, through the participants' expertise, the study reveals other less evident and unexpected connections of game items and platform game mechanics in general with chemical engineering content.

3. Expected outcome

After assessment, it is believed that this case study can show evidence for the efficacy of using a participatory game design technique with an off-the-shelf commercial game editor to tackle difficulties to integrate engineering content in a platform game.

4. Conclusion

SMM2 is used in this study as a co-design tool with chemical engineers and chemical engineering students to create platform game levels informed by chemical engineering sets. Questionnaires, video recording and resulting levels are analysed to spot how the key elements of chemical processes have been represented. Finally, the global results show evidence that the use of a commercial game editor can be an effective tool to approach the alignment of learning content with game mechanics in educational games.

References

Ali, U. (2018) 'An Architectural Approach To Level Design'. doi: 10.1007/s40869-017-0050-7.

Arnseth, H., Hanghøj, T., Henriksen, T., Misfeldt, M., Ramberg, R., and Selander, S. (eds) (2019). Games and Education: Designs in and for Learning, Leiden, The Netherlands: Brill | Sense. https://doi.org/10.1163/9789004388826. (Accessed 22 April 2020).

Aubrey, K. and Riley, A. (2015). Understanding & Using Educational Theories, SAGE Publications Ltd, London.

Baradaran Rahimi, F., & Kim, B. (2019). The role of interest-driven participatory game design: considering design literacy within a technology classroom. International Journal of Technology and Design Education, 29(2), 387–404. https://doi.org/10.1007/s10798-018-9451-6. (Accessed April 20, 2020).

Beard, K.S. Theoretically Speaking: An Interview with Mihaly Csikszentmihalyi on Flow Theory Development and Its Usefulness in Addressing Contemporary Challenges in Education. Educ Psychol Rev 27, 353–364 (2015). https://doi.org/10.1007/s10648-014-9291-1. (Accessed April 22, 2020).

Compton, K. and Mateas, M. (2006) Procedural level design for platform games. https://search.ebscohost.com/login.aspx?direct=true&db=edsbas&AN=edsbas.9E8AF7AF&site=eds-live. (Accessed April 22, 2020).

Habgood, M. P. J., & Ainsworth, S. E. (2011). Motivating children to learn effectively: Exploring the value of intrinsic integration in educational games. Journal of the Learning Sciences, 20(2), 169-206. doi: 10.1080/10508406.2010.508029

Judith Gregory (no date) 'Scandinavian Approaches to Participatory Design*'. Available at: https://search.ebscohost.com/login.aspx?direct=true&db=edsbas&AN=edsbas.130BE3EA&site=eds-live (Accessed: 23 April 2020)

Kamal I Al Malah. A Perspective on Chemical Engineering Education. Glob J Eng Sci. 1(5): 2019. GJES.MS.ID.000523.

Khalifa, A., de Mesentier Silva, F. and Togelius, J. (2019) 'Level Design Patterns in 2D Games', 2019 IEEE Conference on Games (CoG), Games (CoG), 2019 IEEE Conference on, pp. 1–8. doi: 10.1109/CIG.2019.8847953.

Kultima, A. (2015, June). Defining Game Jam. In FDG.

Minkkinen, T. (2016) 'Basics of Platform Games'. Available at: https://search.ebscohost.com/login.aspx?direct=true&db=edsbas&AN=edsbas.A42EE2E9&authtype=shib&site=eds-liveConference