Crafting Game-Based Learning: An Analysis of Lessons for Minecraft Education Edition

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ABSTRACT

Digital games have long been of interest to Game Studies communities, but relatively few have examined how teachers design with and incorporate commercial digital games in their teaching in K-12 classrooms. In this paper, we examine a corpus of 627 online lesson plans designed for Minecraft Education Edition. First, we provide descriptive statistics about the authors, language, subject areas, skills, and intended student age of the lessons. We then share our work-in-progress to analyze lessons uploaded by 16 power users. With this analysis, we hope to work towards a taxonomy of teachers' designs with sandbox games. Our work contributes a snapshot of the current landscape of uses of Minecraft Education Edition as an educational tool and begins exploring how teachers design with a sandbox game for learning.

CCS CONCEPTS

• **Applied computing** → Education; Education; Interactive learning environments.

KEYWORDS

Game-based learning, Minecraft, Minecraft Edu, Teacher Adaptation, Learning, Technological Tools

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1 INTRODUCTION

We are currently living in the second rise of commercial video games for education [2]. Digital game-based learning (DGBL), the use of digital games in educational contexts, is steadily gaining legitimacy. Many studies have examined the properties of "good games for learning" [11, 20] or the efficacy of learning with games [21, 22]. Some argue that for DGBL to succeed at scale, it is not merely a matter of having the right games for learning. Rather, teachers ought to take an active role in designing learning activities with digital games [4, 10]. In other words, teachers should adapt digital games as part of their teaching toolkit.

One game that has emerged as a highly popular title with children and with educators is Minecraft [15]. Minecraft is a virtual sandbox game, where players are free to roam and interact with a world made of blocks. Since its release in 2011, the game has become a cultural phenomenon, with over 176 million units sold worldwide [16]. Due to this success, a dedicated classroom version, Minecraft: Education Edition (Minecraft EDU) was released based on a popular educator Mod [23]. Educators around the globe use Minecraft EDU [24]. For example, the software has been purchased for every government school in the state of Victoria in Australia, leading Microsoft to provide resources for Australian-specific curricula [25, 26].

In this paper, we ask the question: What learning experiences do teachers design with a sandbox game for classroom use? To answer this question, we conducted a mixed-methods analysis of publicly available data from the Minecraft Edu website, drawing on a repository of 627 total lessons. Our contribution is twofold. First, it provides a snapshot of the current landscape of Minecraft EDU Lessons. Secondly, we start examining what learning experiences teachers design with a sandbox game for education.

2 BACKGROUND & RELATED WORK

Briefly, we will define digital game-based learning (DGBL) and past research on Minecraft in education.

2.1 Digital Game-Based Learning

Since the 1980s, we have seen the proliferation of "educational games" with an entire game market specifically for schools and teachers [8]. Research on DGBL has mostly focused on the games themselves, thus backgrounding the work teachers do to use games as an educational tool (e.g., [3, 5, 12]). In particular, there has been attention paid to CS Education (e.g., [17]) and afterschool learning (e.g., [7]). Egenfeldt-Nielsen [9] articulates a third generation of educational use of games. This generation moves beyond observing only the learner-game interaction and considers the role of teachers as users of games within their teaching toolkit.

For teachers to adopt digital games into their teaching is by no means a trivial expectation [2]. The appropriation and adoption of mainstream technology and games in the classroom setting is varied and often constrained by factors such as teacher's training and skills, resources, and regulations [1]. In this research, we are interested in what DGBL experiences teachers design for students using a sandbox game. To do so we examined lesson plans and materials developed by teachers for the popular video game Minecraft EDU.

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2.2 Minecraft EDU

Educators and researchers started using Minecraft towards educational ends as the game grew in popularity [for a review see: [16]]. Minecraft is used across the curriculum from STEM (e.g., [13]) to the arts (e.g., [4]) and even informally for social-emotional development (e.g., [19]). With this growing interest, several books have since been written, guiding teachers in their adoption of Minecraft for their lessons [8, 10]. Minecraft is particularly conducive to user-generated content (UGC), as it is modifiable and flexible [18]. Minecraft EDU in particular has an official add-on that allows teachers to manipulate the world and create their own landscapes, interactions, game-controlled characters, and scripts.

3 METHODS

The Minecraft EDU website includes a platform for sharing lessons. When uploading a lesson, users describe the lesson plan, and may attach supporting materials such as worksheets or Minecraft world files. Moreover, users use checkboxes to specify the subjects, skills, and target ages of the lesson. Through discussions with members of the Minecraft EDU team at Microsoft, we got data for every lesson available on the website as of March 2020. This data corpus included 627 lessons.

In our first pass through the data, we analyzed descriptive statistics from UGC, that is, lessons designed by teachers as users of the sandbox game. We have also started to analyze 159 lessons designed by a sample of 16 power users, authors who uploaded the most lessons of all authors (one standard deviation above the mean). Taking a grounded theory approach [6] we have been reading and annotating the textual descriptions of the lesson plans, looking at external materials, and downloading and playing through the teacher designed worlds. Through this iterative process, we are generating codes to account for patterns in the data. We share dimensions we have identified thus far, as well as a richer description of three teacher profiles and lessons that illustrate how these dimension codes come together to result in a range of lesson designs.

4 RESULTS

In the next three subsections, we provide descriptive statistics from the lesson corpus. Specifically, we share statistics regarding the languages used, authors, intended student age, subject areas, and skills. In the data set, we found 18 lessons without language tags. We opened each of those lessons and tagged them accordingly. Out of 627 lessons, 522 (83.25%) were in English with the remaining 105 lessons being in a variety of languages.

4.1 Authors

237 unique authors contributed lessons to the website. Of these authors, "Minecraft Education", the website admin account, uploaded 143 lessons. We decided to exclude these from further analysis as we were interested in what designs teachers generated with the sandbox game. This meant UGC and not content designed by or for the company. Looking at the remaining 236 authors and 484 lessons, we found that the average number of lessons uploaded by an author was 2.05 (SD = 2.87). The distribution was a right tailed skewed distribution. The median number of lessons per author was one, meaning that the overwhelming majority of authors uploaded one or two lessons to the website. Sixteen authors fell above one standard deviation and contributed 32.8% of the total UCG lessons. We refer to these authors as "power users." Each power user uploaded between 5 and 30 lessons.

4.2 Target audience

The 484 lessons contained 717 age tags. The most frequent age tag was 8-10 year olds with 216 instances, followed by 11-13 year old (166) and 14-18 year olds (152). There were no lessons that contained only the 3-5 tag. In all 10 instances, the 3-5 year tag appeared together with the 6-7 tag. 18+ was only tagged twice as a single tag, once in a lesson for parents and once for teachers to learn about Minecraft EDU. The other 32 instances occurred when users tagged 14-18 target age. The most common age group seems to be 8-10 year olds, that is, elementary school children. This fits with existing studies on the popularity of Minecraft among elementary school students [10].

4.3 What do teachers teach with Minecraft EDU?

4.3.1 Subjects. Of the 484 user generated lessons, 6 lessons did not include any subject tags. 118 included only one tag. 106 and 254 lessons included two or three subject tags respectively. Of the 25 subject tags, the ten most frequent were: Technology (119), Art & Design (110), Math & Economics (105), Science (96), History (87), Geography (79), Computer Science (72), Reading & Writing (70), Climate & Environment (47), and Gaming (39). It seems therefore, that teachers report to use Minecraft EDU for a range of subjects from STEM, social sciences, to the humanities at similar frequencies.

4.3.2 Skills. Seven lessons did not include skill tags. 65 included one skill. 88 lessons included two skills, and 324 included three skills. The following seven skill tags were found in this frequency: Creativity (295), Collaboration (266), Critical Thinking (242), Project Based Learning (171), Communication (144), Citizenship (56), and Character (39).

4.4 Lessons from power users

After looking at the descriptive statistics of the corpus, we decided to examine lessons more closely. We chose the 16 power users identified above, as they provided a subset of authors who generated multiple lessons. In the remaining space, we share our findings from our qualitative analysis of these 159 lessons.

4.4.1 Dimensions. Our coding has led to several codes that reflect dimensions along which we categorize the types of lessons designed by teachers with Minecraft EDU. Table 1 presents the codes and their descriptions.

4.4.2 Teacher profiles. Teacher 1: *A Game within a Game* – This teacher is a world builder, who creates complex worlds with multiple NPCs, with either textual information, or large structures representing natural phenomena or cities. She places her students within these worlds either to experience a participatory simulation (e.g., playing as bees) or to play through a self-contained adventure game, talking to NPCs and completing quests.

Table 1: Qualitative codes reflecting dimensions of teacher generated lessons with Minecraft EDU.

Code	Definition
World Builder	Does the lesson include a world built by the teacher (Yes / No)?
NPCs	Does the world include NPCs (Yes / No)? If yes, what do they do?
Single or Multiplayer	Do students play individually or in groups?
Interactivity	What do students interact with? (Walking around, NPCs, Mobs, Coding Agent)?
Student Builders	Are students expected to build (Yes / No)? If so, what?
External Media	Do students use or interact with media outside of the game (Yes / No)? If yes, what kinds of content (images, videos, worksheets, etc.)?
Documentation	Are students asked to document their work explicitly (Yes / No)? If yes, using what tools (in-game items, building representations, presentation, etc.)?

Teacher 2: *The Game as a Lab or an Expedition* – This teacher builds worlds, which require students to perform tasks and take notes in an accompanying worksheet. For example, in one lesson, students spawn in a survival mode world where a NPC adequately named Archimedes asks them to interact with 10 game entities that might drop items (e.g. killing spiders) and then calculate the probability of getting certain items from each entity. In another lesson, students explore the biomes of Minecraft and, using Venn diagrams, compare the geography, wildlife, and vegetation in the game world and the real world.

Teacher 3: *The Game for Student Representations* – This teacher does not seem to build worlds himself. Rather he uses Minecraft EDU as an environment where students can represent their learning. Throughout a several month-long curriculum about the ancient worlds' buildings in relation to astronomy, students constructed eight ancient landmarks (e.g. Stonehenge). The students then created NPCs that teleport to and from said landmarks and placed boards where they wrote information about the structures' geographical location (longitude and latitude) and our current understanding of its intended use as ways to understand astronomy.

5 DISCUSSION & CONCLUSION

In this paper, we reported on lessons designed with Minecraft Education Edition by educators. We shared findings from a descriptive analysis of the full corpus of lessons available on the Minecraft EDU website and preliminary results of a qualitative analysis of a subset of lessons.

The descriptive data analysis showed that 237 unique authors uploaded lessons to the website. One of these was the Minecraft EDU administrators, which we treated as non-user generated content. An analysis of the 484 user generated lessons led to several findings. In terms of who is learning with Minecraft EDU, we found that the teachers uploaded lessons mainly for students in the 8-10 and 11-13-year-old age groups. Relating back to work on youth use of Minecraft [14], this finding is expected. However, the high number of high school tags surprised us, given that prior research has not reported a lot of work with this age group. Additional work should explore Minecraft EDU in high school contexts.

In exploring the various tags used when uploading the lessons, we found a broad range of subjects (STEM, Social Science and Humanities). Future analysis may better understand what teachers mean by ambiguous subject tags (e.g., "Technology"). Future research should also examine whether teachers design lessons differently in line with specific subject areas. In the category of skills, we see a clear convergence around three tags. As is the case with the subject tags, teachers are constrained to the skills that the website affords. We wonder whether the three most frequent skills (i.e., creativity, collaboration, and critical thinking) are a projection of what teachers see Minecraft EDU affording or are teachers designing deliberately towards these skills? One limitation of this work is the reliance on website provided tags. When teachers check boxes saying the lesson is for a range of age groups, that does not tell us for which age group they specifically designed it for.

Our ongoing qualitative analysis of lessons designed by the 16 "power users" has so far generated seven codes. These codes reflect design dimensions along which teacher generated lessons vary. Across the lessons, we see a range of combinations of the seven codes, which represent a rich variety of the strategies teachers apply when using Minecraft EDU as a teaching tool. We briefly illustrated three different teacher profiles based on their lessons. We are iteratively working to refine our coding towards a taxonomy of lesson designs with Minecraft EDU.

As digital games continue to gain legitimacy as a part of the teacher's toolkit, we believe that understanding what and how teachers design with games is important. Minecraft. as a sandbox game, allows us to examine what teachers design with the freedom that the game affords as a platform. We plan to continue this work by surveying and interviewing teachers who have designed lessons with Minecraft EDU to better understand their thinking and design process.

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