



2020 Presidential Research Grant Report
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Phase II *SpacEscape*

Mobile Game for Learning Space Science 2020 Report

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Project Overview

This project is the phase II of the awarded 2019 Presidential Research Grant Project *SpacEscape* (PRG 2020-07; <https://www.harrisburgu.edu/spacescape/>). By working with teachers and students from Mechanicsburg School District, Susquehanna Township Middle school, Crossroads Middle School, and Pequea Valley High school, the research team published the mobile science learning game *SpacEscape* to Google Play Store, introduced the game to more than 1,000 middle school students even during the pandemic, collected more data to understand how learner conduct problem-solving using mobile games, and presented the research at the Games for Change 2020 Virtual Conference to more than 500 attendees. In this report, we will share the activities, findings, and future research of the project.

Overview of Activities

After receiving the grant, the faculty members assembled the team, and started the game design and development. The overview of activities of this project includes game design and development, research collaboration, conference attendance and presentation.

1. Game Design and Development

The 2020 *SpacEscape* team was consists of 10 members (3 HU faculty members, 1 IMED student, 2 CICS students, 4 high school students). The team worked together for six months on the design, development, and research, see team member roasters in Figure 1.



Figure 1. *SpacEscape* Team Members

The design and development team met bi-weekly to work on assets creation, game concept development, bug fixes, and final publication. Before the pandemic, the team met in person on HU campus to discuss progress. During the pandemic, the team meeting transitioned smoothly to online format using Microsoft Teams, see Figure 2 for team meetings before and after the pandemic.

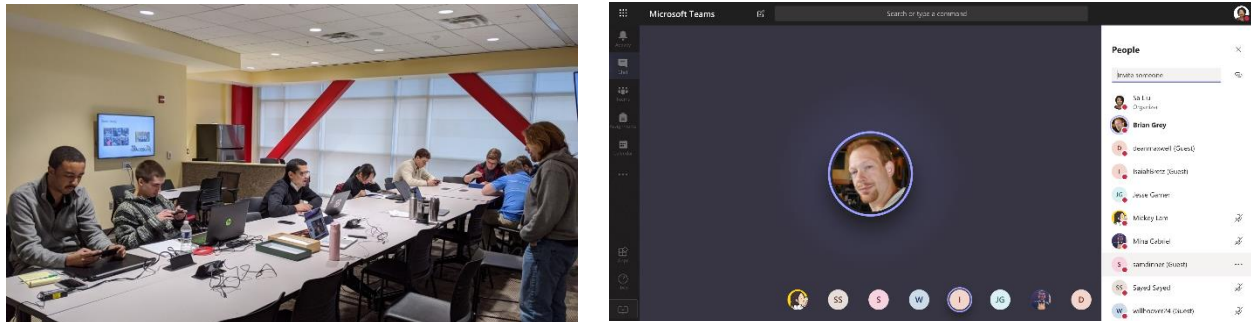


Figure 2. *SpacEscape* Team Meetings (Before and After the Pandemic)

Based on 2019 version, the 2020 design team improved in-game assets design and interface. Take the alien spaceship for example, six revisions were made before the final publication, see Figure 3.



Figure 3. *SpacEscape* Game Assets Revisions

Based on the design mockup, the development team continued to use the Android SDK toolkit (See <https://developer.android.com/studio>) to improve the game. The team also continued using Github (<https://github.com/>) for coding collaboration and version control. Based on Github data, at least 79 revisions (e.g., bug fix, adding new features, update database, etc.) were made to the development code during the Phase II development of the project (February, 2020 to June, 2020), see Figure 4 for the coding revision distributions.

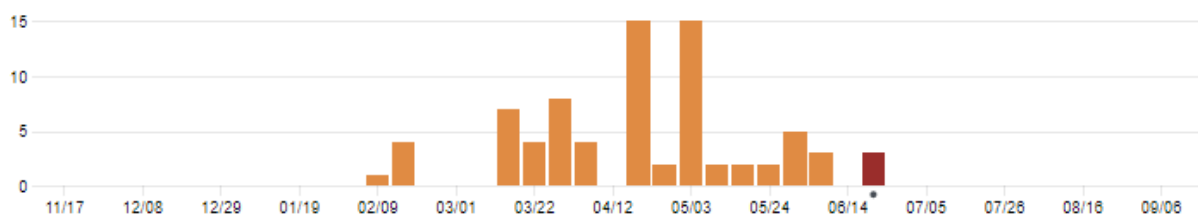


Figure 4. Coding Revisions During the Projects

The team finished the following proposed design and development activities, including 1) Add hints to player when it starts; 2) Provide notes or summary at the end of the game; 3) Add HU theme to the end credits; 4) Add music and sound in the game; 5) Add data log function to the game to better understand student behavior in the game. Eventually, the team published the game in Google Play store (see <https://play.google.com/store/apps/details?id=harisburg.university.spacescape>). Teachers and

students can directly download it on their own android devices (e.g., phone, tablet, Chromebook, etc., see Figure 5). Although the game is free to play, users do need to request an ID by emailing the team.

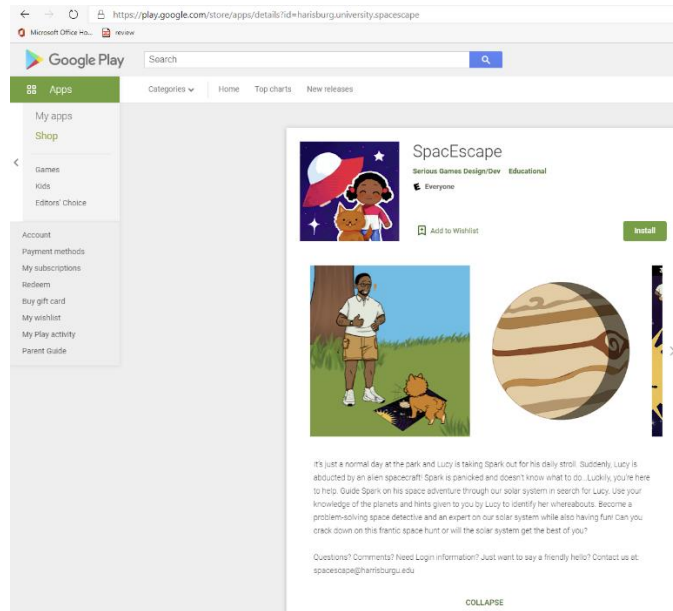


Figure 5. *SpacEscape* is Published in Google Play Store

2. Collaboration

This project includes two major collaborations with local partners. One collaboration is about the game design and development, the other is research.

In collaboration with Mechanicsburg School District, American Literacy Corporation, HU *SpacEscape* team hired 4 high school interns in designing and developing the game. At the end of the project, two of them were admitted to IMED and CICS programs at HU.

As for the research, the data collection was scheduled with Mechanicsburg Middle school in June 2020. Unfortunately, due to the pandemic and the school district transitioning to online format, the team was not able to conduct the research in the classroom. However, since all activities were online, the team was able to reach out to three more school districts (i.e., Susquehanna Township Middle school, Crossroads Middle School, and Pequea Valley High school). As a result, the team created over 1,100 new accounts for both middle school students and teachers in these four schools.

3. Conference attendance and presentation

The team submitted a conference proposal to 2020 Games for Changes Conference (<http://www.gamesforchange.org/>), which was accepted and scheduled to present in New York city in June. 2020. Due to the pandemic, the conference changed into virtual format. With the support from the funding, two faculty and two students presented at the virtual conference. During the presentation, the team discussed design and development process, preliminary research funding and demoed the game to peer attendees. Since the virtual conference did not have the attendee limitation, there were at least 567 audiences watching the 10 minutes presentation, which is the largest audience we have ever had for a conference presentation. See Figure 6 for the conference presentation picture.

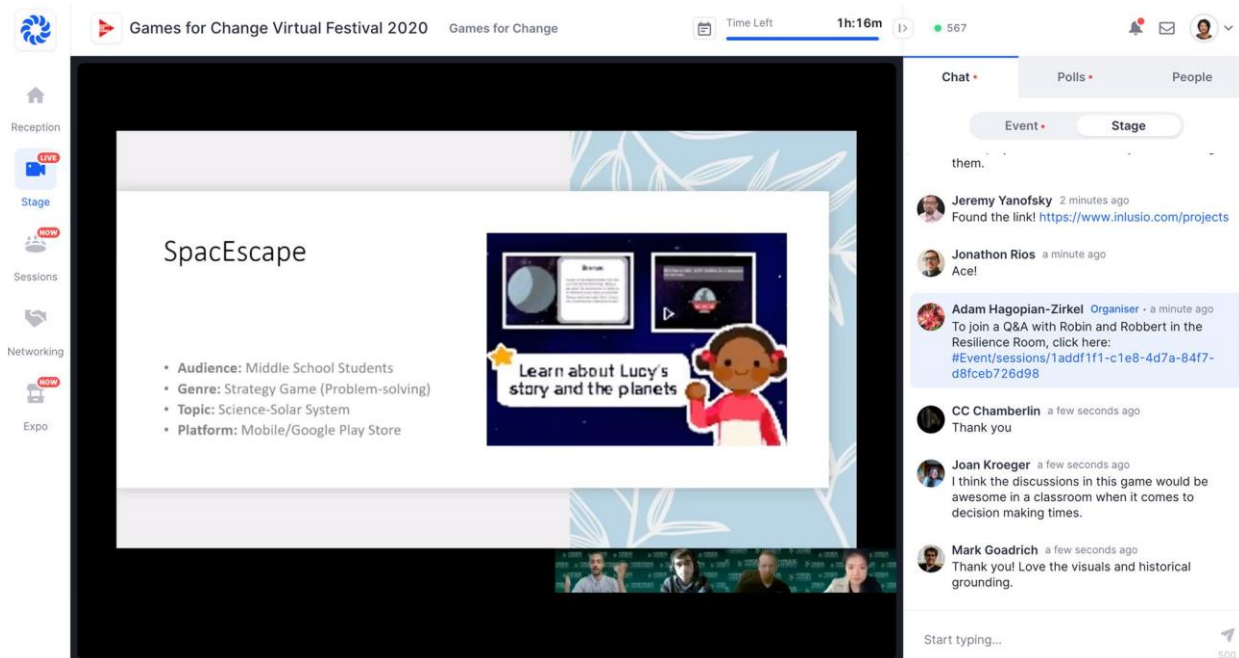


Figure 6. *SpaceEscape* Presentation at Games for Change 2020 Virtual Conference

Findings and Impact of Research to Date

Besides exposing the game to more than 1,000 middle school students, presenting the game to more than 500 audiences in the field, and making the game free accessible to public in Google Play Store, the team also conducted research regarding learning science using mobile game. We will discuss the research process and findings in this section.

1. Research Process

This study aims to further understand whether the learning would sustain after playing the game, therefore, we added retention-test for the 2020 study. Instead of conducting pre- and post-test for both control and experimental group, we conducted pre-test (at least one day before the game play), post-test (right after the game play), and retention-test (two weeks after the game play) for all participants (Chittaro and Buttussi 2015; Van der Spek 2011). It is worth mentioning that due to the pandemic, we were not able to provide device or collect data in real classroom setting. Although all students were provided account and encouraged to download the game in their own device, it was challenging to make sure students play the game and finish all three tests for the study purpose. As a result, despite having over 1,000 students exposed to the game, the final data only included 37 students (16 boys, 21 girls).

2. Research Findings

Preliminary data analysed indicated that students had an average pre-test score of 66 points, and the average post-test score is 74 points, resulting in an average score increase of 8 points. The retention-test showed an average score of 69 points among all participants, which was 5 points lower compared post-test, but was still 3 points higher than pre-test. The data indicate that learning using *SpacEscape* did sustain. However, more data is needed to draw a definitive conclusion.

Future Research Needed

Based on Phase I and II study, the research team will need to focus on the following aspects in the future:

1. **More retention test data is needed:** although a retention test was conducted in Phase II study, it is not clear whether the knowledge gained during this short period would be retained long-term. The research will need to increase the sample size for the future study.
2. **Motivation for learning science:** although students showed increased interests in science learning, more study is also needed to decide whether the engagement in learning about solar system *SpacEscape* have improved learner motivation in learning about other topics in science subject.

3. **Apple store app/Web version needed:** to make the game more accessible, besides the current Android Version, the research team will need to develop a version of *SpacEscape* that would work for Apple Store or web as well.

References

- Charsky, Dennis. 2010. "From edutainment to serious games: A change in the use of game characteristics." *Games and culture* 5, no. 2: 177-198.
<https://doi.org/10.1177/1555412009354727>
- Chittaro, Luca, and Fabio Buttussi. 2015. "Assessing knowledge retention of an immersive serious game vs. a traditional education method in aviation safety." *IEEE transactions on visualization and computer graphics* 21, no. 4: 529-538.
- Gee, James Paul. 2003. "What video games have to teach us about learning and literacy." *Computers in Entertainment (CIE)* 1, no. 1 2003: 20-23.
<https://dl.acm.org/doi/abs/10.1145/950566.950595>
- Hartley, James. 1973. "The effect of pre-testing on post-test performance." *Instructional Science* 2, no. 2: 193-214.
- Liu, Min, Jina Kang, Jaejin Lee, Elena Winzeler, and Sa Liu. 2015. "Examining through visualization what tools learners access as they play a serious game for middle school science." In *Serious Games Analytics*, pp. 181-208. Springer, Cham.
- Marsden, Emma, and Carole J. Torgerson. 2012. "Single group, pre-and post-test research designs: Some methodological concerns." *Oxford Review of Education* 38, no. 5: 583-616.
- Sánchez, Jaime, and Ruby Olivares. 2011. "Problem solving and collaboration using mobile serious games." *Computers & Education* 57, no. 3: 1943-1952.
- Van der Spek, E. D. 2011. "Experiments in serious game design: a cognitive approach." PhD diss., Utrecht University.