# CSUN 2019 Submission – General Track

## Submission Title

Building an Accessible Math Learning Game: The ***Railway Hero*** Case Study

## Speakers

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## Field

* Education

## Topic Association

* K-12 Education
* Software
* Research & Development

## Abstract

The development process and lessons learned while creating ***Railway Hero***, a new PBS Kids accessible math learning game based on the *Cyberchase* TV series.

## Summary/body of the paper:

This presentation will provide a case study examination of the design process used to create “Railway Hero,**”** the first universally designed digital game from the PBS KIDS math series *Cyberchase*, created for use by all children and designed specifically to incorporate accessibility features for children with physical, cognitive, visual, hearing or learning impairments. Released by WNET in August 2018, **“**Railway Hero**”** is currently available for free on the *Cyberchase* website at [pbskids.org](http://pbskids.org) and on the [PBS KIDS Games](http://pbskids.org/apps/play-pbs-kids-games.html) app.

A collaboration with Bridge Multimedia, an NYC-based accessibility organization dedicated to supporting all facets of universal access, with support from the U.S. Department of Education’s Office of Special Education Programs, Railway Hero was designed using a “born accessible” approach with accessibility functions built into the game design from the ground up. In this math-based HTML5 game, players join the CyberSquad in the Solar CyberTrain on a mission to repair cyberspace’s Information SuperRailway, after pieces of its track were stolen by the villain Hacker. Using math problem-solving strategies including counting, addition and algebraic reasoning, players fill in the empty tracks in the railway on an epic journey across cybersites.

There is a growing body of research which supports the concept of learning gains through student usage of well-designed digital gaming applications. Several recent studies have explored cross‐platform learning for young children, which tend to suggest that the learning potential is increased in situations where a combined use of multiple media platforms exists, such as a children’s educational TV series coupled with a digital learning game featuring the same characters (Fisch, 2013). In a recent study, researchers found that students who watched the PBS Kids ODD SQUAD TV series and used associated digital and hands-on resources significantly increased their overall knowledge of algebraic thinking and numbers and operations (Tiu et al, 2015). A previous study conducted with support from the National Science Foundation had specifically connected learning gains for students who watched the *Cyberchase* TV series and used the associated learning games available on the PBS Kids website (Fisch et al, 2010). However, since these older learning games were not designed to be accessible to children with disabilities, this critical population of early learners were unable to enjoy the benefit of such informal learning opportunities.

In 2017, with the assistance of funding from the US Department of Education’s Office of Special Education Programs (OSEP), WNET, PBS Kids and Bridge Multimedia began a collaborative project to design a new accessible learning game based on the long-running *Cyberchase* TV series. This project has not only created the accessible Railway Hero game itself, but also produced a number of guidance products for the gaming industry, educators and parents. These resources will be discussed as part of the presentation with a view toward helping attendees learn the best practices learned in the development of *Railway Hero*.

As part of the development process, a number of stakeholders were involved including researchers, game developers, accessibility professionals and individuals with disabilities. As a foundation, available guidelines and best practices for accessible gaming technology were consulted. These included the foundational guidelines for games accessibility produced by the International Games Developer Association’s Games Accessibility Special Interest Group (GA-SIG), and the MediaLT guideless, both of which were incorporated into the later work done by Ossmann and Miesenberger (Ossmann & Miesenberger, 2006). The ongoing industry collaboration Game Accessibility Guidelines were further consulted as some of the best available guidance available to date (Ellis et al, 2017). While every attempt to follow available best practice and guidance was followed, the realities of developing Railway Hero within a given timeline and within a fixed budget ceiling represents a valuable case study for the gaming industry and accessibility developers.

To make “Railway Hero” accessible to as many children as possible, a number of features were incorporated to support learners with a variety of physical and cognitive needs. While we have not included the full list, a few are included below:

* Customizable screen display options, including text size, color and contrast options
* All types of audio output are individually adjustable. The audio level of background music, sound effects, and narration/audio description can be independently adjusted or turned off completely
* Support for blind or visually impaired users, including audio description and keyboard controls
* Support for deaf or hard of hearing users, including captioning
* A variety of cognitive supports, including the ability to change text sizes and colors, caption controls and audio descriptions
* Captions and audio descriptions can be used at the same time to reinforce meaning
* Periodic visual and audio prompts continue to remind the player of the next step
* Dialog and images are used to help support facial expressions, body language, text, and audio information
* Instead of drag-and-drop, moveable game pieces are activated by keyboard selection, clicking with a mouse or tapping on a tablet or phone
* Keyboard navigation is switchable from tab/shift-tab to left arrow/right arrow
* The hit zone of selectable/clickable objects and buttons is large and easy to access
* A mixture of positive game reinforcements (visual, audio and text) is used to signal when a correct or incorrect game move or problem solution has been entered

During development, field testing of the game included children with and without disabilities to provide critical feedback to make the game accessible and usable by children of different abilities.

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### References:

Ellis, B., Ford-Williams, G., Graham, L., Grammenos, D., Hamilton, I., Lee, E., ... & Westin, T. (2017). Game Accessibility Guidelines: A straightforward reference for inclusive game design.

Fisch, S. M., Lesh, R., Motoki, E., Crespo, S., & Melfi, V. (2010). Children’s learning from multiple media in informal mathematics education. National Science Foundation-funded Research Study.

Fisch, S. M. (2013), Cross‐Platform Learning: On the Nature of Children's Learning from Multiple Media Platforms. New Directions for Child and Adolescent Development, 2013: 59-70. doi:10.1002/cad.20032

Ossmann R., Miesenberger K. (2006) Guidelines for the Development of Accessible Computer Games. In: Miesenberger K., Klaus J., Zagler W.L., Karshmer A.I. (eds) Computers Helping People with Special Needs. ICCHP 2006. Lecture Notes in Computer Science, vol 4061. Springer, Berlin, Heidelberg

Tiu, M., McCarthy, M. B., & Li, L. (2015). Odd Squad: Learning Math with PBS KIDS Transmedia Content at School and Home.