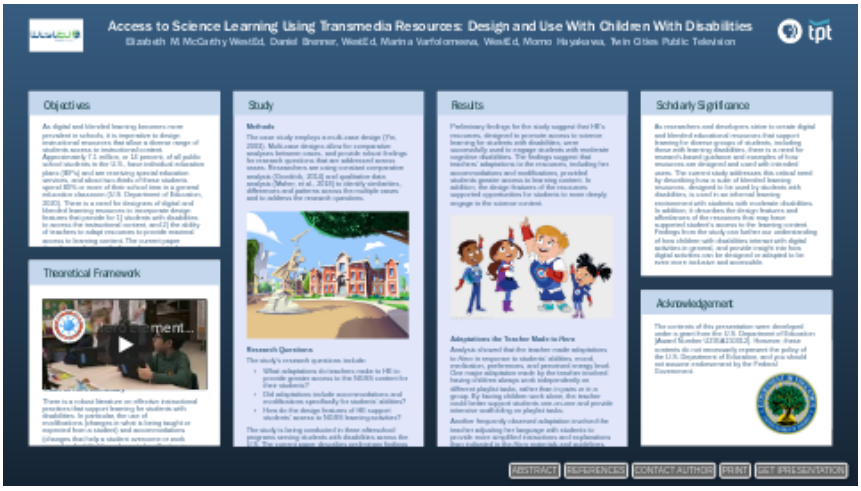
Access to Science Learning Using Transmedia Resources: Design and Use With Children With Disabilities



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OBJECTIVES

As digital and blended learning becomes more prevalent in schools, it is imperative to design instructional resources that allow a diverse range of students access to instructional content. Approximately 7.1 million, or 14 percent, of all public school students in the U.S., have individual education plans (IEPs) and are receiving special education services, and about two-thirds of these students spend 80% or more of their school time in a general education classroom (U.S. Department of Education, 2020). There is a need for designers of digital and blended learning resources to incorporate design features that provide for 1) students with disabilities to access the instructional content, and 2) the ability of teachers to adapt resources to provide maximal access to learning content. The current paper describes preliminary findings of a case study examining the design and use of a collection of blended learning resources with students diagnosed with moderate cognitive disabilities.

Transmedia denotes a process where integral elements of a fiction get dispersed systematically across multiple delivery channels for the purpose of creating a unified and coordinated entertainment experience (Jenkins, 2007).

The transmedia collection of blended resources examined in the study, *Hero Elementary*, was developed by Twin Cities Public Television (TPT) and is designed with accessibility features to support learning in the Next Generation Science Standards (NGSS). *Hero* includes television episodes, digital and analog games, non-fiction eBooks, hands-on activities, a digital science notebook, and educator resources. *Hero* television episodes and resources are now available on PBS. For informal and formal K-2 classrooms, bundled collections of resources, or “playlists,” can be chosen and used in any order, and adapted to meet the needs of students.

THEORETICAL FRAMEWORK

[Video] https://www.youtube.com/embed/tuZy4suwhRE?rel=0&fs=1&modestbranding=1&rel=0&showinfo=0

There is a robust literature on effective instructional practices that support learning for students with disabilities. In particular, the use of modifications (changes in what is being taught or expected from a student) and accommodations (changes that help a student overcome or work around a disability) has shown to be effective in promoting learning for students with disabilities (Berry, 2011; Sandall, Schwartz & Gauvreau, 2016). There is a growing literature on best practices in designing learning resources for students with disabilities. Many of these are represented in the Universal Design for Learning (UDL) framework (CAST, 2011). The framework identifies design features and instructional practices that maximize accessibility and remove barriers for learners at each stage of the learning process, including affordances that provide for multiple means for engagement, representation, and expression and action. There are also research findings related to the design of digital resources that promote inclusion and accessibility (Caria, et al., 2018; Cheng & Lai, 2019; Knight, et al., 2013; Lan, Hsiao & Shih, 2018; Panagopoulou, et al., 2018; Weng, Maeda & Bouck, 2014). This research has led to best practices in the field of computer assisted instruction (CAI), and key learnings have been organized into frameworks and checklists to inform design of digital learning resources (AccessINCLUDES, 2020; Westin, Ku, Dupire, Hamilton, 2018). Research on designing and using science resources for students with disabilities aligns closely with UDL and CAI recommendations (Lee, Miller, & Janusyk, 2015).

TPT designers created an inclusion framework to guide the production of all the digital and analog *Hero* resources. Drawn from best practices specified in UDL, CAI, and research in science education, the framework includes design features meant to create resources that are both welcoming and accessible to students with disabilities. The design features of *Hero* resources are specifically targeted to allow students with disabilities to access NGSS content on their own, and to allow teachers to adapt activities to provide students better access to the content.

STUDY

Methods

The case study employs a multi-case design (Yin, 2003). Multi-case designs allow for comparative analyses between cases, and provide robust findings for research questions that are addressed across cases. Researchers are using constant comparative analysis (Goodrick, 2014) and qualitative data analysis (Maher, et al., 2018) to identify similarities, differences and patterns across the multiple cases and to address the research questions.

Research Questions

The study's research questions include:

- What adaptations do teachers make to HE to provide greater access to the NGSS content for their students?
- Did adaptations include accommodations and modifications specifically for students' abilities?
- How do the design features of HE support students' access to NGSS learning activities?

The study is being conducted in three afterschool programs serving students with disabilities across the U.S. The current paper describes preliminary findings from data collection and analysis at one afterschool program. Data collection and analysis are described below.

Data Sources

Data were collected during two site visits at an afterschool program in southeast region of the U.S. that serves students who qualify for special education and related services under the Individuals with Disabilities Education Act (IDEA) and have IEPs that outline the accommodations and modifications each child needs to be able to access educational content. The afterschool classes observed by researchers included students with moderate cognitive, speech, attention, sensory, and motor disabilities. Data collection involved observations of 18 students with varying abilities and preferences over a two-day period and interviews with 3 teachers. Pre-observation interviews were conducted with teachers prior to the classroom visits to gain an understanding of the role of the teacher in implementing HE, the student participants, activities to date, and plans for implementation during the observations. Researchers used a running record of observations of the teacher and student behavior. Teachers post-observation interviews occurred immediately following the observation sessions.

An initial code book was created based on the research questions, the interview protocol questions, as well as considerations about the students with special educational needs at the school. Transcripts and notes were coded with the tags created in the code book using NVivo software (QSR International) to facilitate analyses. Based on the initial code tagging, the code book was then refined and used to code the remaining interview transcripts and observation data. The software was used to help categorize and classify the data, and to sort sentiment, themes, and attributes from the data. Coding and subsequent data reduction through analytic reviews and case reports were completed independently by two researchers.

RESULTS

Preliminary findings for the study suggest that HE's resources, designed to promote access to science learning for students with disabilities, were successfully used to engage students with moderate cognitive disabilities. The findings suggest that teachers' adaptations to the resources, including her accommodations and modifications, provided students greater access to learning content. In addition, the design features of the resources supported opportunities for students to more deeply engage in the science content.

Adaptations the Teacher Made to *Hero*

Analysis showed that the teacher made adaptations to *Hero* in response to students' abilities, mood, medication, preferences, and perceived energy level. One major adaptation made by the teacher involved having children always work independently on different playlist tasks, rather than in pairs or in a group. By having children work alone, the teacher could better support students one-on-one and provide intensive scaffolding on playlist tasks.

Another frequently observed adaptation involved the teacher adjusting her language with students to provide more simplified instructions and explanations than indicated in the *Hero* materials and guidelines. For the suggested discussion question of "How are the two plants the same or how are they different?" The teacher said, "What color is this one? Red. What color is this one? Green. Okay. This one's red, this one's green. Are they the same or are they different?"

All students required less advanced vocabulary in order to understand concepts. When discussing plant parts, the teacher avoided words like 'midrib', and used more familiar words like 'stem', 'leaf', 'branch'. She said *Hero* is designed to get students into a questioning mode with respect to science and indicated that by simplifying vocabulary, she was successful in implementing questioning with students. The teacher framed lessons around things students can relate to directly in their own lives. She avoided some words suggested by the NGSS-aligned guidelines for K-2, such as 'investigate,' 'compare,' and 'observe.'

All students struggled following series of directions. The teacher provided directions for students to complete tasks one step at a time. She demonstrated and modeled the activity for each student and continuously provided verbal cues and redirection to students as they completed each step.

Accommodations and Modifications

When considering adaptations teachers made, researchers noted instances when the teacher specifically made accommodations and modifications.

One modification used by teachers involved implementing HE in a whole-class format using a SMART Board. The students viewed the videos together on the SMART Board and participated in class discussions about the content of the lesson. While some students had difficulty with the small motor skills needed to operate the tablets, and others had trouble remaining focused and on-task while working independently on a tablet, the introduction to Hero using the SMART Board enabled most students to successfully transition to using the tablets for the games and other digital activities.

One activity in the "Plants Parts" playlist involves placing a leaf under a sheet of paper to create a leaf rubbing and reveal the pattern in the leaf. A student initially had difficulty with this activity, reportedly due to sensory processing differences and motor challenges. The student struggled to use colored pencils to lightly shade and reveal the leaf shape. The teacher was able to provide an accommodation to the activity by having the child take a picture of the leaf using the digital notebook and examining the photo.

Analysis of observation and interview data suggest that some students were more hyperactive and would move away from a task, and other students were more passive and often did not engage unless continuously prompted. With multiple students in the classroom, the teacher said that the wide selection of playlist activities, and the ability to adapt them, helped to engage students while she moved from child to child providing individualized support, constantly supervising each student to ensure they would stay on task. The teacher's accommodations allowed students to frequently reengage in the content and experience science activities and concepts.

Design Features

The teacher mentioned appreciating the accessibility features of the resources, as well as the variety of choices available to her as she plans HE lessons. She chose playlists that were most "basic" or "concrete" as she considered students' cognitive abilities. She reported that students exhibited greater facility to understand and relate to the more basic content of the "Animal Parents and Their Young" playlist versus the "Pushes and Pulls" playlist which includes more abstract concepts. The teacher reported that students seemed to connect best with tangible, familiar objects or concepts from their own lives, such as the fruit or vegetables in their lunchbox (e.g., in the "Plants Parts" playlist).

Flexibility of the HE format allowed the teacher to adapt and improvise activities as needed. She said that being able to return to parts of a playlist to review and revisit content helped to reinforce the learning. She was better able to elicit responses from students to questions about the content on the second exposure. The design features of the curriculum also allowed the teacher to make changes depending on students' mood, preferences, and energy level. For instance, some highly active students were allowed to eat snack while watching the HE television episodes, providing deeper engagement.

Analysis of observations and interviews suggest that eBooks were particularly engaging and informative for all the students. eBook features allowed the teacher to launch the book, then students could interact with the images and audio with little distraction. Even students with significant attentional difficulties were able to focus on the activity and the images. Students were able to relate to recognizable themes and objects in the eBooks.

SCHOLARLY SIGNIFICANCE

As researchers and developers strive to create digital and blended educational resources that support learning for diverse groups of students, including those with learning disabilities, there is a need for research-based guidance and examples of how resources are designed and used with intended users. The current study addresses this critical need by describing how a suite of blended learning resources, designed to be used by students with disabilities, is used in an informal learning environment with students with moderate disabilities. In addition, it describes the design features and affordances of the resources that may have supported student's access to the learning content. Findings from the study can further our understanding of how children with disabilities interact with digital activities in general, and provide insight into how digital activities can be designed or adapted to be even more inclusive and accessible.

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ABSTRACT

This case study examines the design and use of blended learning resources with students diagnosed with moderate cognitive disabilities. The collection of K-2 blended resources examined in the study, Hero Elementary, is designed with accessibility features to support learning in the Next Generation Science Standards (NGSS), and includes television episodes, digital and analog games, non-fiction eBooks, hands-on activities, a digital science notebook, and educator resources. Findings suggest that the resources were successfully used to engage students with moderate cognitive disabilities. The findings suggest that teachers' adaptations to the resources, including accommodations and modifications, provided students greater access to learning content. In addition, the design features of the resources supported opportunities for students to more deeply engage in the science content.

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