# Using Telemetry Data During Early Testing to Improve Digital Learning Resources

Betsy McCarthy, Melissa Cheung, Mingyu Feng, Kelsey Austin-King, Jennifer Wang, *WestEd,* Momoko Hayakawa, Dennis Ramirez*, TPT*

## PURPOSE

The objective of this session is to describe innovative methodologies used to test alpha and beta versions of a digital learning playlist. The methodologies address the wide variations in students' abilities, perspectives and dispositions as they engage in gameplay. The methodologies described provide a relatively low-cost accurate means to: improve the accuracy of telemetry, provide feedback to the developer about how students interact with resources, and improve the adaptive features of a resource.

## SIGNIFICANCE

The underlying structure of a digital resource, which determines at what point during gameplay evidence is captured and recorded, is called telemetry. Well-designed and accurate telemetry can enhance the effectiveness of learning resources by producing data that can provide information about a user's progress and dispositions (Mislevy, Dicerbo, Frezzo, & West, 2012; Shute et al., 2014; Sottilare, Graesser, Hu, & Goodwin, 2017).

## DATA COLLECTION

The alpha and beta testing were conducted on a transmedia playlist from the Hero Elementary suite of digital learning resources created by Twin Cities PBS (TPT) as part of their Ready to Learn project. Funded by the US Department of Education's Ready to Learn grant (USDOE, 2016), TPT is developing a suite of transmedia resources to engage diverse communities in science learning. Participants included 178 K, 1st and 2nd graders (49% low-SES, 30% EL) and included four types of data: 1) researcher observation notes, 2) researchers' post-visit debriefs, 3) tablet screen capture videos taken during gameplay, 4) telemetry log data, and 5) artifacts saved by one of the resources, notebook/drawing tool. Telemetry data included: user ids, time stamps, browser/client information, and events for: start game, end game, answer selections, correct/incorrect answers, mastery tracking, and use of help. Artifacts included screen shots of students' work when they "saved" their work.

## ANALYSIS AND FINDINGS

Results included specific feedback related to: 1) the accuracy of the resources' telemetry, 2) detailed descriptions of how children used the digital learning activities, and 3) refinement and creation of the algorithms that identify children's actions and dispositions while using the playlist. Figure A shows a sample of telemetry log data and the screen capture used in side-by-side analysis.

*The Accuracy of The Resources' Telemetry*
To address the accuracy of the telemetry, the resources were tested in both alpha and beta phases. Three sets of observation and telemetry data were used in analysis: 1) the alpha testing data from 30 students, 2) the beta data from 178 students, and 3) a subset of randomly selected beta students, which included 10 kindergartners, 10 first graders and 10 second graders. In depth analysis using the complete set of alpha telemetry log data, and a subset of beta telemetry data involved a side-by-side comparison of screen capture videos to the telemetry logs. Missing data for students or events were also identified. Errors in telemetry accuracy were found and reported to the developers.

*Figure A*



*Detailed Descriptions of How Students Used the Resources*
To better understand how students used the digital resources, including on-task and off-task behaviors, and task success, researcher observation and debrief notes were used to identify where a student was on-task, off-task, needed support, randomly guessing, or mentioned gameplay was easy or difficult. Researchers then examined screen capture video to review students' precise actions related to the notes and pull clips to share with developers. Findings included detailed descriptions of age group differences in patterns of play, complexity in planning and implementation, and the types of tools students used to complete playlist tasks.

*Performance of the Algorithms That Identify Students' Actions and Dispositions*
During alpha testing, researchers collected observation data around student struggle and engagement in one game in the playlist. Observation and telemetry log data analysis provided information that allowed an improvement in the timing of hint markers. During beta testing, using observation and video screen capture data, researchers identified where instances of struggle and engagement occurred during gameplay. Levels of the game, students' grade level, and video clips of actual struggle behavior were obtained. Using these defined sets of telemetry log data for those instances of struggle, researchers created data models to predict when struggle might occur.

## RECOMMENDATIONS FOR RESEARCHERS AND DESIGNERS

~Use multiple sources of data to check the accuracy of telemetry.
~Include telemetry data, as well as observation data, in early testing of digital learning resources.
~Establish baseline algorithm and observational metrics for important user states and dispositions before testing. Use observational and telemetry log data to validate or change the metrics.
~Use findings from testing to inform the telemetry of subsequent digital learning resources.
~Explore testing methodologies that use smaller observation datasets along with larger, de-identified datasets of student telemetry log data.