No Such Thing as Failure, Only Feedback: Designing Innovative Opportunities for E-assessment and Technology-mediated Feedback

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In this paper we challenge designers, researchers, teachers, students, and parents to re-assess and re-envision the value of technology-mediated feedback and e-assessment by examining the innovative roles feedback and assessment played in the design of three contemporary web-based learning environments. These environments include 1) an e-assessment system for postsecondary American Sign Language learners, 2) a hybrid environment for teaching geography through the use of geospatial technologies, and 3) a progress-monitoring environment for reading, writing, and language development with deaf or hard-of-hearing students. For each design we share a brief overview of the instructional problem, audience, and initial design challenge, followed by a description of the specific feedback and assessment design opportunities. We conclude with suggestions to consider when designing future opportunities for online feedback and assessment.

“Champions know that success is inevitable; that there is no such thing as failure, only feedback. They know that the best way to forecast the future is to create it.” Michael J. Gelb

Feedback is widely discussed in many areas within the academic literature ranging from research on praise (Wilkinson, 1981) to rewards (Deci, Koestner, & Ryan, 2001) to learning goals and activities (Haas, 2005). At its core, feedback plays an integral role in both student performance and
self-efficacy (Wang & Wu, 2007). When feedback is provided as formative assessment, it can be one of the most effective pedagogical strategies for enhancing student performance (Marzano, 2007). Formative assessment involves the evaluation of student work as part of a continuum of growth toward increasing quality or degree of expertise rather than on a right or wrong basis (Sadler, 1989). The purpose of formative assessment is for learning rather than of learning, which is typically the purpose of summative assessment (Black & William, 1998; Pellegrino, Chudowsky, & Glaser, 2001). Black and Williams’ (1998) research suggests, “the gains in achievement appear to be quite considerable” and “amongst the largest ever reported for educational interventions” (p. 61). Moreover, the frequency of assessment is directly related to student achievement (Bangert-Drowns, Kulik, & Kulik, 1991; Fuchs & Fuchs, 1986) as well as immediate versus delayed feedback (Butler & Roediger III, 2008).

Given the wide availability of research on feedback in parallel to exponential advancements in technology, one would imagine that formative assessment is designed and incorporated regularly within online learning environments. However, modern online learning environments routinely and systematically use only summative evaluations with little formative assessments and/or scaffolding of the learner to the learning goals (Miller, Hooper, Rose, & Montalto-Rook, 2008). Instructional designers habitually place feedback and assessment in the last phase of their design and development process, similar to traditional end-of-chapter quizzes and tests. Thus, feedback and assessment exist as a tertiary means to content presentation and interactive functionality.

The design of feedback for e-assessment

It is important for instructional designers to understand and consider the intricate details of when to use and when to avoid different types of feedback, as well as specific components of the feedback itself. Although many believe that feedback traditionally benefits the design of instructional tasks and learning environments, research has suggested that specific features of effective feedback are not always agreed upon (Bangert-Drowns, Kulik, Kulik, & Morgan, 1991; Hattie & Timperley, 2007; Nelson & Schunn, 2009). For example, whether learner praise was included, whether the original problem was described, and whether a solution was included are specific conditions of feedback that have been shown to impact the effectiveness of feedback in writing performance (Nelson & Schunn, 2009).

We believe the nature of feedback should also align with the nature of the task. In other words, the ‘how’ is equally important to the ‘what, why, and when’ of feedback communication. For instance, given the task of com-
Completing a video-recorded language performance, a student in an American Sign Language class would benefit more from a teacher-recorded feedback video that displays proper sign alignment and expression than a printed note card with a score and written feedback. A student of geography using a geographic information system would benefit more from spatial feedback on a map than a summative score in an email. Similarly, for years triathlon coaches have used both above- and under-water video cameras to film their trainees following the belief that students need to see their performances in order to have a meaningful feedback conversation with their coaches to improve stroke, water efficiency, and breathing (Laughlin, 2002). Furthermore, aligning feedback with goal-setting (Marzano, 2007) through clear descriptions of student goals and expectations has also shown to benefit student performance and growth. From foreign language to swimming to math to geography, understanding the nature of feedback and the successful conditions for delivery are important considerations for both teachers and designers when determining how to provide learner feedback.

In this paper we challenge designers, researchers, teachers, students, and parents to re-assess and re-envision the value of feedback by illustrating the innovative roles feedback and e-assessment play in the design of three contemporary web-based learning environments:

1. **AvenueASL**, an integrated e-assessment system developed to capture, evaluate, and manage postsecondary ASL learner video performances;

2. **GeoThentic**, a hybrid learning environment designed to engage K-12 teachers and students with solving real-world geography problems through use of geospatial technologies; and

3. **AvenueDHH**, a progress-monitoring environment designed to help assess reading, writing, and language development for use with deaf or hard-of-hearing (DHH) students.

Each environment was designed and developed by faculty at a large Midwestern university, with current implementation and research being conducted in K-12 and postsecondary classrooms across the U.S. By sharing these three feedback design and implementation narratives, we hope that teachers will reevaluate the types of technology-mediated feedback tools and assessment strategies they employ in their classrooms, and that designers and researchers will expand their beliefs on how technology can support feedback, ultimately leading to enhanced opportunities in online feedback and support.

For each design we provide a brief overview of the instructional problem, audience, and initial design challenge, followed by a description of the specific feedback and assessment design opportunities including the feedback
type (e.g., goal-directed, scaffolding, traditional scoring), function (e.g., directive, facilitative, motivational), delivery mode (e.g., video, audio, text, numeric, etc.), expected/observed feedback outcomes, and an example feedback scenario. Although the problems, audiences, and contexts varied considerably in the development of each environment, the goal of transforming the nature of online feedback and assessment remained constant. Further, the design of each environment moves beyond the traditional approach of assigning feedback to only students; the design, development, implementation, and evaluation of the following environments also focuses on feedback and self-assessment to support teacher development and encourage parent involvement.

**AVENUEASL: RE-DESIGNED CBMS AND TAILORED FEEDBACK PACKAGES**

American Sign Language (ASL) has evolved into the third most widely used language in America preceded only by English and Spanish (Welles, 2004). Currently, more than 500 colleges and universities in the U.S. offer ASL instruction as a world language (Wilcox, 2004). Between the years 1992 and 2006, the rapid increase in demand for postsecondary ASL instruction and linguistic study created a wide range of instructional challenges including 1) assessing, measuring, and documenting learner progress; and 2) providing formative feedback through an efficient, effective, and technically-valid means (Miller & Hooper, 2008).

**AvenueASL design overview**

The most widespread practice for assessing ASL fluency involves evaluating video recordings of interviews with individual students (Newell & Caccamise, 1992). Prior to 2006, approximately 1,800 ASL students per semester at a large Midwestern university completed mid-semester and final exams by renting a video camera from the program office, recording a 15- to 20-minute conversation with a fellow student, and submitting the videotape for evaluation (Miller, Hooper, & Rose, 2005). Instructors then reviewed the video (a process often lasting 45 minutes per videotape, due, in large part, to fast-forwarding through incomplete edits, false starts, and ‘redos’ of the exam), assessed the performance, and recorded a single-digit evaluation score with brief textual feedback comments on a note card. Ultimately, these assessment and examination practices proved burdensome for both students and instructors (Hooper, Miller, Rose, & Veletsianos, 2007). Instructors noted that evaluation time averaged three to five weeks per course, delaying learner feedback and limiting valuable reflection opportunities for students.
Students noted that ‘meaningless’ scores on a 10-point scale and abbreviated feedback comments provided little to no guidance in improving actual ASL signing expression. Furthermore, the feedback delay made it difficult for instructors to modify classroom instruction based on evaluated deficiencies in learner performance.

To address the aforementioned evaluation and feedback challenges, the AvenueASL e-assessment environment was designed to establish (a) a platform for students to capture, submit, and archive ASL video performances, (b) a setting for instructors to evaluate and report student performance and feedback, (c) a portfolio where students can monitor their personal performance and feedback, and (d) an administration component to manage and coordinate performance evaluation and feedback data. To date the AvenueASL environment and assessment/feedback strategies have been used by seven postsecondary ASL departments and eleven K-12 ASL curricula, influencing more than 5,000 students and 200 teachers nationwide. Over 475,000 student performances were captured and evaluated during the 2008-2009 academic year and in excess of 1,100,000 practice and assessment tasks have been completed in the environment, encompassing what is believed to be the largest collection of ASL assessment performances captured in an online environment.

Feedback and assessment designs

The feedback- and assessment-specific development for AvenueASL included (1) the design of evidence-based ASL-specific Curriculum-Based Measures (CBMs), (2) the integration of automatic feedback and self-assessment practice opportunities, and (3) the implementation of learner feedback packages and progress portfolios. These feedback designs are described in the following sections.

ASL-specific CBMs. The typical ASL instructional scenario involves the evaluation of student recordings of conversations with a peer at the end of the semester. However, learning is not always cumulative (and may vary from one lesson to the next) making individual student progress difficult to assess at any given time, thus making the task of providing formative learner feedback nearly impossible. An alternative assessment approach involves using CBMs, a technique for monitoring student progress frequently, consistently, and reliably (Deno, 1985; 2003). CBMs should be valid, sensitive to growth, efficient, repeatable, and easy to administer, producing easily understood results and meaningful formative feedback for the learner. CBMs have been developed extensively for elementary and secondary school settings (cf. Deno, 2003; Shinn & Bamonto, 1998), but less so for use in post-secondary ASL instruction. Therefore, our task involved the identification
and design of CBMs that would produce valid and reliable general outcome measures for ASL learners.

Two facilitative feedback CBMs were identified for use both in class and throughout the online environment to assess students frequently on short linguistic performances and to provide meaningful feedback through a framework that students were already familiar with: fluency, linguistics, expression, and accuracy. It was important for instructors to create a dialogue around these measures early in the semester so that students understood both the meaning and significance of each measure in the online environment. However, the development of CBMs does little to promote formative feedback or performance growth without assessment tasks designed specifically to address these measures. Based on research of common practices in language-acquisition assessment, developmental literacy-skills assessment (Deno, 2003; Gordon, Englehardt, Gabrielson, Bernknopf, 1996; Luckner & Bowen, 2006), and an initial pilot study with several groups of ASL students and instructors, we created two such CBM-driven tasks: Story Retell and Picture Naming (Author 1, 2008). A Story Retell task requires students to view a short online ASL video narrative (approximately 20-seconds in length) signed by an expert ASL actor and, in turn, sign the story back to a webcam for archival and evaluation. Picture Naming tasks, on the other hand, require students to view a series of 20 photographs (e.g., basketball, chair, frog, lightning, bicycle, etc.) and perform the signed name of each image into the webcam.

**Automatic feedback and self-assessment**

Whereas our initial project goal involved using web-based technology to create formative assessment procedures in an online environment, a secondary objective was to empower and encourage self-assessment of continuous performance and reflection on progress over time. Therefore, we designed a self-assessment phase into each Story Retell and Picture Naming task that provided students with tools to view videos containing accurate signs of each story and picture to support reflection on their performances. Self-assessment data were made available to students in the portfolio archive, as well as to instructors in the assessment phase.

**Feedback packages and progress portfolios**

Integrated performance and feedback portfolios were designed to allow students and instructors to visually display language proficiency gains and demonstrate maturing communication abilities. The goal of these feedback packages and performance portfolios was to encourage students to be more reflective regarding their ASL communication skills (Miller, Rose, & Velet-
sianos, 2007; Lupton & Zelazni, 1990). In addition to submitting evaluation scores based on the four ASL CBMs, instructors have the ability to modify feedback based on individual student needs by using various feedback modalities (e.g., text, numeric, video, etc) (Miller, Hooper, & Rose, 2005). In other words, instructors can record video evaluations, in addition to traditional numerical and textual feedback, for students who require further assistance with their expressive and communicative skills (see Figure 1). This feature provides students with a feedback package which covers all aspects of their performances, both quantitative and qualitative. The feedback packages are archived for each student and instructor through a simple progress-monitoring visualization (see Figure 2). Students can view their progress over time, compare and contrast with other students in their class or across their level of ASL study, and click on tests to view the individualized feedback package for each performance, providing on-demand reflection and self-assessment. Further, students can compare their self-assessment scores with instructor feedback to enhance their understanding of the expected CBM-based outcomes.

**Figure 1.** Instructor assessment screen displaying the task video, student performance video, student self-assessment data, and instructor feedback video, in addition to numeric and textual evaluation data.
Figure 2. ‘My progress’ visualization in the student Portfolio layer of the software displaying assessment progress over the first 7 tasks.

**Observed/expected feedback outcomes**

The design of tailored feedback and assessment features for the *AvenueASL* environment, in alignment with frequent in-class assessment discussions, was a crucial step in encouraging environment use by teachers and students. Additionally, providing students with automatic feedback and options for self-assessment proved beneficial as the number of voluntary self-assessment practice tasks completed in the environment rose approximately 200% with each year of use. Further, research indicated that the overall relationship between self-assessment completion and course grade, as well as this relationship within each ASL level of study, was significantly related (Miller, Hooper, Rose, & Montalto-Rook, 2008).

*AvenueASL example feedback scenario.* Mr. Carrol is a professor of post-secondary ASL at a small Northeastern university. He assigns his students three story retell tasks to complete in the *AvenueASL* environment before next week’s meeting. Jeremy, a student in Mr. Carrol’s class, completes each test at home using his webcam to record and submit his video performances. After each test, Jeremy self-assesses his performance by assigning scores
based on the CBM framework (i.e. fluency, linguistics, expression, and accuracy) and leaves a written comment to Mr. Carrol stating that he is having a difficult time with the alignment of his descriptor signs. At home, Mr. Carrol reviews his student submissions in the environment and notes that many students, including Jeremy, have been having similar problems with descriptor alignment. Mr. Carrol submits Jeremy’s scores, writes a few brief comments, and records a video documenting proper alignment to include within Jeremy’s feedback packet. Additionally, Mr. Carrol modifies next week’s lesson to include additional practice of descriptor alignment and expression. Jeremy, after reviewing his feedback packet and practicing the techniques Mr. Carrol demonstrated in the feedback video, felt well prepared for the upcoming class.

**GEOTHENTIC: SCAFFOLDED LEARNER DEBATES AND TPACK REFLECTION**

Geographic education curricula frequently uses geospatial technologies such as geographic information systems (GIS) to assist learners in meeting the National Geography Standards (Doering & Veletsianos, 2007). GIS is a geospatial technology that allows users to store, retrieve, manipulate, and display geographic data about any location in the world. Although it has been noted that GIS is the one technology that can assist students in meeting all of the National Geography Standards (Doering and Veltsianos, 2008; Bednarz, 1999), the actual implementation of GIS within classrooms is far behind expected rates (Doering, Lewis, Veletsianos, & Nichols, 2008; Kerski, 1999). Author 2 (2008) and Bednarz and Audet (1999) have identified numerous reasons that current approaches to teaching GIS in K-12 classrooms have not been effective: (a) the inadequate training of teachers in the use of GIS, (b) a lack of GIS-specific pedagogical teaching models, (c) the failure of preservice teacher education programs to teach GIS in ways that are applicable to the K-12 classroom, and (d) professional development without sustainable teacher and student support. Doering, Veletsianos, Scharber, and Miller (2009) argue that the integration of geospatial technologies within curricula have been greatly hindered by the lack of teachers’ technological pedagogical content knowledge (TPACK) and online scaffolded support within the K-12 classroom. In response to this deficiency, we developed GeoThentic, an online scaffolded learning environment that assists teachers and students to integrate geospatial technologies in the K-12 classroom for teaching and learning geography. The environment was built on the foundation of TPACK and real-time feedback (Doering, Scharber, Miller, & Veletsianos, 2009).
GeoThentic design overview

*GeoThentic* was designed using the cognitive apprenticeship model (Collins, Brown, & Newman, 1989) by situating learning within an authentic setting. *GeoThentic* creates opportunities for students to learn and teachers to teach geography with geospatial technologies by solving authentic complex problems within an online environment (Doering, Scharber, Miller, & Veletsianos 2009). Additionally, the software provides teachers with the necessary TPACK to teach five modules available within the environment (see Figure 3) and four levels of learner-controlled scaffolds that engage them and their students in solving these authentic problems. Students are placed in the role of a geographer, working toward solving a geographic problem while using the choice of scaffolding that they deem appropriate. The scaffolds (i.e. situated movies, screen-capture videos, conversational agents, and collaboration zones) have been designed to successfully model, demonstrate, and provide feedback on the use of geospatial technologies while maintaining an appropriate level of difficulty and reducing unnecessary frustration. In lieu of requiring learners to utilize specific instructional materials, *GeoThentic* affords the freedom to employ any of the scaffolds at any time as learners feel they are necessary to understand and solve the problem. *GeoThentic* differs from traditional scaffolding by providing inherent and gradual withdrawal of support. In other words, all scaffolds are available at all times and the selection of individual scaffolds is the teachers’ and students’ decisions. An example module within *GeoThentic* is the climate change module where students analyze layers of socio-scientific data (e.g., ice sheet data, population density, climate data, etc.) to identify locations of the world that are most impacted by climate change. Once students identify the best location, they provide the latitude and longitude of the location, as well as a written justification of their placement based on their data analyses.

Numerous feedback- and assessment-specific features within *GeoThentic* are available for both the students and teachers. These features include: (1) the design of scaffolding feedback integrated throughout the environment, (2) the integration of a GeoPack visualization tool designed to stimulate classroom discussion and debate of student-submitted justifications through teacher and peer-to-peer feedback, and (3) the implementation of three teacher TPACK assessment and self-reflection modules. These feedback designs are described in the following sections.
Feedback and assessment designs

Scaffolding feedback. In response to the need for sustainable on-demand support and guidance for teachers and students when teaching and learning geography with geospatial technologies, GeoThentic provides scaffolding and on-demand feedback for teachers and students through seamless integration across the environment. The formative feedback for teachers is available at all times and is self-selected based on the technological, pedagogical, or content knowledge that is requested. For example, if a teacher is preparing to teach the Population Density module and does not have the necessary technological knowledge (e.g., how to analyze data within Google Earth), they can select the technological knowledge scaffold to provide feedback and guidance via video, audio, and text. If this feedback is still not optimal, teachers may move into the collaboration zones where there are experts to provide another level of guidance and feedback through synchronous and asynchronous discussion, which is then archived for later reference. Furthermore, teachers can elicit the help of an intelligent agent that provides feedback in freeform and semi-structured discourse (Doering, Veletsianos, Scharber, & Miller, 2009). Most importantly, there is no specific order in which the feedback can or should be selected by the user. The same feedback and guidance that are available within the teacher environment are also available within the student environment. Thus, students can receive
feedback on their uses of technology within each module, participate within and reference synchronous and asynchronous discussions, and have a conversation with the intelligent agent or other students as they work towards solving the problem.

**GeoPack visualization.** Historically, when teachers ask students to analyze and identify locations within a geospatial technology such as *Google Earth*, they must collect each student’s placemarks manually (e.g., on a USB flash drive) and move them to one computer so they can be compared with their fellow classmates. To remedy this cumbersome step, we designed a tool within the environment for students to identify their locations and document their justifications, referred to as a *GeoPack*, which is then automatically synchronized with an interactive map within the teacher environment. Teachers then use the GeoPack visualization tool (see Figure 4) to view all student coordinates/justifications and encourage classroom debate to select a ‘best’ location. As students discuss and defend their selections, they can vote to save or hide the relevant locations within the visualization, ultimately creating a peer-to-peer conversational feedback and debate loop.

![Figure 4. Student-submitted GeoPack visualization tool.](image)

**TPACK self-reflection and assessment.** The GeoThentic teacher interface was designed to support instructors with limited background knowledge in teaching geography with the assistance of geospatial technologies. Each scaffold within the design of the GeoThentic was designed specifically to
address the TPACK domains of each module. For example, when a teacher is preparing to teach the module on global climate change, s/he is scaffolded with content knowledge (i.e. a guided curriculum with resources and background information); pedagogical knowledge (i.e. three pedagogical models for integrating the module within her classroom); and technological knowledge (i.e. screen-capture videos that describe procedural knowledge on how to use the geospatial technologies and assist students with technology problems that may arise). Additionally, GeoThentic addresses the need for teachers to self-assess and reflect on their technological pedagogical knowledge through three interactive TPACK assessment models: (1) a teacher-reported model, (2) an evaluative assessment model, and (3) a user-path model.

First, the teacher-reported model (TRM) was designed to allow teachers to report the TPACK they have and use (see Figure 5). Within this interface teachers use a slider bar to identify where they view themselves within the three knowledge domain areas (i.e. content, technology, and pedagogy). As teachers move the slider in the ‘Current Knowledge’ section, the diamond in the TPACK framework is automatically repositioned based upon a predetermined algorithm. Moreover, the teachers can position the slider bars in the ‘Current Use’ section to identify the TPACK they currently use. By moving this slider, the size of each representative TPACK domain circle is scaled accordingly. Thus, a circle is scaled larger if the knowledge can be used within the classroom, and smaller if it cannot be used.

Figure 5. Teacher-Reported Model (TRM) in GeoThentic.
Teachers who have used *GeoThentic* have noted that although they might have very strong domain knowledge, the context of the face-to-face learning environment is not conducive to employing the knowledge they have (Authors 2, in press). For example, a teacher who places himself in the upper limit of pedagogical and technological knowledge may not be able to employ the knowledge because the context of the classroom does not support such integration (i.e. access to technology). TRM serves as a metacognitive interactive online TPACK journal tool for teachers as they assess themselves throughout the *GeoThentic* modules. This assessment can be done within *GeoThentic* or through a mobile application since self-reflection and assessment does not always occur when sitting down at the computer (see Figure 6).

Figure 6. TRM mobile TPACK self-assessment design.

Second, the evaluative assessment model (EAM) consists of module-specific multiple-choice questions employed to identify the teacher’s current TPACK based on expert feedback. The questions are designed to assess all three knowledge domains while providing the teacher with a visualization of where their knowledge is currently located in the TPACK triangle, in addition to suggesting formative feedback on how to improve their knowledge.
This location is calculated and visualized for the teacher real-time. Based on these scores, teachers can determine if their TRM analysis aligns with their EAM scores and how they may close the gap to assist in moving toward the center of the TPACK triangle (see Figure 7).

**Figure 7.** Evaluative Assessment Model (EAM) in *GeoThentic.*

Finally, the user-path model (UPM) method of assessing teachers’ TPACK relates to analyzing teachers’ actions within the online learning environment. As teachers engage with *GeoThentic,* a data trail is left. These data are mined and analyzed to determine user actions, needs, and requirements. The teacher’s actions in the online learning environment are related to what teachers (a) know, (b) need assistance with, (c) perceive to be interesting, engaging, or difficult, and (d) deem to be mundane. To better understand the UPM consider the following scenario.

Brett, a geography teacher, is using *GeoThentic* for the first time and chooses to explore the *Build a Hospital in San Francisco* module. After logging into the environment, he views the situated movie three times, asks the virtual character (i.e. agent) ten technology related questions, and spends ten minutes watching screen-capture videos which provide guidance on how to use the geospatial software. All of Brett’s actions are recorded in the database and are available for quantitative (e.g., minutes spent on screen capture videos) and qualitative (e.g., types of questions asked of the pedagogi-
Brett notes his TPACK profile (see Figure 8) and determines that he needs to spend more time expanding his technological knowledge domain by exploring more screen capture videos in the environment and working more with *Google Earth*.

**Figure 8.** Screen capture of the User Path Model (UPM) in *GeoThentic*.

**Observed/expected feedback outcomes**

*GeoThentic* was designed to give teachers and students timely and useful feedback throughout the use of the environment. The environment provides teachers with the unique ability to reflect and document their TPACK growth while providing the scaffolding to enhance their knowledge domains. Currently, teachers use the TPACK self-reflection and assessments to monitor where they need to spend the most time within the scaffolds to move their knowledge to the center of the framework. At the same time, teachers are reflecting on how to improve the context of the classroom to enhance the use of all knowledge domains. Thus, the feedback-specific designs incorporated throughout *GeoThentic* provide teachers and instructional designers with examples of how an environment can be designed to provide TPACK assessment and support, while also providing the necessary scaffolds to achieve optimal integration (Doering, Scharber, Miller, & Veletsianos, 2009).
Example feedback scenario. Susie is a first-year social studies teacher who focused on history in her teaching program. To her surprise, she was assigned to teach geography, a subject in which she completed only one course during her college career. Susie reflected on her college educational technology course where she learned about the technology integration planning model (Doering, Scharber, Miller, & Veletsianos, 2009) for assessing her TPACK and preparing her classroom accordingly. Unfortunately, Susie was unsure about how to assess her geographic TPACK and increase her knowledge domains to afford successful technology integration. She learned about GeoThentic through her local geography alliance and began exploring the environment. She learned that there were not only scaffolds within the TPACK domains, but there were also feedback opportunities to assess her TPACK. Susie began using GeoThentic to not only learn about how to teach geography with geospacial technologies, but also to self-assess and monitor her TPACK progress.

AVENUEDHH: INFORMATION VISUALIZATION AND PARENT INVOLVEMENT

A century of research supports the negative impacts of hearing loss on the development of English language skills (i.e. reading and writing) between hearing children and children who are deaf or hard-of-hearing (DHH) (Marschark & Harris, 1996; Rose, McAnally & Quigley, 2004; Marschark, Lang & Albertini, 2002). Progress-monitoring systems currently used by teachers of DHH students are typically unreliable, complex, and time-consuming (Esterbrooks & Huston, 2007), provide little functional information for feedback and instructional decision making, and do little to promote learning (Ewoldt, 1987). Likewise, standardized tools designed for the general population are insensitive to DHH students’ progress, lack validity and reliability (Kelly, 2005; Luckner & Streckler, 2007; Odom et. al., 2005), and are difficult to interpret (Yoshinago-Itano, Snyder, & Mayberry, 1996). Furthermore, available paper-pencil measures (e.g., grade level MAZE passages) are insensitive to small increments of growth exhibited by beginning DHH readers (Rose et al., 2004).

Design overview

Research suggests DHH teachers have difficulty using the results of existing progress-monitoring measures to determine if their instruction, assessments, and feedback lead to improved student progress in reading and writing (Yoshinago-Itano et al., 1996). Therefore, teachers of DHH children typically resort to subjective impressions and anecdotal information, often
resulting in feedback and assessment information that is unused, misused, or misunderstood. This is the challenge we are addressing in the development of *AvenueDHH*, a universally-accessible e-assessment environment for DHH teachers, students, and parents. The goal of *AvenueDHH* is to transform the assessment, feedback, and progress-monitoring strategies in reading, writing, and language development for DHH students in first through eighth grade. The system is comprised of seven categories of assessment tasks (i.e. picture naming, photo description, word slash tests, re-designed MAZE passages, signed/oral reading, story retell, and story completion) and supports the digital capture of multiple communication modalities (i.e. oral, signed, and Cued Speech) and languages (i.e. ASL and English) common to children with hearing loss in the U.S.

**Feedback and assessment designs**

The feedback- and assessment-specific development for *AvenueDHH* includes (1) the implementation of teacher- and student-driven goal-setting, modification, and reflection tools; (2) the design of tailored interactive information visualization feedback components specific to the needs of teachers, students, and parents; and (3) the alignment of student feedback with the nature of each reading or writing assessment. These feedback designs are described in the following sections.

**Goal-setting, modification, and reflection**

Feedback and assessment data are often used to assign grades rather than to improve performance with DHH students. In response to this situation, we designed a portfolio tool inside *AvenueDHH* to create an environment where teachers, students, and parents can view individual evaluations and feedback, monitor personal progress, and set individualized goals. The Portfolio, through interactive continuous progress-monitoring visualizations, provides teachers with the necessary information to set and adapt individual student development goals and interpret immediate feedback required to modify and improve classroom instruction, tailored to the needs of the students. Further, we designed a simple interactive visualization tool that, based on current progress and feedback, allows teachers to modify the difficulty level (in the database) of the next tests that students receive (see figure 9). The large white circle represents a student’s goal (i.e. calculated individually for each student represented in the visualization). Each small circle represents a student’s proximity to his or her goal. Red circles represent students who are struggling with their tests, blue circles represent students on the verge of achieving their goals, and green circles represent students who have achieved proficiency. Teachers can drag these circles toward and away
from the goal line (i.e. changing the color of each circle) and modify the difficulty of tests individual students will receive. This feature allows teachers to place individual students in a zone of proximal development based on progress and feedback, thereby scaffolding struggling learners and challenging proficient ones, without having to analyze complex data for each student.

![Figure 9. Teachers can drag student icons towards or away from the larger goal circle.](image)

Interactive information visualization tools and parent involvement. In education, Information Visualization (InfoViz) is concerned primarily with how large datasets can support cognition. Although InfoViz can be used for lower-level learning outcomes such as knowledge acquisition (Keller, Gerjets, Scheiter, & Garsoffky, 2005), alternative uses involve representing data visually and manipulating the resulting images to support decision-making and sense-making. InfoViz systems create dynamic representations that can be manipulated thereby allowing the viewer to ask ‘what if’ questions that can lead to added insight into issues and the creation of rich and flexible mental models (Spence, 2007). Effective InfoViz design requires designers to create clear, compelling, and convincing visualizations; in other words, the design must (1) present complex information in an easy-to-understand fashion, (2) visually grab the user’s attention, and, most importantly, (3) persuade users to believe in what they see represented in the visualization,
especially users that normally do not recognize the value of statistics and numerical data (Emerson, 2008).

![Image](image_url)

**Figure 10.** Teacher visualization of current student progress and goal proximity.

Incorporated throughout the design of *AvenueDHH*, InfoViz tools are used to communicate feedback to teachers, students, and parents. By adapting the presentation of feedback information and graphed data to the individual needs of teachers, students, and parents, we expect to enhance each user’s understanding, motivation, and overall commitment to progress-monitoring (Shute, 2008). For example, while a teacher may view evaluation and feedback data in a simple, yet detailed arrangement to determine which students are in proximity to their goals (see figure 10), students and parents are presented with a simplified version to enhance understanding of current progress with respect to goal-setting (see figure 11).
No Such Thing as Failure, Only Feedback

Figure 11. Student visualization of progress and goal proximity (in this case, the student has achieved their goal).

Task alignment with student feedback. Finally, it was important to consider the alignment of student feedback with the nature of each reading or writing assessment throughout the environment. Due to the large variety of assessment tasks, ranging from reading a passage and signing a video narrative to viewing a photograph and writing a description, several feedback tools needed to be created. For example, when a student is required to write a passage in the Story Starter task, the software supports the teacher in providing correct word sequence marks and written feedback embedded throughout the student’s written passage. This functionality provides the students with localized and detailed feedback based on the context of their submissions. Alternatively, when a student is required to sign a video description of a photograph, the teacher records video feedback to assist with proper word-sign use and fluency development.

Observed/expected feedback outcomes

The functionality to set, modify, and reflect upon individual goals, as well as the alignment of system feedback options with goal-setting (Marzano, 2007), is expected to play a major role in encouraging teachers, students, and parents to remain involved, motivated, and connected to students’ educational goals. Additionally, it is anticipated that interactive progress-mon-
onitoring information visualizations will provide teachers with the necessary information to set and adapt individual student development goals and interpret immediate feedback to support timely modification and improvement of classroom instruction. For example, we expect that teachers who use data visualization and research-oriented data-analysis tools will pose higher-level instructional questions, indicate improved instructional decision making, provide more informed and effective feedback, and report higher student performance when contrasted with teachers who use traditional progress-monitoring approaches. The following is an example of an anticipated feedback scenario within the AvenueDHH software.

Example feedback scenario. At the beginning of the year, Ms. Davis, a fourth grade DHH teacher, introduces her students to the AvenueDHH software. After using the system for 6 weeks, Jessica, a student in Ms. Davis’ class, has 12 evaluations in her portfolio. Jessica logs on to the system and reviews her archived performance videos and packaged feedback results from her reading and writing fluency tasks through an interactive information visualization tool. She then completes a new performance video for a recently assigned Story Retell task. When Ms. Davis opens her e-mail, a system-generated message informs her that new progress-monitoring tasks are available online for evaluation. She logs on to the assessment tool, accesses a list of her students, and connects to Jessica’s work from earlier that day. Ms. Davis watches Jessica’s video and completes the on-screen assessment form, providing numeric, textual, and video feedback for Jessica to assist with her expression skills. After reviewing Jessica’s graph of performances over the past 6 weeks, Ms. Davis is pleased with Jessica’s progress and reflects back on the instructional changes made during the past week including the metacognitive strategies she practiced with Jessica. Ms. Davis also records a video message within the system for Jessica’s parents regarding her current progress. Later that evening, Jessica’s parents receive an e-mail from the system informing them that Ms. Davis has evaluated Jessica’s recent reading performance. The parents log-on to the portfolio and note Jessica’s progress and teacher feedback. The graph shows Jessica’s growth in reading comprehension increased significantly and exceeded each of the target goal lines set by Jessica, her teacher, and her parents. Jessica and her parents note that this is the largest weekly gain since the beginning of the academic year.

DISCUSSION: NO SUCH THING AS FAILURE

Reflecting back on the three feedback design narratives shared throughout this paper, we have identified four common threads that we believe en-
hanced the design and implementation of each assessment environment: (1) type and communication, (2) theoretical grounding, (3) alignment with goals and the nature of the task, and (4) scaffolding through sense-making tools. In closing, we offer the following set of suggestions to teachers and instructional designers when considering the type of feedback and delivery mode for use in the classroom or in the design of e-assessment environments:

![Feedback Design Diagram](image)

**Figure 12.** Suggestions for feedback and e-assessment design

1. **Type and Communication:** We encourage teachers and designers to think beyond the use of traditional scoring and textual comments when developing a plan for student feedback. When applicable, we believe that feedback should exist as evolving communication between teachers and students (i.e. a feedback package or portfolio), as opposed to a disparate instance of notification. Additionally, feedback does not necessarily end with the student audience; designers should explore options to include teachers, parents, and other parties of interest in the use and communication of feedback (e.g., the teacher TPACK development modules in GeoThentic, the student and parent feedback visualization components in AvenueDHH).

2. **Theoretically Grounded:** Instructional designers often design and develop learning environments that attempt to teach content, but are not theoretically grounded to provide the necessary user-support. We need to move beyond simply talking about what we should do as designers and
begin designing and developing learning environments that are grounded in our theoretical research. Similar to the methods in which GeoThentic provides TPACK support to teachers for successful integration of geospatial technologies, designers must focus on creating opportunities for evolving support, feedback, and assessment, not simply the delivery of content. Decades of research and development informed the design of the reading and writing assessment components in the AvenueDHH environment; however, validation of these assessments rarely informs the nature of feedback. Therefore, we designed and integrated the sense-making information visualization tools for teachers and students in parallel with the development of the assessments to ensure reciprocal support between the two.

3. Aligned with goals and the nature of the task: When applicable, teachers and designers should align feedback with goal setting through clear descriptions of student goals and expectations (Marzano, 2007). Additionally, the nature of feedback should align with the nature of the assessment task (e.g., maps for geospatial identification tasks in the GeoThentic environment, videos for kinesthetic performance tasks in the AvenueASL environment, embedded formative comments for writing tasks in the AvenueDHH environment, etc.).

4. Scaffolded through sense-making tools: Finally, we suggest that designers develop and implement tools that help teachers, students, and parents make sense of formative and summative feedback. These tools can exist in the form of simplified graphs, interactive visualizations, or case-based scenarios of progress. By scaffolding teacher, student, and parent understanding of feedback, similar to the opportunities discussed within the AvenueDHH environment, we anticipate enhanced opportunities for gaining valuable insight in reflection, diagnosis, and problem-solving, as well as increased motivation and dedication toward continued assessments.

Aligning pedagogy, design, feedback, and research

Through considering these three design projects at a macro-level, we understand that the key to their success is the recursive and informative roles of pedagogy, design, feedback, and research in each environment’s design. From each environment’s conception, to its first iterations, to its final design, theoretical and practical perspectives on pedagogy, feedback, and research were omnipresent and continually infused in each stage of the development process – nothing was an add-on. We believe that the recursive loop of these
elements throughout the entire design process is at the heart of developing effective learning environments.

Gelb’s motivational quote at the beginning of this manuscript remained a constant inspiration throughout the design, development, and integration of these projects. Simply put, Gelb stressed the importance of feedback in order to achieve success. Similarly, through effective support and continuous formative and summative feedback, students and teachers can become champions in learning. Our hope is that by sharing the ways in which feedback, support, and assessment were integrated throughout these three learning environments, instructional designers will begin to re-position the design and development of technology-mediated feedback and e-assessment closer to the beginning of the design phases, ultimately transforming how teachers and learners assess and communicate progress within an online setting.

References


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