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Facilitating Authentic Learning Experiences in Distance Education: Embedding Research-Based Practices into an Online Peer Feedback Tool

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ORIGINAL PAPER

Facilitating Authentic Learning Experiences in Distance Education: Embedding Research-Based Practices into an Online Peer Feedback Tool

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Abstract
Authentic learning in online education is feasible with intentional instructional strategies and appropriate educational technologies, yet as a learning approach, barriers to implementation still exist. We argue that authentic learning in online education can be successfully supported when the characteristics of authentic learning are (a) intentionally applied and (b) supported through research-based tools that facilitate the learning process seamlessly for students. To address this challenge, we developed a research-based online application that supports authentic learning. In this article, the theoretical foundations and empirical support for the tool are described, along with critical design decisions that support suggested characteristics of authentic activities. The authors overview formative research conducted during a four-year development process. Several case studies conducted at research-intensive universities are provided to describe how student motivation, metacognition, and strategic behaviors were facilitated through the tool and to encourage readers to apply similar research-based strategies in their own authentic learning contexts

Keywords Authentic learning · Distance learning · Online learning · Peer feedback · Project-based learning · Emerging technologies · Educational technologies

In the past two decades, Jan Herrington and various collaborators (e.g., Herrington and Herrington 2008; Herrington and Oliver 2000; Herrington and Parker 2013; Herrington et al. 2004, 2010, 2014; Reeves et al. 2002) have used educational design research methods (van den Akker et al. 2006) to test, extend, and operationalize theories of situated cognition and authentic learning (Lave 1977; Lave et al. 1984; Rogoff and Lave 1984; see also Brown et al. 1989) in educational environments. Drawing on the literature, Herrington and Oliver (2000) identified nine characteristics of situated learning environments, which led to specifying ten characteristics of authentic activities that teachers and instructional designers can use when designing learning experiences (Reeves et al. 2002). These ten characteristics provide students the opportunity to (a) engage in problems/projects with real-world relevance; (b) address ill-defined problems and (c) complex tasks through sustained investigation; (d) examine tasks from differing perspectives with the support of diverse resources, and (e) collaborate with other learners and (f) reflect on their learning experiences (Reeves et al. 2002). Additionally, for instructors who wish to provide authentic learning experiences, the work that students undertake should (g) be applicable to a variety of subject areas; (h) integrate with assessments; (i) result in meaningful products; and (j) reflect a variety of solutions and possible competing outcomes.

When Reeves et al. (2002) presented these characteristics of authentic learning, they sought to emphasize their particular importance within the context of online education. The authors encouraged the characteristics to be fostered through student collaboration using tools such as discussion boards

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and chat rooms. They noted how online diaries could facilitate reflection and courses could be structured in such a way that content could be accessed freely by students rather than in a linear manner. The authors also encouraged instructors to integrate metaphors based on a "realistic and authentic context" in order to capture "the complexity of the real-life settings" (p. 566). In sum, the authors sought to emphasize that authentic learning in online education is feasible with intentional instructional strategies and appropriate educational technologies.

We find that the characteristics of authentic learning proposed by Reeves, Herrington, and Oliver still have relevancy today, yet authentic learning is still not a common practice in distance education (Parker et al. 2013). Why is this so? If instructional strategies exist that can support authentic learning at a distance and technology tools have only improved over time, where does the problem reside? We argue that authentic learning in online education can be successfully supported when the characteristics of authentic learning (Reeves et al. 2002) described above are (a) intentionally applied and (b) supported through research-based tools that facilitate the learning process seamlessly for students.

The purpose of this article is to present a tool that is designed to facilitate the use of peer feedback in the context of authentic online learning activities. After summarizing the relevant literature, we describe research-based design decisions intended to develop complex skills in learners such as self-reflection, metacognition, and self-regulation through a structured process that encourages multiple rounds of feedback, that promotes the use of prompts to guide both reviewers (in providing formative feedback) and creators (in reflecting on their work-in-progress), and that scaffolds learners' ability to plan revisions to their work and to relate those revisions to assignment criteria and feedback received. It is important to note that the use of the tool itself does not ensure that authentic learning will transpire; an instructor or instructional designer must prioritize meaningful project-based authentic learning at the onset in the online learning environment.

Facilitating Authentic Learning in Online Learning Environments

Facilitation of Learning and Scaffolding

Facilitating and scaffolding learning are two related concepts that are distinct yet complementary. The term *facilitating* is intended "to convey the contemporary view that learning is controlled internally, not externally, and that an external agent can, at best, influence the process" (Robinson et al. 2008, p. 17). The ways in which the learning process may be facilitated are myriad, and selection of instructional methods is guided by, among other considerations, the complexity of the material to be learned and the readiness of the learner to engage with it. The provision of scaffolding is one such facilitation method for enabling a novice "to solve a problem, carry out a task or achieve a goal which would be beyond his unassisted efforts" (Wood et al. 1976, p. 90). Pea (2004) stated that scaffolding was conceived as a dynamic process of cycles of assessment and adjusted support depending on the learner's progress, a technique that later became known as "fading" in Collins et al. (1989). Pea argued that fading is a necessary component of scaffolding and without it, the effect is instead "distributed intelligence" (p. 431) in the form of supports that are always there to enable achievement. Following Wood et al. (1976), Pea described the channeling and focusing function of scaffolding, which reduces "the degrees of freedom for the task at hand by providing constraints that increase the likelihood of the learner's effective action" (p. 432). When learners undertake authentic, complex activities, scaffolding at critical times can be necessary to keep them on a productive path and prevent task failure (Herrington and Oliver 2000; Herrington et al. 2010).

Peer Formative Feedback

Feedback, formative feedback, and peer formative feedback are interrelated concepts that are important to distinguish in their applications and benefits. Numerous studies and meta-analyses over the years have examined the impact of feedback on learning, which has an average effect size of 0.79, making it one of the most effective influences on learner achievement (Hattie and Gan 2011; Hattie and Yates 2014). A large effect size can indicate the impact of an experimental variable and the importance of its contribution (Fritz et al. 2012). Hattie and Timperley (2007) defined feedback as "information provided by an agent. .. regarding aspects of one's performance or understanding" (p. 81) and went on to emphasize the benefits of treating feedback as part of instruction (i.e., formative) rather than something that happens after instruction and learner performance (i.e., summative). Researchers have defined summative feedback as occurring at the end of a unit of instruction to inform a learner as to how well they learned, while formative feedback is "information communicated to the learner that is intended to modify his or her thinking or behavior for the purpose of improving learning" (Shute 2008, p. 154). In examining how various instructional design theories characterize feedback, Crisp and Bonk (2018) identified six dimensions of feedback (see Table 1).

The *source* dimension is of particular interest because the use of peer feedback in both educational and professional settings is on the rise (Nelson and Schunn 2009), yet researchers have had difficulty in identifying the conditions and methods that result in effective peer feedback (van Zundert et al. 2010). The giving and receiving peer feedback, as defined by Topping (1998), is an "arrangement in which individuals consider the amount, level, value, worth, quality

Table 1 Crisp and Bonk's six dimensions of feedback

Dimension	Description
Timeliness	The length of time between a learner's attempt and the response of either a peer or instructor.
Frequency	The number of feedback instances experienced by the learner in a given unit.
Distribution	The interval of time between feedback instances. Ex: The value of distributed versus massed practice.
Source	The provider of the feedback is trusted by the learner (e.g., artificial or human).
Individualization	The learner perceives that feedback is specific to his/her goals, strengths, needs, or questions.
Content	The content of the feedback either provides the learner with next steps to correct misunderstandings or prompts the learner to extend their learning in some new and novel way- often through offering new questions for consideration.

Reprinted from "Defining the Learner Feedback Experience," by E. Crisp and C. J. Bonk, 2018, *TechTrends, 62*(6), p. 588 (https://doi.org/10.1007/s11528-018-0264-y). Copyright 2018 by Association for Educational Communications & Technology

or success of the products or outcomes of learning of peers of similar status" (p. 250). Peer feedback is both a type of formative assessment and a type of collaborative learning. As formative assessment, the main concern "is that peers are not domain experts" and therefore may provide judgments that are "partially correct, fully incorrect or misleading" (Gielen et al. 2010, p. 305). However, receivers of peer assessment may think more critically about the feedback because it is not coming from the instructor (Berg 1999). Yang et al. (2006) concluded that this led to more significant revisions than feedback from the instructor, which resulted in more surface-level changes. So how can we capitalize on the collaborative aspects of peer feedback while also improving the quality of learner exchanges?

The literature suggests that for peer feedback to be useful, learners must have practice in giving and receiving feedback and have support from scaffolds that structure and guide the process (Gielen and De Wever 2015). Peer and formative feedback can be facilitated online, yet this process requires incredible amounts of time (Ozogul et al. 2008), especially when considering the number of students in a course (Olina and Sullivan 2002). Formative peer feedback can ameliorate this burden while also promoting authentic learning; however, to facilitate peer feedback successfully, strong organization and the integrity of the implementation are critical (Topping 2009). For online educators, supporting peer feedback and iterations of project-based work in an efficient and effective manner is logistically difficult.

To help facilitate authentic learning, emerging technologies can be used as cognitive tools (Herrington and Parker 2013; Kim and Reeves 2007). For example, tools such as Peerceptiv (see Schunn et al. 2016), Eli Review (see Sloan 2017), and peerScholar (see Paré and Joordens 2008) can facilitate peer feedback to improve student writing. A study of one peer feedback tool, Critviz, suggested that peer feedback improves student motivation and learning in a course, fosters self-reflection, and builds a sense of community in large classes (Sadauskas et al. 2013). The challenge with existing peer feedback tools, of which there are more than 40, is that no singular peer feedback tool currently supports all desired characteristics that learners and instructors seek (Wind et al. 2018). To address this need, a team of scholars created a practical, research-based tool specifically to facilitate peer feedback as part of authentic learning in online education.

The tool we designed and developed, to provide a succinct overview for contextual purposes, is cloud-based software that enables instructors (e.g., higher education, secondary level) to rapidly set up and facilitate structured formative feedback while monitoring student progress of authentic, project-based work. The tool is intended to effectively support critical skills like metacognition and self-regulation, while being pedagogically flexible across grade levels and content areas. The intent of the tool was to replicate the experience of a studio-oriented, face-to-face critique where students share iterations of meaningful projects to their peers and their instructor for constructive feedback. Our aim was to translate the reflective dialogue of in-class critiques to a dedicated space for asynchronous online learning. We did not assume that reflective dialogue would function in the same way in distance education settings, rather we sought to translate the benefits of in-class studio-based critiques, even if imperfectly, to online courses where authentic learning was already valued and promoted. Thus, the central repository of the tool enables students to share iterations on their work over a sustained period of time, with the opportunity for students to examine their own work and the work of their peers using guided reflection prompts in a process called *feedback rounds*, which are set up and guided by the pedagogical needs of the instructor.

It is important to clarify that this scholarship is not traditional in the sense that empirical research questions were posed to investigate a phenomenon. So pressing was the need to create a tool that could comprehensively support authentic

learning at a distance that the development of a stand-alone tool was paramount, particularly once the efficacy of the tool had been established at the prototype stage. This article thus focuses on four years of development and implementation of the tool into a stand-alone product, including pilot projects which were carried out as a means to evaluate the tool's efficacy and the design iterations required.

In the sections below, the theoretical foundations and empirical support for the tool are described, along with critical design decisions that support suggested characteristics of authentic activities (Reeves et al. 2002). The scaffolds embedded within the tool may be of interest to scholars who conduct research in this domain, along with the tool's capacity to collect instructor and student data on project-based, authentic learning in distance education settings. Following a description of the tool and the origins of its development, several case studies are described in order to provide a grounded context to address how student motivation, metacognition, and strategic behaviors were scaffolded with the tool. The case studies offer rich descriptions of how the tool was integrated into online courses at three research-intensive universities.

Theoretical Framework and Empirical Support

Underlying Theoretical Foundation The underlying theoretical foundation of social interaction within learning is a core component of the tool's design. Social interaction is a key component of successful collaborative learning (Järvelä et al. 2015) and collaborative learning is a key tenet of authentic learning (Reeves et al. 2002). Benefits of social interaction include argumentation (Baker 1994), knowledge building (Bereiter and Scardamalia 2003), mutual regulation (Light and Blaye 1990), and building and sustaining shared understanding (Kirschner et al. 2008). Social interaction is embedded into the tool's design through the use of formative rounds of feedback. Within peer feedback interactions, students have the capacity to develop professional skills (Sluijsmans et al. 1999) and foster interpersonal relationships (Sluijsmans et al. 2002).

The design of the tool is also influenced by self-regulated learning theory. Self-regulation requires planning, monitoring, and evaluating. Self-regulation may range from task understanding (Fransen et al. 2011) to strategic planning and action (Järvelä and Hadwin 2013). Self-regulated learning theory extends beyond cognitive processes and outcomes to include interactions between motivation, emotion, metacognition, and strategic behavior (Zimmerman and Schunk 2011). In the case of computer-supported, collaborative learning environments, prompting regulation requires support (Järvelä et al. 2015). To foster self-regulation with the tool we designed, we integrated self-reflection prompts to foster motivation, metacognition, and strategic behaviors, engaging students by asking them to monitor their own level of understanding (Bransford et al. 2000).

Additionally, as students develop their self-regulation of learning, the role of the teacher is critical. Educators need to "share in the process of monitoring and evaluating progress" (Järvelä et al. 2015, p. 133). Reviewing student work and providing formative feedback can require incredible amounts of time (Ozogul et al. 2008), especially when considering the number of students in most classrooms (Olina and Sullivan 2002). Therefore, to provide students with support that results in peer feedback equivalent in quality to that of an instructor, we sought to create a flexible application that tied together learner objectives, assessment rubrics, learning goals, and/or standards within the interface of the tool through instructor-customizable feedback prompts. The aim of the tool's design was to provide students with higher quality feedback, as instructors would need less time to provide reviews if they could agree to peer statements.

Empirical Evidence to Support Formative Peer Feedback When identifying the necessary elements to create an optimal authentic learning experience in distance education, it was imperative to establish a research-based framework to guide the tool's design. To create the formative peer feedback system, we included the following research-based supports: 1) Structuring the peer feedback process through the use of prompts, questions, or rubrics results in peer feedback of similar quality to teachers and experts (Falchikov and Goldfinch 2000); 2) Feedback from multiple peers is superior to feedback from a single individual (Topping 2009); 3) In order to synthesize and apply feedback, students should be given an opportunity to revise their work after receiving feedback (van Zundert et al. 2010); 4) Rather than a single round of feedback and revision, multiple rounds have been shown to improve student outcomes, with three rounds of feedback during a project cycle being optimal (Tsai et al. 2002). The development of the tool presented here grew out of these evidence-based recommendations. When the elements outlined above are implemented in a formative peer feedback process, research has shown that formative peer feedback: 1) enhances student learning and work products (Topping 1998; van Zundert et al. 2010); 2) improves self-regulation of learning, problem-solving, and reflective thinking (Sluijsmans et al. 1999; Topping 1998), and; 3) provides opportunities for students to engage in meaningful dialogue and collaboration around course content (Bransford et al. 2000).

Tool Development and Initial Pilots

To support authentic learning in distance education, Roman and Callison (2014) identified a need to develop a tool to facilitate metacognition, formative feedback, work iterations, and project monitoring within project-based, authentic learning environments. The tool was designed to reduce teachers'

workloads by efficiently and effectively facilitating project monitoring, or formative assessment, which includes ongoing activities designed to make students' thinking visible, track learning progress, and guide instructional modifications (Bransford et al. 2000). Formative assessment is especially challenging within collaborative, project-based environments where traditional assessment approaches are unable to accurately capture the extent of student learning (Conley and Darling-Hammond 2013).

A key feature of the tool is the creation of feedback rounds (see Fig. 1). With the appropriate scaffolding, formative peer feedback can be of similar caliber to that of teachers and experts, and by engaging in a structured peer feedback process, students develop self-reflective, self-regulatory, and meta-cognitive practices and improve learning outcomes. During each feedback round students are engaged in a research-based, five-step process that encourages self-reflection, structured peer review, planning, and work revisions (see Fig. 2).

Pedagogically, instructors working in authentic, project-based online learning environments are ideal users of the tool. Currently, teachers tend to facilitate peer feedback at a project's midpoint or end-of-project review. The process may vary depending upon the teacher's instructional preference, but certain elements typically remain consistent. In general, students are asked to provide feedback to one or more of their peers, as directed by their instructor. In a face-to-face setting at the secondary level, this may take the form of a "gallery walk," in which students move around the room and write feedback on a sticky note located near project-based work. In other instances, such as studio-based courses at the college or university level, extensive time may be spent in the presentation of student work, which is followed by verbal feedback from peers in a large group setting. Regardless of the format, frequently information is not recorded in a way that a teacher can easily monitor or track. In contrast, to archive student reflection in online learning environments, it is essential that thinking and work progress is stored in one centralized location, making it easy for teachers to quickly view student data and access the review process at any time. Furthermore, the process needs to be flexible so that it can be used within any content area, on any Internet-capable device, and can accommodate all project media (e.g., audio, video, images).

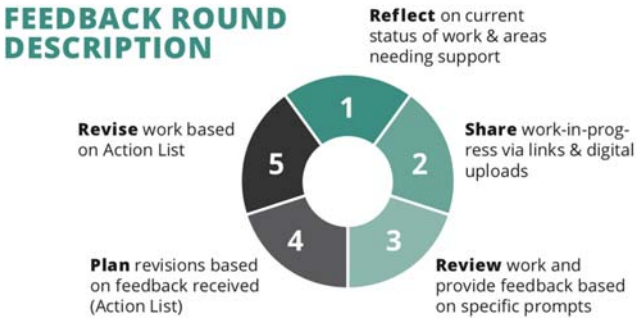

Fig. 2 The five-step process of a feedback round

The initial concept and prototype of the tool were developed in 2012 by Author A for use in a fully online, project-based undergraduate education technology course. The prototype interface created by Author A existed in Google Sheets (see Fig. 3) due to its user-friendly interface and collaborative functionality. Author B piloted the prototype within his technology leadership courses that same year with success. The colleagues collaborated and published an article summarizing the instructional methods and applications of the technique using the prototype (Author and Author 2014). In 2015 and 2016, Author A and Author B were fortunate to receive a series of small grants and awards to develop the prototype into a stand-alone, cloud-based tool.

User Experience and User Interface Design

In addition to key theoretical and empirical foundations to the tool's design, the user experience design and user interface design support authentic learning in three ways:

1. **Intuitive UI.** As an educational tool, the user interface and user experience design were conceived with authentic learning in mind. In its prototype stage (see Fig. 3), the tool interface provided straightforward interactions for students and educators from a usability standpoint. Maintaining the simplicity of interface was a key design objective as the tool evolved into an independent cloud-based application. Beyond providing a platform for collaboration, the app had to serve a functional role; students and educators had to first find the app intuitive and easy to use.

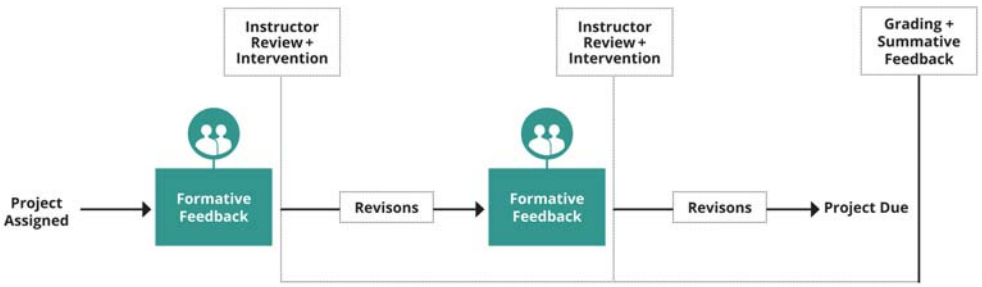

Fig. 1 Assignment process with authentic learning, project-based, peer feedback tool

Name	Name of Reviewer #1	Name of Reviewer #2	Name of Reviewer #3
			Prof. Berry
Provide a link to your work	Date and Time you reviewed the work	Date and Time you reviewed the work	
https://drive.google.com/a/nd.edu/file/d/0B8c7teQ_I6xkVTdMY0tHN3VDZUE/view?usp=sharing	12/8/2015 22:00:00	12/8/2015 23:30:00	
Tell us what you have been working on and how you've revised your work since last time.	Questions and Comments (e.g., concept communication/ effectiveness, typeface choice with concept, etc.)	Questions and Comments (e.g., concept communication/ effectiveness, typeface choice with concept, etc.)	Questions and Comments (e.g., concept communication/ effectiveness, typeface choice with concept, etc.)
Kept working and developing the under my previous concept for the typeface, Meta while trying to keep the layouts different yet still consistent.	I think the layouts look great! I love the simplicity, but the pages still look interesting and engaging. I also appreciate the repetition of the dashed circles.	You do a really good job of communicating the typeface's "quirks", and I'm loving the overall consistency in color scheme and design elements.	Overall design/aesthetic is coming together. As we discussed in class, there are areas where you can still push the design to keep the text visually engaging yet consistent with the look/feel you established, including adding the content (!). But in general, the design is coming together.
Issues or problems that have arisen	Alternatives/Suggestions for Improvement [based on class lectures and critiques, etc]	Alternatives/Suggestions for Improvement [based on class lectures and critiques, etc]	Alternatives/Suggestions for Improvement [based on class lectures and critiques, etc]
Initially wanted to laser cut out some aspects of my project to reveal colored paper underneath, but I've heard it's unlikely the laser cutter will be back up and running. Wondering its necessary to hand cut those aspects out or they are unnecessary.	Yes the laser cutter being down is quite inconvenient... I think it would be cool to cut out parts, but I also think the layouts are strong as they are, and cutting things put by hand can be risky. I think the book could still be successful even without cutouts.	I agree with [redacted]. I hand-cut my handmade box for my Helvetica Neue blocks and it was a PAIN. Though I think it turned out ok, the cuts I made were not precise no matter how careful I was, and I don't want you to take away from a clean, sharp design by trying to hand-cut something that may be better left untouched. Also I really like how you have circled elements of the letters (the center of the uppercase R, the uneven terminals of all of the letters), but though I do understand what is unique about the terminals, I don't know why you circled the R. It may help if you provided some explanations of Meta's quirks, i.e. the characteristics you circled.	Architecture also has a laser cutter--might not be too late to see if you can do your die-cuts with their machine. Alternatively, you "should" consider doing the die-cuts by hand. It's worth practicing on a scrap sheet of paper to get a sense of how difficult it may/may not be for you. If the letters were smaller, I would probably suggest otherwise, but given the scale, the combination of scissors + xacto make it doable.
Areas where I could use feedback	Positive aspects of the work [based on readings, class lectures, experience, etc.]	Positive aspects of the work [based on readings, class lectures, experience, etc.]	Positive aspects of the work [based on readings, class lectures, experience, etc.]
Due to the potential thickness of the accordion book, I'm wondering if I should just create the front and back book covers to appear like an envelope instead of actually putting the book inside one.	I think that making the front and back covers just look like an envelope would work just as well if not better than actually putting the book in an envelope. It would metaphorically be like opening an envelope rather than literally.	Again, I agree with [redacted]. If presentation suffers because of a bulky envelope, definitely don't do that. You could do just as good if not a better/more clever job making the front and back covers appear as an envelope.	Yes. I think this got resolved in class--making the front/back as the envelope is a good way to work around the thickness issue.

Fig. 3 Google Sheet online peer-review feedback tool

2. **Display of peer feedback.** Within the tool, each student can view peer feedback clearly. Identifying who is providing feedback and what the feedback is addressing is straightforward. Students have the ability to quickly compare/contrast feedback comments from group members (see Fig. 4). In addition to looking at feedback from peers, students are able to see how their own self reflections compare to the observations and comments of their peers.

3. **Prototyping the UX/UI development.** We have followed a user-centered design approach, preserving basic functionality while addressing user experience design issues in advance of adding more features (see Fig. 5). This has been a necessary part of prioritizing the usefulness of the tool for learners and instructors, as well as emphasizing digital accessibility through colors (see Fig. 6), typography, and page structure. Prototyping and user testing are ongoing to ensure that pain points—or disruptions to user flows—are minimized as the tool develops.

Case Studies

In the section below, we present examples from the initial pilot testing conducted with the tool followed by specific case studies of the tool's use at three different institutions of higher education. All pilot tests conducted are listed in Table 2. The intent of the case studies is to provide rich descriptions of the ways in which the tool was used to foster authentic learning in online graduate education courses, as well as an instance of the tool's use in a blended learning environment at an undergraduate university.

Initial Pilot Testing from 2015 to 2016 During the 2015–16 academic year, pilot tests were conducted with over 400 students and seven instructors at three research-intensive universities in both business and education courses. Pilot tests lasted between 1 and 3 weeks and included peer feedback on 1–3 projects at each site. In two pilots with undergraduate and graduate education courses, the tool replaced existing online peer feedback practices; within a business course at Indiana University, a quasi-experimental approach was employed to compare the use of the tool to face-to-face group feedback sessions. The evaluation team also compared the amount of time spent on various aspects of peer review. Within face-to-face conferences, students were observed providing feedback to their peers for an average of four minutes per student, compared to an average of 45 min reported for reviewing work of two peers using the tool. The difference in time spent on peer feedback was due to time constraints, as face-to-face peer feedback sessions were limited to an hour, with most of the time devoted to student presentations, whereas online feedback sessions were not constrained by time limits. After each pilot, instructors were interviewed and an electronic survey consisting of 13 open-ended and Likert-type questions was distributed to students. Instructors and students across all

Fig. 4 Example of peer feedback from group members within the cloud-based tool

pilots reported positive perceptions about the tool and its impact on project-based, authentic learning experiences. All pilot instructors expanded implementation of the prototype following initial use. The Kelley School of Business at Indiana University implemented the tool fully in spring 2016 with approximately 230 undergraduate students.

During spring 2016 and fall 2016, pilot tests were also conducted at the K-12 level where the tool was integrated into two high schools in the Midwest. In spring 2016, nine senior-level English students at Ellettsville High School used the tool to provide four rounds of feedback across three large writing assignments over a period of three months. In fall 2016, Lane Tech High School in Chicago used the initial stand-alone prototype with one teacher and 73 students across three sections of a Media Computation class. The results of the K-12 pilots provided mixed feedback. Instructors readily identified the aspects of the tool that needed further development (e.g., instructor were unable to copy rounds of feedback across several sections of a class at the time). Our aim was to address the specified issues and to make sure that the tool was working as

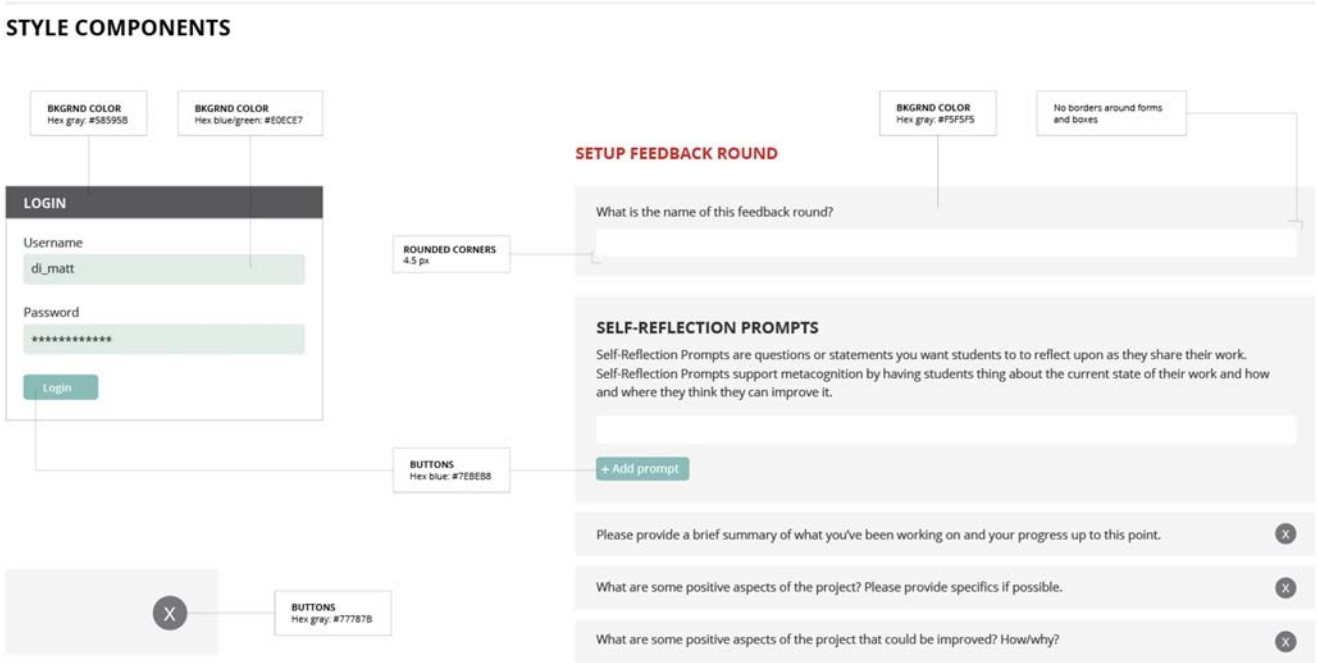

Fig. 5 Development of online peer-review feedback tool user interface design

intended prior to quasi-experimental research studies that focused specifically on the tool's efficacy in K-12 settings. Despite the glitches that were encountered, teachers wanted to continue using the tool in the future as the software development progressed.

University of Tennessee at Knoxville In fall 2018, in a graduate-level course focusing on the topic of online interaction, the course instructor created an assignment that required students to design an online discussion using a tool other than a traditional threaded discussion forum. Example media choices included video sharing websites (e.g., YouTube, DailyMotion), comments on a blog (e.g., LiveJournal, Wordpress), audio and video tools such as VoiceThread, annotation tools (e.g., VideoAnt, Reclipped), and so forth. As future instructional designers, this task was authentic for students as it required them to identify, evaluate, and demonstrate the use of tools just as they would, for example, while helping an online teacher to employ asynchronous discussion as an instructional strategy.

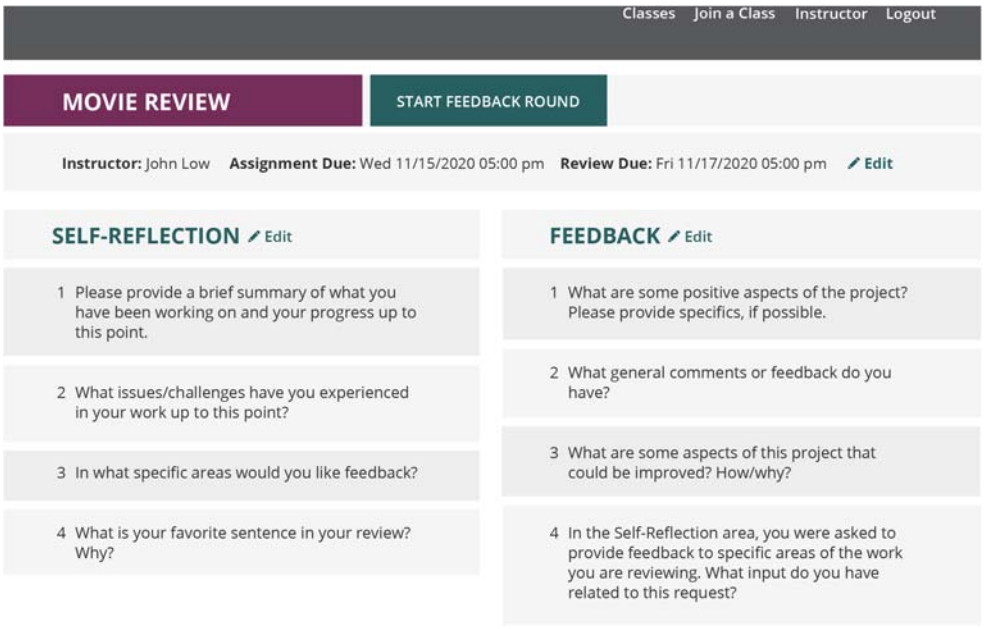

Fig. 6 Revised user interface design, including accessible color palette

Table 2 Background information for case studies

Initial pilots	Semester	Participants	Discipline	Project type	Development phase
Indiana University Kelley School of Business	Fall 2015	Undergraduate	Business	Semester-long leadership project	Prototype (Google Sheets)
University of Oklahoma	Fall 2015	Undergraduate	Education	K-12 technology-integration lesson plans	Prototype (Google Sheets)
University of Notre Dame	Fall 2015	Undergraduate	Design	Type specimen and type history Books	Prototype (Google Sheets)
Ellettsville High School, Ellettsville, IN	Spring 2016	Secondary	English	Comparative critique essay project	Prototype (Google Sheets)
Indiana University Kelley School of Business	Spring 2016	Undergraduate	Business	Semester-long leadership project	Prototype (Google Sheets)
Lane Technical High School, Chicago, IL	Fall 2016	Secondary	Computer Science	Computer programming project	Alpha version of stand-alone web app
Cleveland State University	Spring 2017	Undergraduate	Data Visualization and Information Design	Simplifying complex forms and instructions	Alpha version of stand-alone web app
University of Tennessee Knoxville	Fall 2017	Graduate	Instructional Technology	Designing alternative discussions	Beta version of stand-alone web app
Texas Tech University	Fall 2017/ Summer 2018	Graduate	Education	Instructional, communication, and management plans related to blended and personalized learning	Beta version of stand-alone web app
Eagle Tech Academy, Columbia City, IN	Spring 2018	Secondary	Various	Video production, business communication, feedback on collaborative skills	Beta version of stand-alone web app
Indiana University	Summer 2019 and Fall 2019	Graduate	Instructional Technology	Instructional graphics design	Beta version of stand-alone web app

After creating or mocking up a discussion prompt in their tool of choice, the students were to take a screenshot and post it, along with a description of the tool's distinctive mechanisms that discussion participants might use, in the tool described within this article. They were then to respond to other students' posts by predicting how they thought discussion participants might use the chosen tool given the discussion prompt, the described mechanics, and other perceived affordances.

In past semesters, students posted and discussed their designs in the course's Learning Management System (LMS) discussion forum; however, the use of multiple question prompts in the instructor's post often led some authors to respond only to some of the prompts and to ignore others. To address this issue, in this instance, the instructor used the peer feedback tool described in this article because (a) it modeled a novel approach to completing the assignment, and (b) it provided better structure and control than the typical LMS forum. By requiring students and their peer reviewers to respond to separate prompts within the peer review activity, students were scaffolded toward a richer and more focused discourse. For example, a discussion in a traditional forum usually begins with a post from the instructor containing questions or prompts to frame the responses. Using the peer feedback tool, the instructor can provide one or more separate prompts for the student who is sharing their work and other prompts for students who are providing feedback. In addition, the tool made it quick and easy to divide students into feedback groups, either manually or randomly, and to review each group's interactions on a single page.

In a subsequent class meeting, students reported that they found the peer feedback tool easy to use, with most agreeing that it was a welcome change from the LMS discussion forum. Several students mentioned that they liked responding to separate prompts rather than a single post with multiple embedded prompts.

Cleveland State University The peer feedback tool described in this article served as a supplemental and complementary format for conducting critiques with undergraduate students in upper-level visual communication design courses at Cleveland State. Due to the relatively short class periods, which run 75 min instead of standard-length design studios that typically last 2–2.5 h, creating additional opportunities for critique and feedback was a necessity.

Within a design education context, the critique process builds a foundation for scaffolding which students learn and practice in face-to-face class meetings. The online prompts follow a similar pattern: Students evaluate project components based on assignment criteria and using terms that are also employed in the classroom. This allows students to expand on their feedback reflections—which they might not

otherwise have time to do—and supports equal participation. The following examples represent two ways in which the tool functioned inside and outside of the classroom.

In a Data Visualization and Information Design course, students are tasked with learning to analyze and visualize data, interpret, and organize information. The course is composed of a variety of exercises and assignments that focus on how data and visuals can be used to both tell stories and engage audiences. During the spring semester of 2017, one learning activity included a "forms" assignment. Students were required to identify a government form that they determined to be particularly difficult to understand, then redesign an improved version that demonstrated a clearer information hierarchy, developed with the user in mind. In addition to in-class critiques, students were asked to use the peer feedback tool to provide feedback outside of class; each student uploaded their initial form redesigns to the cloud-based tool and responded to self-reflection questions, then subsequently provided feedback to the other students in their assigned groups.

As a second example, the tool was integrated for accountability purposes in a Human-Centered Graphic Design course. Unlike the majority of design classes offered at university in which students generate design deliverables, the Human-Centered Graphic Design course is primarily concerned with teaching students research methods. Managing group dynamics can be challenging within this context, yet a structured format within the tool helped students evaluate one another in a professional, respectful, and critical way. Self-reflection questions and feedback questions included the following:

- Have you fulfilled your responsibilities for the project to date? Explain.
- Identify one specific task or component of Project 2 that you have been working on. How would you evaluate the quality of the work you have produced and/or the efforts you've made?
- Identify a specific component you would like feedback on. (Upload a pdf file or share a link.)
- What general comments or feedback do you have regarding your classmate's participation and assigned tasks?
- What comments or feedback do you have regarding the components or tasks your classmate has been working on?

In both examples, students were briefly introduced to the tool in class and then provided feedback outside of class on their own time. The tool was initially yet another application and process they had to learn, but they found value in having their classmates' feedback in writing and in a location where they could go back and reference it as needed. Facilitating a critique process outside of class also promoted more interaction among students who might not otherwise talk to each other in person.

Though aspects of authentic learning are naturally built into design education, the prompts within the tool amplified and facilitated these processes in the following ways. By writing about their own work/contributions and then commenting on the contributions of their classmates, students were naturally examining tasks from a variety of perspectives and automatically engaged in reflection and self-reflection. Additionally, by virtue of their feedback to one another being public, they were held to account for their individual and collaborative efforts.

Texas Tech University The peer feedback tool was used in two graduate-level education courses that were part of a graduate certificate in blended and personalized learning. Students consisted of K-12 teachers, administrators, and instructional coaches who were currently working in schools and districts that were using blended and personalized learning. The courses in which the tool was implemented were the third and fourth courses in a sequence of five required courses. Course 3, a five-week, asynchronous 100% online summer course, was designed to equip teachers with the knowledge and skills necessary to implement specific structures, strategies, and scaffolds that promote student data use and facilitate self- and peer-assessment and monitoring. Course 4, an online course with both weekly synchronous meetings and asynchronous components, was designed to provide students with exposure to a variety of advanced technology-enhanced instructional strategies (e.g., student-centered learning, adaptive learning, blended learning) and to inquiry-based unit design to support students' development of higher-order thinking within personalized learning environments. Because students were professional educators currently working in schools implementing personalized learning, these courses were designed to be authentic learning experiences involving projects that could be implemented within their professional context.

In both courses, the peer review process built on course readings and was scaffolded with an instructor created video outlining the specific process that would be used and how that process was supported by research. In addition, examples high-quality and poor-quality peer feedback responses as well as sentence frames were made available to provide additional scaffolding for students.

Course 3 Students in Course 3, conducted in summer 2018, were required to create five different instructional, management, and communication plans related to student use of data. Within a personalized learning environment, a culture of learning and revision is nurtured by providing ongoing opportunities for students to identify, analyze and use data to inform their learning, give and receive peer feedback, and revise and improve their work over time (Lokey-Vega et al. 2018). Through this process of self- and peer-assessment and monitoring, students gain ownership over their learning (Berger

et al. 2014). In an effort to model the type of structured peer feedback educators could implement within their own professional environments, students were asked to use the tool described in this article to provide peer feedback for an assignment of their choice within a group of 2–3 other students. Students were organized into small groups within the tool with other educators who were working within the same grade-span and subject. Students were required to share an assignment of their choice and provide feedback on other students work within four days. In an end-of-course feedback survey, students reported that assigning peer feedback using the peer feedback tool was an effective approach to preparing them to better support student data use in their professional roles. A majority of students also reported that they could see themselves using the peer feedback tool within their classrooms.

Course 4 A main goal for Course 4, conducted in fall 2017, was to provide students with opportunities to develop competencies associated with designing and implementing advanced instructional strategies that promote student ownership and epitomize blended and personalized learning. Students were required to create an inquiry-based instructional unit that included the unit topic, a driving question, academic content standards to be addressed, a culminating project their students will complete, and a plan for when and how this unit would be implemented within a classroom. As a semester-long project, students were also asked to share their project plan and give and receive peer feedback. Students were grouped with others who worked in the same grade-span and subject. After sharing their inquiry-based unit, students were given five days to provide detailed feedback on the plans using the peer feedback tool.

At the end of the semester feedback on the course was collected using a student feedback survey. Over 91% of students reported that the peer feedback received through the peer feedback tool was useful to their learning in the course (see Table 3). Students also explained that:

- I [was] were able to gain ideas from reviewing others work and from their feedback.
- The perspective of other students was what I found most beneficial. Students were courteous and gave positive feedback. The feedback provided helped strengthen my unit and help improve the structure.
- It's always helpful to be able to see your work through someone else's eyes. It can help you see things that you missed or could be done differently.

Table 3 Student perceptions of tool use in a project-based graduate online course

Statement	Percentage agree or strongly agree
The self-reflection prompts supported self-reflection on the current status of my project.	100
It was beneficial to share what areas of my project I wanted feedback.	91
The feedback I received helped me in making my work better.	83
The feedback prompts helped guide me in providing peer feedback.	91
Knowing the areas where others needed feedback helped guide me in providing feedback.	100
Completing peer feedback on other student's work have me ideas about how to improve my own work	96
The tool was easy to use.	87

Summary of Case Studies

In this article, we presented a peer feedback tool created to address the challenge of facilitating authentic learning in distance education settings. The stand-alone tool is intended to support: 1) reduced teacher workload in the formative feedback process; 2) increased frequency and quality of formative feedback; 3) improved learning outcomes, student products, and metacognitive skills, and; 4) additional formative assessment data that facilitates teachers in making data-informed instructional decisions.

The cases described above form a succession of pilot tests that took place in real learning contexts using the tool to support authentic learning activities. The results guided further development of the tool's features. Researchers observed and participants reported a variety of improvements to authentic, project-based learning experiences through use of the tool. Most of the identified benefits were related to improved processes, such as having greater structure and control of the feedback process, having a central location for work and feedback, and receiving multiple perspectives on one's work over several iterations. These improvements resulted in increased time on task for learners, deeper questioning, greater interaction among learners, and a heightened sense of accountability both for providing useful feedback and for applying it.

Practical Ideas to Cultivate Authentic Learning in Distance Education

The development of an educational technology begins with a perceived need. After identifying the need for a pedagogically flexible tool to facilitate online peer feedback, our approach has been (a) to better understand the perspectives and needs of educators who want to use peer feedback as part of authentic learning, and (b) to make design decisions to address those needs that are grounded in the relevant instructional design

literature. Earlier we summarized the literature on peer feedback and relevant theories of social learning, self-regulation, and metacognition and described how they influenced our design decisions. In Table 4, we describe the ways in which the tool provides or supports the characteristics of authentic activities as identified by Reeves et al. (2002).

For those who desire to create similar cloud-based tools that foster authentic learning in distance education settings, we suggest taking the following research-based considerations into account: (a) the enhancement of student learning and work products (Topping 1998; van Zundert et al. 2010); (b) the improvement of self-regulation of learning, problem-solving, and reflective thinking (Sluijsmans et al. 1999; Topping 1998), and; (c) the opportunity for students to engage in authentic learning, meaningful dialogue, and collaboration around course content (Bransford et al. 2000). To engage students in authentic learning, instructors should start by designing learning activities that engage students in problems or projects with real-world relevance (Reeves et al. 2002). The inherent challenge of this aspect of authentic learning is its

Table 4 How the peer feedback tool addresses the characteristics of authentic activities

Characteristics of authentic activities (Reeves et al. 2002)	The peer feedback tool
Engage in problems/projects with real-world relevance	Providing feedback is a real-world skill; because of the flexibility of the tool, faculty can use it within any type of authentic project.
Address ill-defined problems	The tool scaffolds student work on ill-defined problems through the careful use of prompts, through the provision of multiple perspectives from reviewers, and through action lists used to identify tasks and sub-tasks.
Address complex tasks through sustained investigation	Providing feedback is a complex task that is situated within the context of a larger project tied to specific learning outcomes/objectives. The tool promotes the use of multiple rounds of feedback requiring "significant investment of time and intellectual resources" (Reeves et al. 2002, p. 564).
Examine tasks from differing perspectives with the support of diverse resources	Students are given specific prompts to address in their feedback. They must use their growing expertise informed by their own experience and relevant course concepts and resources to provide feedback. Receiving feedback from multiple peers results in students encountering diverse perspectives on their work.
Collaborate with other learners	The tool is collaborative in nature and enables students to view the work-in-progress and feedback of others as well as contribute feedback to a specific group of learners.
Reflect on their learning experiences	The tool facilitates reflection on learning as part of each feedback round. As part of the work sharing process, students address Self-Reflection prompts that require them to reflect on the current status of their work, learning issues they may be experiencing, and an opportunity to specify feedback they would like to receive.
The work students undertake should be applicable to a variety of subject areas	The tool supports work from virtually any discipline. Work is shared through file upload or a link (e.g., Google Drive, YouTube, Box).
Integrate with assessments	The work product (i.e., work-in-progress) and peer feedback shared during each feedback round serve as integrated formative assessments. Instructors can evaluate learning progress on the student work products and their ability to accurately articulate course concepts within the feedback they provide to peers.
Result in meaningful products	This depends on the design of the assignment, but the tool supports the creation of whole, polished artifacts.
Reflect a variety of solutions and possible competing outcomes	When providing feedback to work-in-progress, students must weigh a variety of criteria and related concepts and identify multiple potential solutions.
	Additionally, students must analyze the feedback they received and prioritize it based on a variety of factors including their own expertise and goals for the project, time and resource constraints, and other relevant project parameters. Feedback may contain competing ideas and students must identify the relevant feedback given the desired outcome.

variability; therefore cloud-based tools need to be flexible. Instructors need to have the ability to shape the tool to their particular instructional context. Creating malleable cloud-based tools that both address the needs of instructors while facilitating authentic learning for students will remain an ongoing challenge. It is our intent that readers apply the research-based and development strategies noted in this article to their unique learning situations to support authentic learning in online educational settings.

A simple application like Google Sheets is a practical starting point for developers and teachers who want to create their own custom authentic learning tool. In 2012, when the authors' prototype of the initial idea came to fruition, creating a cloud-based web application or a mobile app required programming skills. Without a capable programmer on one's project team—experienced programmers can charge well over $120 an hour—cost estimates for tool development loom large. To build out an enterprise ready application for integration into learning management systems such as Canvas, Desire to Learn, Blackboard, Sakai, and others typically requires an investment of three hundred thousand dollars, conservatively. The total development costs of the stand-alone peer feedback tool described in this paper were $65,000 in two years, an estimate that does not include the hours invested by the authors in testing software and reporting bugs, modifying and debugging code, designing and testing the user interface, and conducting user experience research and pilot tests. Even design choices, such as the modality of feedback (e.g., oral, video-based) were considered and desired, but the enactment of those modalities were put on hold purely due to development costs.

To mitigate initial development costs, we encourage individuals and teams to use applications like Glide, which allow users to create an app directly from a Google Spreadsheet thereby simplifying an inherently challenging development process. Ideas can be validated without having a programmer on one's team or without substantial funding at hand. Low cost app development, using resources such as Glide, even presents an avenue for future research. There is a greater potential to develop, streamline, and validate instructional technologies if cost is eliminated as a prohibitive factor in the creation of enterprise-ready solutions.

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Compliance with Ethical Standards

Ethical Approval The intent of the project described in this manuscript was to evaluate a specific technology software tool and to only provide information for and about that specific program in question. Pilot evaluations concentrated on improvements to the software tool. The subsequent aim of the article is to suggest potentially effective educational strategies and tools based on existing research, as opposed to developing or contributing to generalizable knowledge; the purpose is to share the process inherent in building a software tool, rather than the outcomes or implications of the project.

Informed Consent For the procedures performed that involved human participants, informed consent was obtained from all participants included in the study.

Conflict of Interest Author A and Author B are co-founders of the tool program and have joint ownership of its intellectual property. Author A and B receive no monetary profit from the tool; all funding received is directed to the tool's development. Authors C and D are project team members in the tool's development. Author C assists in the user experience and programming of the tool and Author D leads the visual identity and user interface design.

References

Baker, M. (1994). A model for negotiation in teaching-learning dialogues. *Journal of Interactive Learning Research, 5*(2), 199–254.

Bereiter, C., & Scardamalia, M. (2003). Learning to work creatively with knowledge. In E. De Corte, L. Verschaffel, N. Entwistle, & J. van Merriënboer (Eds.), *Powerful learning environments: Unraveling basic components and dimensions*. (Advances in learning and instruction series, pp. 55–68). Oxford, UK: Elsevier Science.

Berg, E. C. (1999). The effects of trained peer response on ESL students' revision types and writing quality. *Journal of Second Language Writing, 8*(3), 215–241.

Berger, R., Rugen, L., & Woodfin, L. (2014). *Leaders of their own learning: Transforming schools through student-engaged assessment*. San Francisco: John Wiley & Sons, Inc..

Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (2000). *How people learn: Brain, mind, experience, and school*. Washington D.C.: National Academy Press.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18*(1), 32–42.

Collins, A., Brown, J. S., & Newman, S. E. (1989). Cognitive apprenticeship: Teaching the crafts of reading, writing, and mathematics. In L. B. Resnick (Ed.), *Knowing, learning, and instruction: Essays in honor of Robert Glaser* (pp. 453–494). Hillsdale: Lawrence Erlbaum Associates, Inc..

Conley, D. T., & Darling-Hammond, L. (2013). *Creating systems of assessment for deeper learning*. Stanford: Stanford University, Stanford Center for Opportunity Policy in Ed.

Crisp, E., & Bonk, C. J. (2018). Defining the learner feedback experience. *TechTrends, 62*(6), 585–593.

Falchikov, N., & Goldfinch, J. (2000). Student peer assessment in higher education: a meta- analysis comparing peer and teacher marks. *Review of Educational Research, 70*(3), 287–322.

Fransen, J., Kirschner, P. A., & Erkens, G. (2011). Mediating team effectiveness in the context of collaborative learning: the importance of team and task awareness. *Computers in Human Behavior, 27*(3), 1103–1113.

Fritz, C. O., Morris, P. E., & Richler, J. J. (2012). Effect size estimates: current use, calculations, and interpretation. *Journal of Experimental Psychology: General, 141*(1), 2–18.

Gielen, M., & De Wever, B. (2015). Structuring the peer assessment process: a multilevel approach for the impact on product

improvement and peer feedback quality. *Journal of Computer Assisted Learning, 31*(5), 435–449.

Gielen, S., Peeters, E., Dochy, F., Onghena, P., & Struyven, K. (2010). Improving the effectiveness of peer feedback for learning. *Learning and Instruction, 20*, 304–315. https://doi.org/10.1016/j.learninstruc.2009.08.007.

Hattie, J., & Gan, M. (2011). Instruction based on feedback. In R. Mayer & P. Alexander (Eds.), *Handbook of research on learning and instruction* (pp. 249–271). New York: Routledge.

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research, 77*(1), 81–112.

Hattie, J. & Yates, G. (2014). Using feedback to promote learning. In V. A. Benassi, C. E. Overson, & C. M. Hakala (Eds.). *Applying science of learning in education: Infusing psychological science into the curriculum* (pp. 45-58). Retrieved from http://teachpsych.org/Resources/Documents/ebooks/asle2014.pdf

Herrington, A., & Herrington, J. (2008). What is an authentic learning environment? In L. Tomei (Ed.), *Online and distance learning: Concepts, methodologies, tools, and applications* (pp. 68–77). Hershey: IGI Global.

Herrington, J., & Oliver, R. (2000). An instructional design framework for authentic learning environments. *Educational Technology Research and Development, 48*(3), 23–48.

Herrington, J., & Parker, J. (2013). Emerging technologies as cognitive tools for authentic learning. *British Journal of Educational Technology, 44*(4), 607–615.

Herrington, J., Reeves, T. C., Oliver, R., & Woo, Y. (2004). Designing authentic activities in web-based courses. *Journal of Computing in Higher Education, 16*(1), 3–29. https://doi.org/10.1007/BF02960280.

Herrington, J., Reeves, T. C., & Oliver, R. (2010). *A guide to authentic e-learning*. New York: Routledge Retrieved from http://researchrepository.murdoch.edu.au/1903/.

Herrington, J., Parker, J., & Boase-Jelinek, D. (2014). Connected authentic learning: reflection and intentional learning. *Australian Journal of Education, 58*(1), 23–35. https://doi.org/10.1177/0004944113517830.

Järvelä, S., & Hadwin, A. F. (2013). New frontiers: regulating learning in CSCL. *Educational Psychologist, 48*(1), 25–39. https://doi.org/10.1080/00461520.2012.74800.

Järvelä, S., Kirschner, P. A., Panadero, E., Malmberg, J., Phielix, C., Jaspers, J., et al. (2015). Enhancing socially shared regulation in collaborative learning groups: designing for CSCL regulation tools. *Educational Technology Research and Development, 63*(1), 125–142.

Kim, B., & Reeves, T. C. (2007). Reframing research on learning with technology: in search of the meaning of cognitive tools. *Instructional Science: An International Journal of the Learning Sciences, 35*(3), 207–256.

Kirschner, P., Beers, P., Boshuizen, H., & Gijselaers, W. (2008). Coercing shared knowledge in collaborative learning environments. *Computers in Human Behavior, 24*(2), 403–420.

Lave, J. (1977). Cognitive consequences of traditional apprenticeship training in Africa. *Anthropology and Education Quarterly, 7*, 177–180.

Lave, J., Murtaugh, M., & de la Rocha, O. (1984). The dialectic of arithmetic in grocery shopping. In B. Rogoff & J. Lave (Eds.), *Everyday cognition: Its development in social context* (pp. 67–94). Cambridge: Harvard University Press.

Roman, T. & Callison, M. (2014). The art of online critique. *Learning and Leading with Technology, 41*(6), 10–15.

Light, P., & Blaye, A. (1990). Computer-based learning: The social dimensions. In H. C. Foot, M. J. Morgan, & R. H. Shute (Eds.), *Children helping children* (pp. 205–218). Chichester: Wiley.

Lokey-Vega, A., Williamson, J., & Bondeson, K. (2018). A lesson structure and an instructional design model for project-based online learning. *Journal of Online Learning Research, 4*(3), 327–345.

Nelson, M. M., & Schunn, C. D. (2009). The nature of feedback: how different types of peer feedback affect writing performance. *Instructional Science, 37*, 375–401. https://doi.org/10.1007/s11251-008-9053-x.

Olina, Z., & Sullivan, H. (2002). Effects of classroom evaluation strategies on student achieve- ment and attitudes. *Educational Technology Research and Development, 50*(3), 61–75.

Ozogul, G., Olina, Z., & Sullivan, H. (2008). Teacher, self & peer evaluation of lesson plans written by preservice teachers. *Educational Technology Research & Development, 56*(2), 181–201.

Paré, D. E., & Joordens, S. (2008). Peering into large lectures: examining peer and expert mark agreement using peerScholar, an online peer assessment tool. *Journal of Computer Assisted Learning, 24*(6), 526–540.

Parker, J., Maor, D., & Herrington, J. (2013). Authentic online learning: aligning learner needs, pedagogy and technology. *Issues in Educational Research, 23*(2), 227–241.

Pea, R. D. (2004). The social and technological dimensions of scaffolding and related theoretical concepts for learning, education, and human activity. *Journal of the Learning Sciences, 13*(3), 423–451.

Reeves, T. C., Herrington, J., & Oliver, R. (2002). Authentic activities and online learning. In T. Herrington (Ed.) *Research and Development in higher education: Quality conversations Vol. 25* (pp. 562–567). Hammondville, NSW, Australia: HERDSA. Retrieved from http://www.herdsa.org.au/system/files/Reeves_0.pdf

Robinson, R., Molenda, M., & Rezabek, L. (2008). Facilitating learning. In A. Januszewski & M. Molenda (Eds.), *Educational technology: A definition with commentary* (pp. 15–48). New York: Routledge.

Rogoff, B., & Lave, J. (Eds.). (1984). *Everyday cognition: Its development in social context (pp. 67–94)*. Cambridge: Harvard University Press.

Sadauskas, J., Tinapple, D., Olson, L. & Atkinson, R. (2013). CritViz: A network peer critique structure for large classrooms. In J. Herrington, A. Couros, & V. Irvine (Eds.), *Proceedings of EdMedia: World Conference on Educational Media and Technology 2013* (pp. 1437–45). Association for the Advancement of Computing in Education (AACE).

Schunn, C., Godley, A., & DeMartino, S. (2016). The reliability and validity of peer review of writing in high school AP English classes. *Journal of Adolescent & Adult Literacy, 60*(1), 13–23.

Shute, V. J. (2008). Focus on formative feedback. *Review of Educational Research, 78*, 153–189. https://doi.org/10.3102/0034654307313795.

Sloan, C. C. (2017). Types of feedback in peer review and the effect on student motivation writing quality (doctoral dissertation). Retrieved from ProQuest. (10281143).

Sluijsmans, D., Dochy, F., & Moerkerke, G. (1999). Creating a learning environment by using self-, peer- and co-assessment. *Learning Environment Research, 1*, 293–319.

Sluijsmans, D., Brand-Gruwel, S., & van Merriënboer, J. J. G. (2002). Peer assessment training in teacher education: effects on performance and perceptions. *Assessment and Evaluation in Higher Education, 27*, 443–454.

Topping, K. (1998). Peer assessment between students in colleges and universities. *Review of Educational Research, 68*(3), 249–276.

Topping, K. J. (2009). Peer assessment. *Theory Into Practice, 48*(1), 20–27.

Tsai, C.-C., Lin, S. S. J., & Yuan, S. M. (2002). Developing science activities through a networked peer assessment system. *Computers and Education, 38*, 241–252.

van den Akker, J., Gravemeijer, K., McKenney, S., & Nieveen, N. (Eds.). (2006). *Educational design research*. London, England: Routledge.

van Zundert, M., Sluijsmans, D., & van Merriënboer, J. (2010). Effective peer assessment processes: research findings and future directions. *Learning and Instruction, 20*(4), 270–279.

Wind, D. K., Jørgensen, R. M., & Hansen, S. L. (2018). Peer feedback with Peergrade. In E. Ivala (Ed.), 13th international conference on e-learning (p. 184). Sonning Common, England: Academic Conferences and Publishing International Limited.

Wood, D., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. *The Journal of Child Psychology and Psychiatry, 17*, 89–100. https://doi.org/10.1111/j.1469-7610.1976.tb00381.x.

Yang, M., Badger, R., & Zhen, Y. (2006). A comparative study of peer and teacher feedback in a Chinese EFL writing class. *Journal of Second Language Writing, 15*, 179–200.

Zimmerman, B. J., & Schunk, D. H. (2011). Motivational sources and outcomes of self-regulated learning and performance. In B. Zimmerman & D. Schunk (Eds.), *Handbook of self-regulation of learning and performance* (pp. 49–64). New York: Routledge.