

Defining the Learner Feedback Experience

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Citation: Crisp, E., & Bonk, C. J. (2018, November). Defining the Learner Feedback Experience in Learner-centered Instruction. *TechTrends*, 62(6), 585-593. DOI 10.1007/s11528-018-0264-y.

Abstract

A surge in the proliferation of educational technology tools and models means that postsecondary learners and instructional designers have more options than ever before. Selecting the most appropriate tool for a given learner-centered instructional situation is challenging. The construct of feedback is central to an effective learner-centered instructional design. The present summary of the research on feedback in learner-centered instructional design models provides a rationale for the value of defining the dimensions of a high-quality learner feedback experience. Six dimensions of feedback are proposed; namely, timeliness, frequency, distribution, source, individualization, and content. Key questions posed include whether an analysis of the learner's feedback experience is a better proxy for measuring the quality in postsecondary online learning than grades, satisfaction, or regular and substantive contact.

Keywords: design, evaluation, feedback, higher education, implementation, instruction, learner-centered, postsecondary, technology

Defining the Learner Feedback Experience in Learner-Centered Instruction

The Challenge

Quality assurance in higher education is a monumental task. Historically, employers and learners have entrusted the quality of their learning experiences to expert faculty and administrators who attempt to design, develop, implement, evaluate, innovate, and continuously improve postsecondary education. In recent decades, however, as the educational paradigm shifts away from the industrial age, new models and educational technologies have emerged from all corners of the globe and the marketplace (Carey, 2016; Engle, 2016; Gallagher, 2016; McGee, 2015; Selingo, 2013). Adult learners and instructional designers have an increasing range of learning options that previous did not exist including micro-credentials, bootcamps, digital badges, mobile-ready skill development apps, adaptive learning tools, massive open online courses (MOOCs), open and free college courses, simulations, virtual or augmented reality, learning analytics, competency-based education, and open educational resources. This proliferation of options is accompanied by needs for new ways of communicating the distinct dimensions of various tools and applications to employers, policymakers, accreditors, and investors as well as to the learners themselves.

An Emerging Solution

We propose a definition of the distinct dimensions of feedback that work in concert to provide effective learner-centered instruction. A shared framework for the design of feedback would be useful to faculty, instructional designers, educational technology companies, and learners. Feedback is a construct that is central to the learning process, relevant across cultures, and necessary in every discipline. By articulating six dimensions of the construct of learner feedback in a quantifiable way, we ask if the learner feedback experience could serve as a proxy for measuring quality of a formal online educational experience, where much of the necessary data could now be collected and analyzed using learning analytics.

The Rationale Behind a Definition of Feedback

The Benefits for Consumers

Over 2.5 billion dollars were invested in educational technology companies in just the first six months of 2015 (Straumsheim, 2015). These investments represent technology development and implementation in over 118 countries. From 2002 to 2009, the bulk of investment funds were funneled toward learning management systems or courseware resources, but a shift is occurring. From 2013 to 2015, the educational technology industry saw investment increases of 268% and most of those funds were used for educational technology that is marketed directly to the learner-consumer (Adkins, 2016). In addition to venture capital funding, in 2014, the Bill and Melinda Gates Foundation sponsored a \$20 million competition related to the development of digital courseware in higher education that offered more personalized and adaptive learning experiences (Schaffhauser, 2014). Seven finalists were selected for this 36 month competition targeted toward low-income postsecondary students. They were challenged to not only to design and develop exemplary digital courseware but also to creatively think about their distribution, adoption, implementation, and delivery. Educational technology companies and investors are clearly looking to please a new audience--the individual--as opposed to the provider institution or organization (Adkins, 2016). Marketing campaigns of these educational

technology companies often tout artificial intelligence and adaptive forms of learning and instruction, big data and associated learning analytics, and various aspects of learning personalization. Unfortunately, they rarely address the instructional design issues, challenges, and opportunities that should wrap around the technology to increase the probability of a quality learning experience. Better articulating the dimensions of the feedback construct could help companies communicate effective implementation strategies for their products while also helping consumers choose appropriately to meet an instructional need.

The Benefits for Policymakers

Simultaneous to this unprecedented rise in educational technology funding, federal government policymakers struggle to satisfy the divergent needs of institutions and employers in the postsecondary market. While quality assurance is increasingly needed to keep bad actors and inferior or ill-designed products out of the higher education marketplace, at the same time, employers voice concerns about an ever-widening skills gap and need for a skilled workforce (Jaschik, 2015), thereby opening the door to an increasing array of emerging technology systems and solutions. In brief, financial aid is disbursed for distance education only to institutions that can prove regular and substantive contact with students. In effect, these concerns about contact mean that students have regular access to and consistent interaction with a qualified faculty member (qualified according to the regional or specialized accrediting body) (Harris, 2002). Furthermore, contact must be initiated by the faculty member, and the exact frequency is not defined beyond “regular” (Laitinen, 2012).

When the rules for regular and substantive interaction were written, multi-million dollar cognitive tutoring educational technology companies did not exist (Laitinen, 2012). Pressures to lower the cost of higher education to fill the workforce skills gaps have produced innovative technology to meet some of a student’s feedback needs. According to some educators (Prensky, 2016; Reigeluth, Myers, & Lee 2016), leveraging technology could reduce online course and program costs without sacrificing quality. While advances in the fields of educational technology and learning science signal that we should let technology do what it does best and reserve human interaction for the things that humans do best (Prensky, 2016), this premise conflicts with current federal policy (Harris, 2002). In higher education in the United States, federal distance education policies related to regular and substantive interaction limit the degree to which innovations can impact the design of learner-centered instruction (Laitinen, 2012).

New methods of measuring the quality of a learner’s higher education experience are needed. Policymakers have relied on contact hours and units of time as proxies for measures of learning for too long (Laitinen, 2012). As long as the *regular and substantive* rules remain in force, and as long as the Office of the Inspector General continues to recommend fines to institutions like Western Governor’s University for a lack of regular and substantive interaction, innovations that include AI, adaptive learning technologies, intelligent tutoring, and whatever else emerges next will remain in their experimental and nascent stages for years, if not decades, to come (United States Department of Education, 2017).

To review, the rationale for defining the dimensions of feedback is twofold. First, communicating the dimensions of the learner feedback experience provides educational technology companies with methods for communicating the distinct elements of their products, while also enhancing effective implementation for consumers. Second, measuring the dimensions of a learner’s feedback experience could lead to better methods for measuring quality in innovative online, postsecondary education.

Feedback as a Central Construct

Feedback is a construct that is central to the learning process. Feedback “describe[s] any of the numerous procedures that are used to tell a learner if an instructional response is right or wrong” (Kulhavy, 1977, p. 211). Also, feedback provides “information about the correctness of the response,” and extends or expands a learner’s knowledge state (Jaehing, 2007, p. 220). Feedback can be a pre-programmed, automated response delivered from the adaptive-learning platform to the student or authored by an individual. The positive effects of timely, relevant feedback have been reported in multiple K-12 and postsecondary studies from the past 25 years (Black & Wiliam, 1998; Fraser et. al, 1987; Pennebaker, Gosling, & Ferrell, 2013) as well as several comprehensive literature reviews (Fraser et. al, 1987; Gibbs & Simpson, 2004; Hattie, 2015; Jaehing & Miller, 2007; Kulhavy, 1977). Pedagogically, feedback is a critical component of all learning theories and instructional theories and models (Smith & Dillon, 1999).

Inroads in both pedagogy and psychology have well documented the necessity of feedback for learning (Pennebaker, Gosling & Ferrell, 2013; Kulik et al., 1990; Smith & Dillon, 1999). In psychology, the Dunning-Kruger effect is the well-publicized principle that people need an incompetency exposed before recognizing it (Kruger & Dunning, 1999). This exposure occurs through feedback that illuminates our misconceptions or incompetence. Psychologically, people need feedback for change to occur. In effect, they need some sense of cognitive dissonance (Festinger, 1957) from their various feedback mechanisms. As noted in the remaining sections of this paper, the timing, intensity, and amount of feedback as well as one’s overall prior experiences or background knowledge related to that feedback can each factor into the degree to which such cognitive dissonance is acted upon.

Feedback Experience

Although these findings all point to the value of feedback, none attempts to define the ideal feedback experience for a learner holistically. Four decades ago, Kulhavy found that “elaborated feedback” was more effective than “knowledge of response” feedback (Kulhavy, 1977). Interestingly, Gibbs and Simpson (2004) concluded in their review that when studies showed negative or no results related to learner feedback, there were flaws in the study designs. Despite these flaws, some reviews of feedback have resulted in practical implications for the field of instructional design and learning technology. For instance, Hattie’s (2015) recent review resulted in learner-centered instructional design recommendations for educators. Unfortunately, however, none of these studies has, as its aim, the description of the learner’s overall feedback experience within the design of a unit or module of instruction.

Operationalized Definitions

A *learner interaction* is a period of time when a learner engages with some aspect of curriculum or instruction where concepts or skills are presented. Examples of interactions include attending a class, watching a video, working through a problem, sketching a design, writing an essay, creating a digital product, reading an article, learning a dance, collaborating with a group, using a learning app, and playing a video game. In effect, the time-length of an interaction occurs in one sitting and setting.

A *feedback instance* occurs either after or in the midst of an *interaction* and involves a *source* providing the learner with information about how well the presented knowledge or skill has been demonstrated by the learner. Many *feedback instances* could occur within a single

learner interaction (i.e., each comment provided throughout the text of a student's essay, each scaffold in a problem-based learning group's collaboration, and each question/answer/feedback instance on a math problem set).

The *feedback experience* is the combination of all of a learner's feedback instances within a given unit of instruction. The larger the unit of instruction, the more complex and complicated it would become to measure the dimensions of the learner feedback experience; however, advances in learning analytics and AI will continue to help evaluators address and potentially overcome this challenge in the future.

The term *dimension* was chosen intentionally (rather than component or element) to communicate aspects of feedback that should be considered when designing instruction. Each dimension of feedback is distinct from the others, non-hierarchical, and measurable (Dirlam, 2017). Just as a cabinet has dimensions including length, breadth, depth and height, a learner has an experience that includes six dimensions of feedback.

Dimensions of Feedback

To determine a preliminary set of dimensions, we reviewed all of the learner-centered instructional models found in chapters of Volume IV of *Instructional-Design Theories and Models: The Learner-Centered Paradigm of Education* by Reigeluth, Beatty, and Myers (2016); a recent compilation of fifteen learner-centered instructional models. This review revealed over one hundred references to the concept of feedback in those various chapters. As detailed in Table 1, these references were grouped into the six dimensions of feedback. While a broader investigation is definitely needed, the preliminary evidence to warrant these dimensions as essential considerations for effective learner-centered feedback experiences is compelling.

Before applying these dimensions, it is vital to provide theoretical and research-related grounding for each one. For each dimension, there is a continuum of possibilities for the instructional designer and ultimately the learner. In keeping with sufficiency theory, the following results provide a sufficient foundation for the distinct qualities inherent in each dimension (Kozma, 1994).

Dimension 1: Timeliness

Perhaps the earliest dimension of feedback to be empirically researched is timeliness. Several literature reviews have concluded that there is great value of timely feedback (Gibbs & Simpson, 2004; Hattie, 2015; Jaehing & Miller, 2007). Behaviorists concluded that timeliness was effective because it acted as a positive reinforcer of the student's response behavior. However, this rationale for the importance of timeliness has since been successfully refuted (Kulhavy, 1977; Kulhavy & Anderson, 1972). Instead, many propose that timeliness is important because cognitive pathways are still malleable directly after a response. Timely feedback solidifies the learner's cognition or addresses a misconception before the thoughts of the learner move too far astray to other topics (Brown, Collins & Duguid, 1989; Merrill, 2013).

Other research on timeliness reveals that Bloom's two sigma effect is realized when time is variable and feedback is used to continue to improve performance and responsiveness for as many iterations as is needed (Reigeluth, Myers, & Lee, 2016). Along these same lines, Merrill (2013) points out that just-in-time tutoring is recognized as a highly effective instructional practice. Merrill also notes that timely feedback is a key aspect of problem and project-based learning since it is necessary when students are stuck on a problem situation and cannot proceed (2013). Learners need timely responses (scaffolds) to continue to move forward (Watson, &

Watson, 2016). Finally, timely formative feedback allows learners to satisfy their own timelines for creative production instead of working toward an imposed deadline (Kalaitzidis, Litts, & Halverson, 2016). Clearly, there are many ways to interpret and implement the dimension of timely feedback.

Dimension 2: Frequency

The second dimension of the model proposed here is that feedback should be continuous and integrated (Reigeluth, Myers, & Lee, 2016). Naturally, feedback should be frequent enough to inform both the instructor and the student of the knowledge state of the student compared with the outcome to be achieved (Voorhees, & Voorhees, 2016). As detailed by Francom (2016), the frequency of such feedback should be faded over time as learners become more skilled. Studies find that time for the provision and use of feedback is "severely limited" and often learning designs could be improved by moving some of the modeling or demonstration activities to independent video such as seen in notions of "flipping the classroom" (Zainuddin & Halili, 2016). Such approaches provide in-class time for feedback and application (Francom, 2016). As shown in this dimension, frequent feedback gives the learner knowledge of her individual progress (Reigeluth, 2016).

Dimension 3: Distribution

According to Reigeluth, Myers, and Lee (2016), the distribution of feedback instances across a unit of instruction should allow for goal setting and self-regulation. While providing a thorough and even distribution of feedback instances is challenging for human instructors, technology provides options for immediate feedback delivered on an intentionally distributed timeline (Reigeluth et al., 2016). While designing the distribution of feedback, the design can be universal (all students receive the same distribution), triggered (students who do x receive y), or requested by the student (Reigeluth et al., 2016). In task-centered instruction, for better task completion, coaching leads to better transfer especially with "whole-task" integrative learning. By definition, in such forms of instruction, effective coaching involves distributed feedback to continue motivating and guiding a learner (Francom, 2016). Of course, providing the right distribution of feedback for each learner is a complex task. Prensky (2016) recommends leveraging technology to do what it does best (automated feedback) and developing human capacity to interact in more complex dimensions.

Dimension 4: Source

From the learner's perspective, the source of feedback could be the instructor, a teaching aide, an outside expert or practitioner, the general public, a peer, or canned responses via the Web. Each source has value. On the surface, no one of these sources is inherently better than another. The dimension to be measured is the degree to which the learner trusts the source (i.e., learner perception). Trust can perhaps be measured simply by asking the learner "Did you trust the source of this feedback?" Trusted sources of feedback create positive emotion that are essential for effective learner-centered instruction (Reigeluth et al., 2016). Furthermore, it is possible that flexible, diverse settings and sources of feedback are more effective because learners gain a greater variety of perspectives (Reigeluth et al., 2016).

What is clear is that learners need to have respected relationships with those who grasp their unique talents (Reigeluth et al., 2016) and find instructionally effective ways to tap into and extend them. Such relationships are vital since a trusted source can help produce a love of

learning and appreciation for peers (Reigeluth et al., 2016). Principle Four of Reigeluth et al.'s (2016) learner-centered paradigm is that feedback can be delivered by a mentor, coach, or outside expert as well as an expert faculty member or instructional assistant. In effect, definitions of sources of feedback often mention coach, teacher, peer, mentor, another learner, or a virtual computer-enabled environment. Importantly, Principle 2.2 argues that virtual coaching is a justifiable expense if the number of learners can offset the budget needed for such human resources.

Other research cautions designers to maintain a balance of locally developed (faculty or instructional designer) and commercially developed (e.g., courseware, adaptive learning tools, intelligent tutoring, etc.) sources of feedback (Voorhees, & Voorhees, 2016). In task-centered instructional design models, the role of the peer has been researched and found to be a trusted source (Francom, 2016). The real world can also be a trusted source of feedback if the assignment calls for responses from an authentic, real-world audience (Kalaitzidis, Litts, & Halverson, 2016). In summary, the ideal feedback experience contains diverse sources of feedback that are trusted by the learners.

Dimension 5: Individualization

In an effective feedback experience, success is unique to every learner (Reigeluth et al., 2016). Feedback is customized to each learner in some way--skill development, interest, specific goals, prior outcomes, etc., or perhaps offering learners a choice for their preferred method of assessment and feedback (Reigeluth et al., 2016). It is important to note that Principle Three of the learner-centered paradigm from Reigeluth et al. (2016) relates to personalization. Of course, the provision of feedback to individuals, by an instructor, is one way to realize the personalization aspect of learner-centered instructional design.

Feedback can also come from the learner herself when instructional resources are introduced as a fixed point of comparison for the learner. In their research on the competency-based education, for example, Voorhees and Voorhees find that learners are more successful when they use a rubric to self-assess their work rather than the rubric being a tool used solely by the instructor (2016). After drafting a product, if a learner moves systematically through an analytic rubric, articulating the comparison of her work to the rubric criteria described, her own self-assessment of her work becomes individualized feedback for herself. As this occurs, she is making her justifications visible so that a trusted peer or instructor can identify misconceptions and offer additional individualized feedback that fits the learner's pre-existing rationale for her choices.

Similarly, personalized reflection can be an effective instructional strategy and can provide unique opportunities for the individual formative feedback of others (Watson & Watson, 2016). Advances in personalized learning meet the need for students to receive individualized feedback generated from an artificially intelligent program (Jarrett, 2013). Finally, maker-based research indicates that learning is more effective when learners are shown the value of the learning to the outside world and also when they are made aware of the necessity for change (McKay & Glazewski, 2016). Connecting each learner to the world and connecting learning to each individual will be different for every learner, thereby pointing to the need for individualization in a learner's overall feedback experience.

Dimension 6: Content of the Feedback

Finally, the content of learner feedback matters. Content can move the learner forward and solidify accurate understandings, or it can be motivational. In feedback research during the 1970s, the categories developed included three kinds of content as detailed below.

1. Knowledge of results which is mostly motivational feedback (e.g., “Good job!” or “You did excellent work once again.”).
2. Verification feedback (e.g., “You selected B but C is the best answer”).
3. Elaborated feedback (e.g., “You should review Chapter 10 and consider the laws of motion.”) (Kulhavy, 1977).

Research from Kulhavy (1977) found that elaborated feedback is most effective of the three, whereas knowledge of results feedback produces almost no effect (Kulhavy, 1977). Beyond these previously existing broad categories, what follows are descriptions of newer research that provide more granular detail into the content dimension of feedback.

First, the content of high-quality feedback is connected to the learner’s existing knowledge or skill (their knowledge state). Related to cognitivism, rather than the behaviorist tendency to see feedback as behavioral reinforcement, the content of feedback should help learners process and store their own thinking; in effect, it helps the learner think about their thinking (Reigeluth, Myers, & Lee, 2016). Second, the content of feedback should include emotional, social, and character development as well as input on the cognitive and physical knowledge or skill to be mastered (Reigeluth et al., 2016). Third, there are models for the content of feedback that can be followed to improve learner success. In one example from Social Serious Game design, the content of feedback delivered to players is categorized as “question, information, hint or solution” and then delivered to the player/learner when certain conditions are met (Konert, Gobel & Steinmetz, 2012).

Other considerations related to the content of feedback include the finding that granular feedback is better suited for formative assessments, whereas broad feedback is more effective for summative competencies (Voorhees & Voorhees, 2016). According to Francom (2016), feedback related to the actual task accomplished by the learners rather than the topic of instruction tends to have greater relevance and effectiveness. He also notes that the content of feedback instances should range from simple to complex and then fade with independence (Francom, 2016). Among some of the other relevant findings, Watson and Watson (2016) suggest that mentoring is a method of identifying the strengths and interests of the learner so that the content of the feedback can be authentically connected. Moreover, in the maker-based instructional model, the content of feedback should help learners articulate a question that will guide their learning and prompt them to reflect and consider their own design thinking (McKay & Glazewski, 2016). Finally, the content of feedback in a learner’s overall feedback experience should clearly reflect the purpose of the learning.

The Impact of a Diverse Feedback Experience

The online learning market for adult learners is the broadest educational market on the globe. From micro-credentials to competency-based education to open universities, a learner’s options are dizzying and continually expanding. Before selecting a learning opportunity, how can a learner know more about what she will experience? How can consumers and philanthropists know what to fund? How could policymakers better protect the learner from bad actors in the market? Clearly, everyone could benefit by measuring aspects of learning that matter most.

To clarify the array of options, if all stakeholders had a better awareness of the feedback experience learners could expect with a given educational technology tool or product, those

tasked with purchasing decisions and funding options could reward instructional offerings that are explicit about the overall quality and components of the learner's feedback experience. Learners are negatively impacted when one dimension of feedback (e.g., Timeliness: automated responses from adaptive learning software) eclipses other equally important dimensions (e.g., Source: trusting the source and whether the feedback is inclusive of a diversity of perspectives). In online discussion forums, if students experience too much peer feedback without adequate instructor feedback, they can lose trust in the discussion forum as a source of valuable feedback. If the implementation of publisher courseware allows learners to only use the educational technology resource or tool as they choose, and they select to engage the technology exclusively during the week, or perhaps just the day, before the test, it will not have the intended effect that is realized from distributed practice and extending interaction throughout the course.

Intentionally designed feedback experiences that attend to the six dimensions mitigate challenges such as the lack of distributed practice across a learning experience. Such feedback experiences can also address the lack of learner engagement or personal connection as well as the lack of ownership in the learning process. It is vital to ask who can help in this regard. First of all, policymakers and accreditors need to validate effective implementation of educational tools, systems, and feedback mechanisms. Second, educational technology providers need to differentiate themselves among competitors by designing feedback components that are in line with the six dimensions of feedback (i.e., timeliness, frequency, distribution, source, individualization, and content) embedded in the model presented here. Third, instructors and instructional designers need to become more aware of the importance of these six dimensions through professional training as well as implementation.

Leveraging learning analytics to track the first three dimensions of learner feedback could lead to reliable measurements of timely, frequent, and distributed feedback. The dimensions described in this article work in concert with one another to produce learner-centered instructional experiences suitable for academically diverse groups of learners who display a variety of interests, style preferences, and levels of motivation. Such diversity and individual differences effectively describes a wide gamut of learning settings in the adult learning world from higher education to corporate training environments to casual informal learning in one's home setting.

As learner-consumers, humans living in the twenty-first century enter a learning experience expecting to receive regular, individualized feedback from a qualified expert. In response, some organizations and institutions are increasingly willing to invest time and money into the learning experience for specific, detailed, and timely feedback on demand. On the other hand, if someone seeks to brush-up on a previously mastered but fast fading skill (e.g., Microsoft Excel formulas), and does not need or want extensive or individualized feedback, free online videos and associated transcripts of those videos or other guides or expert tips may suffice. Defining and communicating the dimensions of feedback means that developers can provide learners with an accurate picture of the feedback experience that they expect as well as need. Learners are then empowered as informed consumers of their own learning experiences.

Closing Comments

Exploring feedback components in many of the chapters of Reigeluth et al. (2016) helped reveal several key aspects of feedback in learner-centered instruction. It is now important to ask whether an analysis of the learner's feedback experience is a better proxy for measuring quality in postsecondary online learning than other mechanisms currently in use (i.e., grades,

satisfaction, or regular and substantive contact). We argue that the ideal learner feedback experience, regardless of instructional model or technology, would be comprised of effective implementation in each feedback dimension. A potential rubric for measuring the learner's feedback experience is presented in Appendix A. Defining the dimensions of the learner's feedback experience in learner-centered instructional design, as we have presented here, is merely the first step. Next steps might include evaluating emerging educational technology tools and products for such feedback dimensions as well as professional development of educational professionals for each of them.

The forms of learning design and delivery are expanding at a rapid pace. As such expansion occurs, there are mounting needs to better grasp the functions of all aspects of the learning experience and environment. Learner feedback is a key component. Each element described in this paper—timeliness, frequency, distribution, source, individualization, and content—is vital to the design of high quality online learning in higher education settings. As such, this six-part model is intended to provide a vital mechanism for the design, delivery, and evaluation of effective online learning environments. Key aspects of human existence in the twenty-first century may, in fact, depend on it.

Funding: There was no funding for this study.

Conflict of Interest: Author A declares that he/she has no conflict of interest. Author B declares that he/she has no conflict of interest.

Ethical approval: This article does not contain any studies with human participants performed by any of the authors.

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Appendix A

A Continuum of the Dimensions of Feedback

The following framework, if used to evaluate the learner's feedback experience across a unit of instruction (course, module, lesson, training, etc.), would quantify the dimensions that are of value for effective, efficient, and appealing learning. Learning analytics could be leveraged to automate many of these measures.

| | 1 | 2 | 3 |
|---|---|---|---|
| Timeliness- How quickly is feedback provided to the learner? | On average, > 72 hours after the interaction. | On average, 24-72 hours after each interaction. | On average, immediately to 24 hours after each interaction. |
| Frequency- How often is feedback received? | Feedback is provided after fewer than 50% of learner interactions. | Feedback is provided after 51-89% of learner interactions. | Feedback is provided after 90% of learner interactions. |
| Distribution- To what extent are interactions disbursed throughout the experience? | The only designed interaction occurs at one point (usually the end) of the learning experience. Other interactions are student initiated. | The designed interactions are massed around 2 or 3 points in time (midterm and final for example). | Interactions are equally disbursed throughout the learning experience so that learners are receiving feedback at regular and predictable intervals. |
| Source- To what extent does the learner trust the source of the feedback? | > 80% of the feedback instances are from similarly knowledgeable peers or sources lacking trust from learners. | 50-79% of feedback instances are from similarly knowledgeable peers. | > 80% of feedback instances are from a highly qualified subject matter expert or a source trusted by most learners. |
| Individualization- To what extent is the feedback connected to the learner's unique strengths, needs or interests? | < 50% of feedback instances are uniquely connected to individual learner's strengths, needs or interests. | 50-79% of feedback instances are uniquely connected to individual learner's strengths, needs or interests. | > 80% of feedback instances are uniquely connected to an individual learner's strengths, needs or interests. |
| Content- To what extent is the content of the feedback useful for the learner? | > 80% of the feedback is either motivational or provides a simple knowledge of response | 50-79% of feedback instances are of the type described in level 1 and the remaining instances provide next steps for learners | > 50% of feedback instances provide next steps for learners to either extend their learning or correct misconceptions. |

Table 1

The Six Dimensions of Feedback

| <u>Dimension</u> | <u>Description</u> |
|-------------------|---|
| 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. |