UNDERSTANDING FEEDBACK TO IMPROVE ONLINE COURSE DESIGN

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ABSTRACT

Quality feedback is a crucial ingredient in learning. The growth of online course delivery has altered the way that feedback is obtained and shared; new approaches have been and will be required to capture feedback, particularly informal types, in online environments. This paper examines the nature of feedback in the context of education and the creative approaches authors are currently exploring to capture and share it. A review of over 30 publications was conducted; techniques for sharing feedback from face-to-face to online delivery were mapped, and future trends for capturing informal feedback in the context of online environments were examined. Four main techniques for harnessing informal feedback in an online environment were found: increasing emphasis on formal feedback – particularly in the form of formative assessment; facilitating alternative "face-to-face" experiences; manual analysis of unstructured learner generated data; and automated: artificial intelligence, gamification, machine learning, smart platforms.

KEYWORDS

Feedback, Blended learning, Online learning, Standards: 2, 3, 7, 8, 10, 12.

INTRODUCTION

In any design process, a designer must understand the user's needs, assess trade-offs and analyze alternatives based on a list of criteria. Instructional design also follows this process. In the case of traditional instructional design, content delivery alternatives are few, mainly consisting of face-to-face interactions such as lectures, tutorials or laboratories. The growth of the internet has substantially increased the number of delivery options, and hence the complexity of instructional design. With the growth of online delivery alternatives, possibilities range from face-to-face with minimal online components to full online delivery. Of particular note to this movement is the impact of user generated content (Web 2.0) which allows virtually any internet user anywhere in the world to generate and share lecture material on content sharing sites such as YouTube or Vimeo. In certain cases, the content is even organized into structured courses using free open-source educational platforms that include Moodle, Google Course Builder, and Open edX. There is little doubt that the growth of these technologies is changing the relationship between instructor and student, and in the process transforming the nature of education. Traditionally held views on feedback are challenged in these new educational regimes.

Literature has mainly been concerned with determining which combination of course delivery results in a change in student learning (Bowen, 2012; de Freitas, Morgan, & Gibson, 2015). While this is one approach that can offer insights into "better" course design, our objective here is different. Rather than attempt to determine a "best" or "better" blend for delivery, as

this question has been discussed extensively in the literature, we attempt here to offer a comprehensive discussion of the historical role of feedback in learning and offer insights for future possibilities given recent technological advances. This paper attempts to generate an understanding of feedback from both the student and the instructor perspective and how technology may mediate this process.

MOTIVATION

The motivation for this paper came from an experiment conducted in 2013 in which all lecture content offered in a course taught by one of the authors was migrated to an online delivery platform. In the process, face-to-face student contact time was reduced by 66% and student questions were responded to using e-mail (Hugo, 2014). End-of-term course evaluations indicated that students desired increased contact time with the instructor. A possible explanation for this was that with decreased contact time students lost opportunities to formally express concerns about the material; another explanation was that students missed having engaging, informal interactions that they felt contributed to their learning. Our motivation for this paper was to better understand how student-student and student-instructor interactions in the form of feedback loops contribute to learning, and how these interactions are currently evolving with the rise of online learning. While the literature has emphasized the importance of formalized methods – particularly formative and summative assessment techniques to align on online course design, mediating and capturing informal interactions in the online space is a growing area of interest.

OBJECTIVE

The objective of this study was to gather and describe feedback methods that have historically been used by both instructors and students that contribute to engagement, motivation and depth of learning, and to map techniques researchers are implementing to harness feedback in online environments to improve course design.

METHODOLOGY

To better understand the ways that educators have harnessed feedback for course improvement and the ways students have used feedback to improve their learning, a literature review was conducted. A search was first conducted by combining variations of keywords such as “online learning” (e-learning, blended course, or MOOC design), and “feedback” in major databases including: IEEE Xplore, Scopus, and Web of Science. The primary concern for our preliminary research was to gather the methods authors have reported to give or gather feedback in online course design. Later iterations of research focused more heavily on reconciling those methods with the educational literature about feedback from a more philosophical standpoint. Reported methods were aggregated with our own experience as both users and designers of courses. Aggregated methods were then mapped against our established definition of feedback. The mapping was used to better situate feedback techniques for the online space, identify gaps, and further focus next iterations of research.

BACKGROUND

Course design in tertiary education is subject to a number of constraints, including reduced funding levels and increasing enrollment (Bowen, 2012). As with any design process, user input and iterations are required to drive continuous improvement. Course design is

particularly challenging because design cycles are long for a single course (approximately 4 months), and even longer for an entire degree program (up to 4 years). In design, feedback is a crucial tool that the designer can utilize to better understand whether a design is functioning as intended. Collection of quality feedback can be used to make improvements in subsequent generations of a product; instructors and students both use feedback to improve their work. In traditional course design, feedback has been used to improve learning experiences by gathering information obtained in formal (e.g. assessments) and informal (other verbal and non-verbal) interactions. Online platforms can inhibit the feedback process somewhat by altering the nature of informal interactions, but they also offer exciting opportunities to gather new types of feedback in the form of user data, such as watch minutes for videos (Hugo & Meikleham, 2016; Tisdell, 2016). Educators interested in improving online learning experiences can benefit from understanding the formal and informal feedback flows that exist in face-to-face environments, how these transfer to the online space, and what types of feedback unique to online spaces can be used to improve course design.

In his synthesis of over 500,000 educational studies, Hattie (2003) found that feedback was ranked first in the over 30 factors that impact the quality of student learning when using face-to-face delivery. Feedback not only plays a critical role in learning, but can also drive engagement and student motivation (Biggs & Tang, 2007; Gorham & Millette, 1997; Hattie, 2003), and it is critically important in establishing course climate (Ambrose, 2010). When harnessed properly, the feedback process is transformative for both student and instructor (Ambrose, 2010; Boud & Molloy, 2013). Recognizing that feedback has and will continue to play a critical role in student and instructor development, an ability to understand the complex nature of feedback in online course delivery is of critical importance. To guide this study, we have compiled the following research questions:

1. Is an emphasis on quality assessment enough to achieve quality learning?
2. Is formalized feedback the only feedback shared in a course?
3. How is informal feedback mediated by technology?

Is an emphasis on quality assessment enough to achieve quality learning?

Formative and summative assessments play a necessary but not sufficient role in achieving quality feedback in a classroom; we argue that recognizing this nuance is critical to developing meaningful online learning experiences. Biggs and Tang (2007), in their discussion on constructive alignment emphasize the importance of assessment design, but also discuss the general role that feedback plays in the learning journey. Nicol and Macfarlane-Dick (2006) examine the importance of "formative assessment and feedback" in developing self-regulated learning. In "How Learning Works," Ambrose (2010, 121-152) dedicates an entire chapter to the importance of feedback, referring to the roles of "formative feedback" and "summative feedback" (139) in quality student learning. Countless authors have described their approaches to *assessing* student learning (both formative and summative) in the spectrum of face-to-face to online environments (Asarta & Schmidt, 2016; Sarmento, 2011; Zhang, Dang, & Amer, 2016), but many more authors have recognized there is a broader role for feedback in the process.

Is formalized feedback the only feedback shared in a course?

Feedback is a communicative interaction that provides the sender information about how the receiver has received their message. In learning, it gives us an understanding of how students are doing at any point in time and in teaching it allows us to engage in reflective practices that improve course delivery. In education, feedback usually refers to a closed-loop

process that formally benchmarks actions with desired learning outcomes; it can take verbal or non-verbal forms. In a more formalized view of feedback, the student and instructor co-navigate learning through a shared, directed dialogue (Boud & Molloy, 2013). This more formal view of feedback includes both formative and summative techniques (Ambrose, 2010). Many authors concentrate more specifically on formative and summative *assessment* techniques which work to validate successful uptake of learning outcomes. Like Ambrose (2010), we treat formative and summative assessment methods synonymously with formal feedback. We recognize the role of formative assessments to support the learning process with no or "low-stakes" grades (CMU Eberly Centre, 2015), and summative assessments to verify that overall constructive alignment is achieved through use of higher-stakes tasks. While formative and summative feedback remain an important area of constructive alignment (Biggs & Tang, 2007) for course designers, we argue that the growth of technology-mediated course delivery necessitates a broader discussion of feedback.

We propose that informal types of feedback also contribute to student learning, motivation, and engagement (Gorham & Millette, 1997; Hattie, 2003), but might not fall into the formalized definition described above. Here our definition of informal feedback is left intentionally broad. We do this to encompass traditional and newer forms of feedback, such as online user watch data, which do not fully align with the more formal definition of feedback above. A traditional example of informal feedback can be taken from a face-to-face lecture: an instructor is introducing a concept to a group of students and the students pull their eyebrows together in confusion. The instructor can (if they so choose) immediately interpret this feedback and pivot their delivery, or present an alternate example which might clarify the concept. Hattie (2003) refers to this as the "flexibility" of the expert instructor and discusses how flexibility is of critical importance to quality student learning.

The above example demonstrates how informal feedback can be an invaluable tool to both allow the instructor to improve their practice, and for students to gain an opportunity to improve their learning. Transactions like this may seem negligible, but we argue that their sum across an entire course can play a significant role in learning experiences (Hattie, 2003); these transactions appear to be missed by students (and instructors) if they are not somehow supplemented when courses are transferred online. These transactions have also historically played a critical role in establishing course climate, which has been shown to have significant repercussions on student learning (Ambrose, 2010). Student motivation also appears to be heavily linked to informal feedback cues (Gorham & Millette, 1997). Figure 1 illustrates our classification of feedback types for this discussion on student learning.

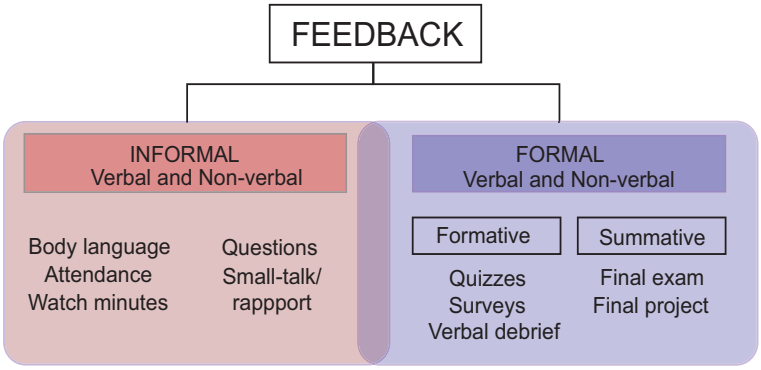

Figure 1. Feedback categorization used in this study.

To avoid the appearance of a false dichotomy, we note that informal and formal feedback are probably not binary classifications. The purpose of presenting formal and informal feedback separately is not to functionally discretize feedback, but to highlight that a formalized view of feedback ignores some critical components that appear to contribute to learning experiences; we argue that this appears to be amplified in online learning environments.

How is informal feedback mediated by technology?

Traditional formal feedback mechanisms have historically transferred well to online delivery (Schuessler, Kolomenski, Bunker, & Perkins, 2016; Zhang et al., 2016), but informal feedback, for example body language and small talk, transfer less naturally to online environments (Jokinen, 2009). This phenomenon is depicted in Figure 2.

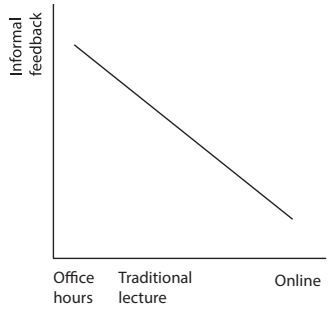

Figure 2. Relationship between nature of contact and ability to share informal feedback.

The student-instructor feedback loop with the mediating roles of peer and self-reflection (Nicol & Macfarlane-Dick, 2006), is visualized in Figure 3.

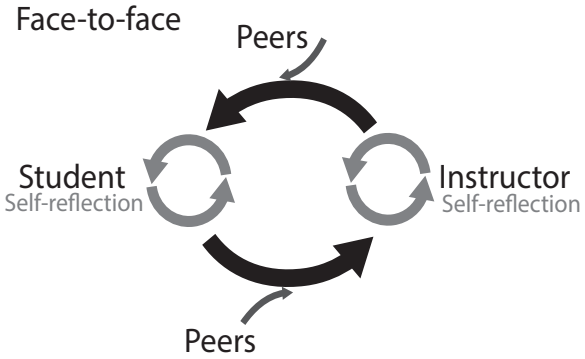

Figure 3. Feedback loop in face-to-face learning environments.

Peer feedback can also be shared formally (e.g. peer comments on an assignment) or informally (e.g. self-organized group study session), and peer feedback to the instructor about the student can be received both formally (e.g. peer evaluations) and informally (e.g. student visits during office hours). This loop broadly represents any interaction in the context of a course. In the ideal case this feedback loop is actively engaged throughout a learning experience, whether it is a lecture, lab or the sum of all activities in a course, Boud and Molloy (2013) refer to this as nested feedback. When this feedback loop breaks down, student learning and instructor reflective practice are compromised (Ambrose, 2010; Hattie, 2003).

What does the feedback loop look like with online delivery? Figure 4 depicts how the feedback loop between the student and instructor is mediated by a technological interface, such as a computer.

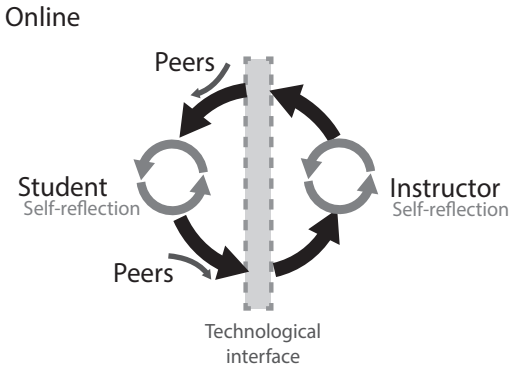

Figure 4. Feedback loop in technologically mediated learning environments.

It is important to note that while a technological interface acts as a mediator for feedback, this does not necessarily imply less feedback overall, but rather a change in how feedback is shared. There is plenty of literature to demonstrate that formal feedback, in terms of formative and summative assessment, are mediated quite seamlessly through technological interfaces. Others have also examined the potential for gathering new forms of feedback previously not possible in a face-to-face environment (Goncher & Boles, 2016; Hugo & Meikleham, 2016; Tisdell, 2016). This is discussed more thoroughly in the following section.

RESULTS AND DISCUSSION

To-instructor and to-student feedback methods reported in the literature were gathered and classified according to type: from informal to formal. They were then placed on a continuum from “face-to-face” to “online” deliveries based on how the literature described their use, as shown in Figure 5.

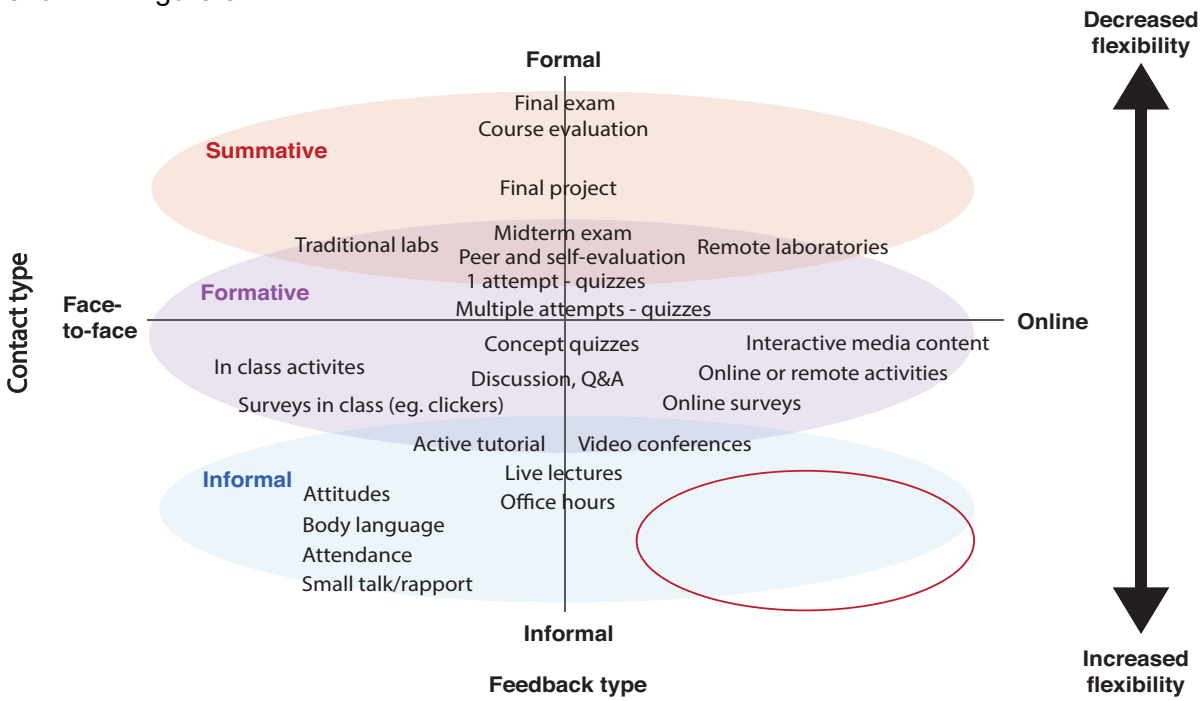

Figure 5. Mapping of feedback types identified in the literature and their relation to delivery type.

Techniques located on the vertical axis were those which were found to have been easily translatable from face-to-face to online, usually with relatively few operations. Some feedback mechanisms were found to have counterparts that required significant design work and coordination to be translated from face-to-face to online, these were separated in the visual – for example, traditional and remote laboratories as described in Mikroyannidis et al., (2016).

As feedback type progressed from informal to formal, it was found that there was a decrease in the flexibility of the instructor to "pivot" their delivery in real-time based on the feedback they received. Similarly, students receiving more frequent informal and summative feedback appear to be in a better position to pivot their learning approaches to achieve learning goals within a course (Zhang et al., 2016). Ideally, for both the student and the instructor, feedback received throughout the course is cumulative (working from informal to summative) and is utilized in future iterations of teaching and learning. Shifting from face-to-face to online deliveries also reduces flexibility somewhat, because content may need to be re-created when a pivot is required; for example, a 10-minute online video clip that is unclear cannot be simply erased from the board and re-done in real-time as in a classroom, it must be re-filmed, edited, and uploaded.

The quadrant at the intersection of online delivery and informal feedback was left intentionally blank because its methodologies were less straight-forward and warranted further discussion. Authors have come up with a number of creative approaches to bridge the informal feedback gap. The approaches reported in the literature can be categorized as follows; it is important to note that these categories are not necessarily mutually exclusive and were separated mainly for ease of discussion and emphasis on certain themes:

1. ***Increasing emphasis on formal feedback – particularly formative***

One of the most common techniques used to supplement the lack of informal feedback was instructors placed more emphasis on gathering formal feedback. The feedback loop was apparently tightened by increasing the frequency of formal feedback, usually formative assessment. Authors reported using randomly generated multiple-attempt quizzes (sometimes as many as three per week), which helped to reduce knowledge gaps and allowed students and instructors to iterate on learning quickly (Zhang et al., 2016). De Freitas et al., (2015) reported that the simulator designed for their astronomy MOOC offered a valuable opportunity for students to validate learning before progressing onto successive modules. Zhang et al., (2016) required students to complete and submit "Cornell notes" – approximately 0.75-1 page per textbook page assigned for reading. Sharing of preparatory notes and findings with peers was required in a class and found to facilitate informal discussion and feedback between students (Gillet, Nguyen Ngoc, & Rekik, 2005). Nicol & Macfarlane-Dick (2006) also discuss how online assessments help to improve timeliness and relevance of feedback; they discuss the importance of relying on peer- and self-evaluation to regulate the learning process. A drawback of this methodology is that providing students with too much formal feedback can cause information overload (Ambrose 2010, 149) and result in a lack of direction for the student and instructor.

2. ***Facilitating alternative "face-to-face" experiences***

Many authors have investigated the potential to implement blended approaches, offering project based and experiential learning in tandem with online deliveries (Delgado Kloos, Muñoz-Merino, Alario-Hoyos, Estévez Ayres, & Fernández-Panadero, 2015; Kloos, Muñoz-Merino, & Muñoz-Organero, 2015). CDIO institutions are particularly well positioned to make this type of adjustment given that project-based learning is integral to CDIO, and

consequently institutions have both the necessary workspaces and experience required to make this type of transition. Courses offered with a blended delivery appear to offer a best-of-both-worlds approach, where online video lectures allow students to learn at their own pace and face-to-face lecture time is spent sharing informal and formal feedback (Schuessler et al., 2016). Courses restricted to only online delivery cannot benefit from structured face-to-face lecture time, but could offer video conferences (Koen, 2002), virtual office hours, or assign group projects which require students to interact with one another, thereby facilitating channels for feedback (Gillet et al., 2005). Online discussions are also used extensively, especially in the context of MOOCs to facilitate the peer-feedback process. It has been suggested that this method can rapidly become overwhelming for an instructor with large enrolment, so it is recommended the instructor only intervene in a small number of cases (Wautelet, Heng, Kolp, Penserini, & Poelmans, 2016). A drawback in this approach is that there are less clear pathways to scalability, particularly for assessment, which contradicts one of the key motivations for offering online courses in the first place (de Freitas et al., 2015). Authors have begun to examine the potential ways that automation can be used to solve this problem. These studies are discussed in the following sections.

3. Manual analysis of unstructured learner generated data

The potential to utilize unstructured user data to inform course design has been identified as an area of great promise (Wise, Cui, Jin, & Vytasek, 2017). Learning management systems are now formally designed to leave a "trail of data" (Dodero et al., 2017) that can be analyzed by the instructor. While a variety of user behaviours can be tracked in an online environment, Zacharis (2015) identified four main usage categories as significant predictors of success in an online environment: reading and posting messages, content creation contribution, quiz efforts, and files viewed. Whether site usage statistics alone can be used to predict success in a course is an ongoing debate (Gašević, Dawson, Rogers, & Gasevic, 2016); it is clear that the use of analytics can provide a valuable source of feedback to the instructor to inform pedagogical practices. Even non-learning oriented websites, such as Youtube.com, provide valuable analytics for educators: comments, likes, user retention, and watch minutes can all be used to gather feedback about student learning (Hugo & Meikleham, 2016; Sheridan, 2015; Tisdell, 2016; Topps, Helmer, & Ellaway, 2013). This data has been used as a proxy for informal feedback in an online environment (as identified in Figure 5). A major challenge with relying too heavily on analytics, as identified by Zacharis, (2015), is that while it may be relatively straight forward for the average instructor to gather data, finding "meaningful behaviour patterns and relationships that inform effective learning" can take considerable time and effort; there is considerable work to be done to facilitate this process. Another area of growth identified was that this feedback is rather one-directional in the short term (data goes only from student to instructor). Authors often report using current student usage data to inform "future" iterations of a course. Data analytics are "gold mines" (Wise et al., 2017) of feedback, but whether they are effective at closing the feedback loop between student and instructor in a given course remains unclear.

4. Automation: artificial intelligence, gamification, machine learning, smart platforms

If computers can be taught to understand what is pedagogically relevant, they can help to reduce the burden on instructors who are conducting manual data analyses by automating the process. In the spring of 2016, an artificial intelligence teaching assistant based on IBM's Watson platform was successfully implemented in a course at Georgia Tech University (Gose, 2016). Gamification has also been used successfully to drive learner engagement in online courses (de Freitas et al., 2015); user-system (e.g. number of logins) and user-user interactions (e.g. discussions) are automatically tracked and quantified. Badges, levels and a

variety of other rewards can be obtained based on site usage and interaction (Kuo & Chuang, 2016). Gamification appears to offer automatic feedback and reinforcement for students that are engaged in a course, which is somewhat of a gap given that engagement is a necessary but not sufficient requirement for deep learning (Biggs & Tang, 2007). Gamification could perhaps be better used to target pedagogical outcomes, rather than engagement metrics - machine learning would likely be required to fill this gap. For example, linguistics and machine learning are being used to mine and classify pedagogically relevant comment data (Goncher & Boles, 2016; Wise et al., 2017). Bassi et al., (2014) have suggested software agents as another area of opportunity in online education design due to their ability to perceive, operate autonomously, and reason. Smart platform design is another area of research that is specifically addressing the gap in nonverbal interactions in online interactions; this research has the potential to utilize machine learning to capture gesture and facial expression data (Jokinen, 2009). The growth in mobile devices and other augmented reality interfaces for course delivery (Halupka, 2012) could offer potentially new and exciting avenues for discovery in terms of mediating the feedback experience.

CONCLUSIONS

The literature indicates that while having strong formal channels of feedback are critical, they are not the only components required to achieve deep learning, reflective practice, and quality educational experiences. Informal feedback contributes to student engagement and establishment of course climate and can be taken for granted or ignored altogether when courses are transferred to the online environment. This paper presented four interventions authors have implemented to close the informal feedback loop in their online classrooms: increasing emphasis on formal feedback – particularly formative; facilitating alternative "face-to-face" experiences; manual analysis of unstructured learner generated data; and automated: artificial intelligence, gamification, machine learning, smart platforms.

The findings in the paper indicate that instructors who are considering implementing online components in their course deliveries should consider creative ways to open informal channels of feedback. Feedback mapping could be used by instructors in their course designs to identify the flow of feedback in their course and assessment design, thereby highlighting potential barriers to the sharing of quality feedback.

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