



Using Interteaching to Promote Online Learning Outcomes

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Abstract

Due to the COVID-19 pandemic, educators have been forced to rapidly transition away from in-person learning environments to completely online formats. Many of these educators have had little or no training and experience teaching online, contributing to stress and anxiety. To compound this problem even further, there are a multitude of online learning technologies from which to choose that can be relatively costly and require an intensive production process. In an effort to provide immediate relief to those dealing with this problem, we detail how interteaching, an empirically supported behavioral teaching technique, can be used to cultivate an interactive online learning environment in either an asynchronous or synchronous format. Specifically, we describe some best practices and provide some examples on how to generate active student responding (ASR) as well as provide pinpointed performance-based feedback. We specifically reference the relatively easy-to-use online software Kaltura, but it is hoped that our suggestions inspire others to develop and use these strategies across a variety of platforms in effort to provide evidence-based quality education during this crisis.

Keywords Online teaching · Active student responding · Interteaching · Feedback

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On March 11, 2020, the World Health Organization (WHO) declared the novel coronavirus (COVID-19) outbreak to be a global pandemic (WHO 2020). In response to this crisis, educators around the world rapidly scrambled to convert their in-person, face-to-face classrooms into completely online environments. With little notice or training, faculty were forced to make difficult decisions regarding which online

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meeting software to use (e.g., Zoom, WebEx, Teams, Kaltura, Panopto, etc.), how to integrate that software with their Learning Management Systems (LMS; e.g., Blackboard or Canvas), and whether an asynchronous, synchronous, or blended learning environment was best suited for their educational goals. This resulted in much stress and anxiety for faculty and students alike and added to the spectrum of psychological health distress that individuals were already facing due to the ongoing public health crisis (Zhai and Du 2020).

At the time of this writing, we all face an uncertain future. It is not clear when or if this pandemic will abate and it is unknown how current standards and structures of higher education will be affected. According to the American Council on Education (2020), sustaining an online learning environment is one of the top three issues currently facing college and university presidents. Across the USA, universities are working hard to determine strategic responses to ensure that quality instruction continues into the coming semesters regardless of whether classes resume as normal, are completely online, or somewhere in between.

In the midst of all this planning, it is important to note that distance (or online) learning is not something new; its origins can be traced back to as early as the eighteenth century (Kentnor, 2015). In fact, one could even argue that online learning was mainstream before the current pandemic. For example, in the Fall of 2017, at least 34% (6.6 million out of 19 million) of students enrolled at degree-granting postsecondary institutions had taken an online course (United States Department of Education 2018). Further, enrollment in online classes has been increasing and even outpaced overall enrollment in higher education (Allen and Seaman 2010, 2013) and there have been numerous descriptive and experimental studies examining online pedagogy (Blackman et al. 2020; Crawford-Ferre and West 2012; Gayman et al. 2018; Heinicke et al. 2017; Kentnor 2015; Malkin et al. 2018; Rieken et al. 2018; Rios et al. 2018; Sieber 2005; Watts 2016). In a recent review, Sun and Chen (2016) summarized some key design factors that need to be considered to make online instruction effective. These include having well-designed course content, having a motivated interaction between instructors and students, creating an online environment community, and being in tune with recent developments in technology (Sun and Chen 2016).

Interteaching (e.g., Boyce and Hinline 2002; for a review, see Querol et al. 2015) is an empirically supported behavioral teaching technique that can be used to improve course content quality and also garner quality interaction between students and faculty. Because the current pandemic has forced many, if not all, faculty to transition from on-ground instruction to online learning, the goal of this paper is to highlight how faculty can leverage interteaching to facilitate individual learning outcomes and create a sense of community in an online learning environment. To accomplish this goal, we briefly describe interteaching and two of its critical components: active student responding (ASR) and feedback. Then, we provide an overview of Kaltura, a relatively easy-to-use online learning technology, and how two of its main tools, Capture and Virtual Classroom, can be used for interteaching. We also provide some examples of interteaching and offer suggestions for future research.

Interteaching

Behavior analysts working on issues of instructional design have developed an array of tools that have successfully been applied in education settings (Lindsley 1964, 1991; Keller 1968; Skinner 1968; Engelmann and Carine 1991). These techniques share the following traits: management of educational consequences, the division of course material into small units, multiple opportunities for responding, observable behavior as a measurement of learning, individualized education, and emphasis on social validity (Bernstein and Chase 2013). Adapting these strategies for online learning can be a fruitful venture, enhancing student engagement and learning.

Interteaching is one technique that shares the above traits. In addition, interteaching promotes rapport via student engagement and learning through mutually probing and mutually informing conversation (Boyce and Hineline 2002). It is similar to active-learning strategies such as *think-pair-share* (Bernstein and Chase 2013; see also Angelo and Cross 1993; Mazur 1997) and consists of several key components (for detailed discussions of these components, please see Saville et al. 2011; Querol et al. 2015; Soldner et al. 2017). The first main component of interteaching consists of a *preparation guide*, which can be distributed via hard copy or electronically prior to or at the start of the next class session. Preparation guides should contain questions about the to-be learned material with question types ranging from strictly definitional to application and synthesis. Further, these questions should help students create clear links between the reading and test materials. The second main component of interteaching is the *small-group discussion*. This is a core component and can be conducted in person or online during normally scheduled class time (Soldner et al. 2017). Here, students can be randomly assigned each session to work in different small groups (at least two students) where they review and discuss their answers to the preparation guide as well as the readings. The instructor's role during this time is to facilitate discussion, clarify questions, and ensure students remain on topic. The third main component of interteaching is the *record form*. These record forms are to be completed by students following the small-group discussion and should be designed to give students the ability to report the quality of discussion with their peers and also a chance to indicate which, if any, material they found difficult or confusing to understand. Records forms should be collected after each interteaching session and reviewed by the instructor prior to the next class. The fourth main component of interteaching is a *clarifying lecture*. This lecture is meant to be short and focused on the most important and challenging topics as indicated on the record forms. It should also follow the small-group discussions (e.g., next class). The fifth main component of interteaching is *assessment* (i.e., quizzes and exams). Ideally, instructors will arrange multiple assessment opportunities throughout the course as this gives students frequent opportunities to demonstrate what they have learned, identify and correct any learning deficits, and minimize the impact that poor performance during any one specific assessment has on the final course grade. In addition, having frequent assessment opportunities can

improve long-term retention of information (Felderman 2014; Bangert-Drowns et al. 2016; Saville et al. 2014). To reinforce participation during interteaching, questions on quizzes and exams should be connected to material on preparation guides and clarifying lectures (Bernstein and Chase 2013).

In a seminal study, Saville et al. (2005) systematically compared interteaching to multiple traditional teaching methods (i.e., lecture and reading). In their study, undergraduate students were randomly assigned to one of four conditions (inter-teaching, lecture, reading, or control) and then exposed to material from an empirical article. Students returned to the laboratory one week later and completed a 10-item multiple-choice question quiz about that article. Importantly, students in the interteaching condition answered more questions correctly (74%) than did students in any of the other three conditions—lecture (60%), reading (55%), and control (52%). Numerous on-ground follow-up studies have been conducted and many show similar sized effects (i.e., increases scores on quizzes, exams, and course grade) of interteaching on student performance and there remain numerous ripe areas to further research interteaching (e.g., Saville et al. 2006; Slezak and Faas 2017; Wheaton et al. 2019; for reviews, see Querol et al. 2015; Steingrimsdottir and Arntzen, 2020).

Even though interteaching relies on peer interactions, at least three empirical studies have demonstrated that it can be effective in an online learning environment (Gayman et al. 2018; Rieken et al. 2018; Soldner et al. 2017). For example, Gayman et al. evaluated effects of interteaching on undergraduate student performance and retention in an asynchronous online class. They found that students performed better in the interteaching component of the course, as indicated by performance on weekly quizzes and that students retained inter-taught material better, as indicated by performance on a cumulative final exam. In terms of social validity, students indicated that they learned more in interteaching and rated it as higher quality than standard lecture. Similar outcomes with graduate students have been obtained using interteaching in both asynchronous (Rieken et al. 2018) and synchronous (Soldner et al. 2017) formats. Taken together, these studies provide empirical evidence that interteaching is an effective teaching pedagogy that can be used in online learning environments.

Active Student Responding

One critical component of interteaching centers around creating opportunities for active student responding (ASR). Inspired by Dewey's (1916) teaching philosophy that students learn by doing, active student responding (ASR) opportunities utilize an instructional antecedent to occasion an observable student response (Kellum et al. 2001). For decades, research has consistently shown that ASR promotes learning (e.g., Malanga and Sweeney 2008; Pratton and Hales 1986; Zayac et al. 2016). In traditional classrooms there are a multitude of ways to provide students with opportunities to respond (OTR) (Menzies et al. 2017; Rila et al. 2019; for review, see Common et al. 2020; Van Camp et al. 2020) including hand raising (e.g., Landrum 2015), response cards (e.g., Gardner et al. 1994; Marmolejo et al. 2004; Randolph 2007), choral responding (Haydon and Hunter 2011; Haydon et al. 2010) and

using “clickers” to answer questions (e.g., Dallaire 2011; Kay and LeSage 2009). Interestingly, although the particular modality of ASR does not appear to influence student learning (Zayac et al. 2016), the type of technology used can have an effect on participation rates. For example, Stowell and Nelson (2007) found that students participated more in standard in-person lectures when using clickers as compared to when they used either response cards or hand-raising.

There are many possible reasons why participation in typical lecture-based classes might be low. It could be that individual attention from the instructor is scarce or that students do not encounter high rates of reinforcement when they do participate (e.g., Keller 1968). Lectures also typically move along at a pace set by the instructor. Some students might be bored and others might get lost. However, even when students do actively participate in class sessions, the participation can be uneven or just a small proportion of students provide most of the comments or questions. Interteaching can be used to address the above problems because it requires high levels of active engagement and self-pacing from all students (Boyce and Hine-line 2002).

Feedback

Feedback is another critical component of interteaching, and regardless of the instructional techniques employed, it is necessary for learning. Generally, there are two types of feedback given for academic work: descriptive and evaluative. Descriptive feedback allows students to adjust their future work based on strengths and weaknesses. In contrast, evaluative feedback is the assignment of letter grades or scores on assignments. Providing descriptive feedback has been shown to increase undergraduate student performance, even when feedback is independent of grades or praise (e.g., Lipnevich and Smith 2009). Interestingly, Lipnevitch and Smith found no differentiation in performance when feedback was delivered by an instructor or by a computer program. This may suggest that automated grading software may help supplement feedback provided by an instructor without losing effectiveness. With interteaching, it is important to provide students with frequent opportunities to assess their learning as this will give them feedback about their performance including their strengths, their writing ability, and their ability to identify and integrate information from readings, discussions, and lectures.

Kaltura

Kaltura (<https://corp.kaltura.com/solutions/education/>) is an online video-collaboration program that gives educators the tools to build real-time, live and video-on-demand experiences that can be used to promote student engagement and interaction. Kaltura easily integrates with major Learning Management Systems (LMS) such as Blackboard, Canvas, Moodle, and Sakai. Students access Kaltura through the University LMS (i.e., it does not require a separate login, platform, etc.). Two features within Kaltura that make it especially conducive to

online education are Capture and Virtual Classroom. These user-friendly tools equip instructors with the ability to deliver materials in a synchronous, asynchronous, or blended format, which is an important consideration to make when designing an online course (Crawford-Ferre and Wiesst 2012; Watts 2016). Although there are other features within Kaltura that can be used to facilitate learning, our focus will be on Capture and Virtual Classroom because both of these features can be easily adapted to incorporate interteaching. Note, although our focus here is describing how interteaching can be used via Kaltura, there are other online applications (e.g., Panopto) which are user friendly and have similar features.

Kaltura Capture

Capture is a feature that enables users to record screen, webcam, or both screen and webcam, which can then be uploaded in whichever LMS is being used. Instructors can use Capture to record lectures using PowerPoint slides, webcam, screen capture, or a combination of these features. It also allows users to upload videos created using other recording methods to the LMS. With these features, a web-based lecture can be recorded wherein an instructor presents the slides to the class via webcam or voice only. This lecture can then be easily delivered to students by uploading it to the LMS being used. These lectures can be edited for length and users (both faculty and students) can create clips (i.e., shorter videos created from a lengthier video) in the LMS using the video editor. In addition, users can activate captions for recorded videos. The captions can be turned on and off by the users and can be edited for accuracy by the instructor. Making content usable by students with a broad range of abilities is a vital consideration in online instruction. Captioning lectures can make online instruction more accessible (Huss and Eastep 2016), and this tool is particularly well suited for asynchronous delivery of instruction (i.e., pre-recorded, available on demand lectures). Both asynchronous and synchronous instruction have advantages (Watts 2016). Benefits for synchronous online instruction include the real-time interaction between instructors and students and the ability to get immediate feedback. Benefits for asynchronous online instruction is that it can offer students with more time to interact or reflect on the content before being asked to respond as well as give students more flexibility with their schedules. Regardless of the modality selected, it is important to take into account students past experiences with online learning. For example, Beyth-Marom et al. (2005) found that student preference for synchronous or asynchronous online instruction was related to their study habits and views on class interactions. Students who had stronger views on the positive aspects of interaction and less need for autonomy preferred synchronous over asynchronous learning. Thus, when instructors should consider students as individual learners rather than a homogenous group as well as the time constraints, available technology, and desired student interactions when deciding the format of their online instruction.

Kaltura Virtual Classroom

Virtual Classroom (also referred to as Kaltura Newrow Module and Kaltura Live Room) allows instructors to open a real-time “room” from Kaltura Mediaspace in the LMS and allows delivery of synchronous online instruction. The real-time class can be recorded and is automatically uploaded to the LMS (e.g., My Media in Blackboard). In Kaltura Virtual Classroom, instructors can also share pre-recorded video content, YouTube videos, and other media content. In addition, there are share screen and white board options that enable the instructor to deliver lectures with slides or display other materials on their computer. Another extremely useful option within the Virtual Classroom is breakout rooms. With this option, instructors can divide the class into smaller groups, move from the main page to the breakout groups, and even broadcast messages to the groups or individual students. Importantly, instructors can move among the different breakout rooms to interact with the students in those rooms and also bring the groups back to the main room individually or at the same time.

Incorporating Interteaching

Active Student Responding (ASR)

In traditional face-to-face classrooms, instructors arrange for ASR using a variety of methods such as hand raising (e.g., Landrum 2015), response cards (e.g., Marmolejo et al. 2004), and clickers (e.g., Dallaire 2011). Active student responding has been shown to be effective at improving academic performance in higher education classrooms (e.g., quizzes: Malanga and Sweeney 2008) and beyond (for a meta-analysis see, Randolph 2007). Some best practices for ASRs include arranging clear contingencies for how accurate ASR earns points toward one’s final grade (Austin 2000). A major challenge raised by the COVID-19 crisis is the urgent need for rapid translation from traditional face-to-face ASRs to online learning environments in synchronous and asynchronous formats.

To limit the scope of the current article, we focus on describing how ASR can be incorporated into an asynchronous, online interteaching environment. For example, a pre-recorded clarifying lecture led by the instructor, based on the record of interteach and quiz performance, could be enriched with ASR questions (e.g., multiple-choice, true/false, reflection, etc.) interspersed throughout the lecture. At the outset of the lecture, learning objectives could be provided to the students. For example, as shown in the first slide of Fig. 1, a learning objective might be that students should be able to define delay discounting (for a review see, Madden and Johnson 2010) by the end of the lecture. After describing the learning objectives, the instructor would advance through the next slides that directly teach the objective at a steady pace, breaking the complex material into smaller manageable units (see Fig. 1, slides 2–4). To conclude, the instructor would provide the students with several ASR questions (see Fig. 1, slides 5–6) to assess mastery of the learning objectives. A major benefit of enhancing online lectures with ASR is that it ensures that students watch

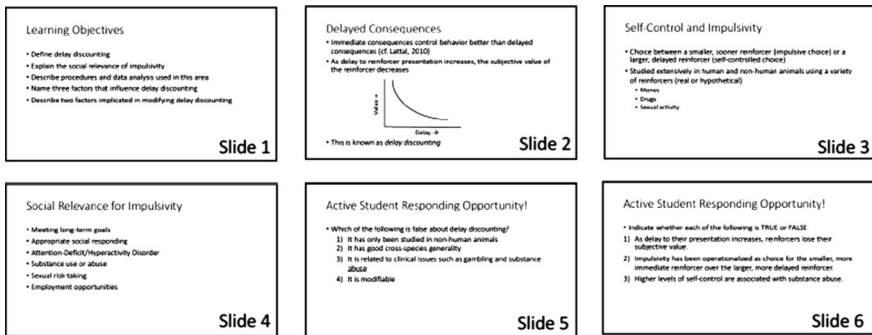


Fig. 1 Sample PowerPoint slides with Active Student Responding (ASRs)

the video and it provides both students and the instructor with a way to assess mastery of the learning objectives. An important question for future research is whether face-to-face versus asynchronous online lectures enhanced with ASR questions produce similar learning outcomes Table 1.

Peer-Guided Instruction

Virtual Classroom breakout rooms have many potential uses, one of which is the implementation of the peer-guided instruction component of interteaching. In order to implement this using Virtual Classroom, the instructor would create an assignment in the LMS that includes a set of questions that students are required to complete and turn in prior to the start of class, which can be arranged using due date features in the LMS. An example of some questions that might be used in a preparation guide centered on the topic of delay discounting is listed in Table 2. Prior to the start of the synchronous peer-guided instruction, the students should have already completed the aforementioned, asynchronous ASR-enhanced brief lecture and read any assigned readings. Upon arriving at the synchronous peer-guided instruction session, the instructor would place the students into small groups (usually 2 to 4 students) using the breakout groups feature of Kaltura Virtual Classroom (see Rosales and Soldner 2018). In the breakout groups, students would be directed to discuss the preparation guide and complete a Record of Interteach form to provide feedback to the instructor about material that was still unclear and also indicate the quality of participation by each member of the small group. An example of some questions that might be included in a Record of Interteach is listed in Table 3. While students are teaching one another, the instructor can join the various breakout groups to assess progress and help with any questions or guide discussions.

The Record of Interteach is important because it provides the instructor pinpointed feedback about what material needs to be further explained to the students. The format of the clarifying lecture can vary, but two options include: 1) recording and posting a video lecture using Kaltura Capture to be viewed by students on the LMS prior to the next lecture or 2) presenting a brief lecture at the beginning of the

Table 1 Kaltura © User Guide Web Links

Web Links

Kaltura© Capture: <https://knowledge.kaltura.com/help/kaltura-capture---user-guide>

Kaltura© Video Quiz: <https://knowledge.kaltura.com/help/kaltura-video-editing-tools-quiz-tab>

Kaltura© Video Quiz Gradebook: <https://knowledge.kaltura.com/help/kaltura-video-quiz-blackboard-gradebook-user-guide-01b2c46>

Kaltura© Live Room: <https://knowledge.kaltura.com/help/virtual-classroom-basics>

next live Kaltura Virtual Classroom session. Future research could directly evaluate the effectiveness and social validity of these two strategies.

In some situations, it may not be possible to use breakout rooms. When this occurs, instructors could assign the preparation guide as homework and ask students to video chat remotely at time convenient for them (for example, see Rieken et al. 2018). To ensure variety and breadth of discussion, instructors could pre-determine who is in which group each week and then let students work together to determine when is most convenient to meet. Record forms would still be collected after the interteach and a pre-recorded lecture addressing questions on the record forms could then be uploaded to the LMS.

Feedback

Kaltura Capture also allows instructors several options on how to deliver feedback. In Blackboard, for example, instructors can use Kaltura Capture to provide recorded video feedback to students across multiple course assessments including Tests, Self, and Peer Assessments. Kaltura Capture video feedback is not an option on Blackboard, at least in the version used to develop this content, but the feature is available for Discussion Board forums including the description of the board (i.e., the topic for the board), creating threads, and responding to threads. For example, an instructor can create a graded or ungraded Discussion Board using written text and/or video that requires students to post a video of themselves engaged in a particular task. This could take the form of rote rehearsal of factual information or a more hands-on activity such as giving a professional conference-style presentation. Note, students can record the video using Kaltura Capture or upload video recorded using other tools. Next, the instructor and fellow students can provide feedback using written text and/or video. Using the video option, the instructor can use Kaltura Capture to model or demonstrate correct responses for a skill not performed correctly while also providing verbal praise and feedback for portions of the skill that were performed correctly. Instructors can also require that the student use the information from the modeling and feedback to revise the submitted video until mastery criteria are met or even use a team-based learning approach (Madson et al. 2020). Kaltura Capture can also be used to both create video-based test questions and to provide video feedback based on student responses to test questions.

Table 2 Possible questions to include in a preparation guide

Questions

1. What is delay discounting? How would you explain this concept to a friend compared to your professor?
2. What is the difference between a self-controlled choice and an impulsive choice?
3. Give an example of a self-controlled choice you made within the last week?
4. Give an example of an impulsive choice you made within the last week?
5. Describe a behavioral excess that is due, in part, to smaller reinforcers being available sooner for that behavior over larger reinforcers available after delays for that behavior
6. Describe a behavior deficiency that is due, in part, because the behavior leads to immediate small punishers over cumulatively significant punishers for that behavior
7. Describe at least one procedure used to study delay discounting. Be sure to describe the procedure using examples that would be relevant to human participants
8. Describe three (3) different variables known to influence delay discounting
9. Describe two (2) different ways in which delay discounting can be modified

Table 3 Possible questions to Include in record of interteach

Questions

1. Was sufficient time provided?
2. Please provide a rating of the work of each of your peers on a scale from 0 (poor) to 10 (excellent) and give a brief rationale of why that person earned that score
3. What topics gave you difficulty (e.g., text was unclear, question was ambiguous)?
4. What topics would you like covered in class?
5. What parts did you find most interesting?
6. If a question were to be omitted, which should it be?
7. Do you have any other comments or suggestions?

Assessment of Learning Outcomes

Within Kaltura, there is an analytics tool available to the instructor in the LMS. Using the analytics feature, instructors can view the number of plays, number of minutes viewed, and average completion rate of lectures or other materials posted. In addition, analytics include information on engagement per user. If an individual student is demonstrating performance issues in the course (e.g., low quiz or test grades), an instructor can easily access analytics and determine the percentage of the lecture video viewed by that student. If the percentage viewed is low, the instructor can provide precise feedback and support to the student regarding “time spent in class”. In addition, if there are large “drop-offs” in viewing, instructors can use this as feedback regarding the content of the video and make adjustments accordingly (see Ozan and Ozarslan 2016).

There is also an assessment option in Blackboard called Self and Peer Assessments that works nicely with Kaltura Capture. Using the Self and Peer Assessment feature

students can review the work of fellow students and provide criteria-based reference evaluations. Students can also give and receive written and/or video feedback using Kaltura Capture. Within the Self and Peer Assessment, the instructor provides a series of questions that contain at least two parts: 1) question text and 2) a model response. For the model response, the instructor can provide a written example or use Kaltura Capture to provide a video demonstration of an exemplary response. These tools are unique in that they give the instructor the ability to create high-quality interactive assignments which could take a variety of forms. For example, instructors could create step-by-step written instructions for a student to design and implement a procedure such as clinical interviewing. Instructors could also provide a video model of how to implement the steps of a procedure and have the ability to view the video in Blackboard such that they could provide written and/or video-based feedback based on the student's performance. In addition, instructors could assign peers to provide written and/or video-based feedback based on both written criteria and the provided video-model.

Summary

The current COVID-19 pandemic has presented instructors around the world with a challenge of figuring out how to successfully adapt and create new learning environments. Although the majority of us now have some experience teaching in an online learning environment, there remains a plethora of questions about the form that future learning environments will take and perhaps most importantly, how do we ensure learning outcomes are satisfied across these new environments. In this time of uncertainty, it is critical to rely on evidence-based instructional techniques such as interteaching, which has been shown to promote learning. Further, maintaining proper social distancing has resulted in many students and instructors feeling more isolated and alone. Interteaching, which is designed to create rapport among students and foster a community of motivated online learning, may be able to mitigate, at least in part, this sense of a loss of community. The present paper provided guidance on some possible ways that instructors can incorporate interteaching into their classroom. Specific reference was given to the Kaltura platform because of its ease of use and also our familiarity with the platform, but other technologies (e.g., Panopto) could be leveraged to provide similar experiences. Although devastating, this crisis has provided an opportunity for researchers to answer important pedagogical questions. For example, more work could be done to determine the relative effectiveness of interteaching compared to other pedagogies as well as different classroom setups (hybrid courses, face-to-face courses, blended formats, etc.). Moreover, we can also use this forced opportunity to enhance, improve, and innovate instruction and truly bring education into the twenty-first century.

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