

A Comparison of Three Assessment Types on Student Engagement and Content Knowledge in Online Instruction

Lynda E. Randall

Jessica Jaynes

California State University, Fullerton, USA

Abstract

The research described in this article focuses on determining the effectiveness of Bongo in promoting student retention of concepts in online learning. This study used both quantitative and qualitative measures to examine the effectiveness of student video presentation assignments on student retention of learning and perceptions of the assignment's contributions to learning. The quantitative methods compared the effects of three treatment conditions (independent reading, Bongo video presentation, and Bongo video presentation with Auto Analysis) on retention of concepts (quizzes administered two weeks after the presentation recordings). Qualitative analysis of student perceptions of the perceived value of Bongo in general, and specifically the Auto Analysis tool, were accomplished through video surveys, transcription, and analysis. Analysis of the data provided strong support for the use of Bongo to increase student retention of concepts, and also revealed that students held favorable perceptions of the value and utility of the tool.

Keywords: retention of learning, online instruction, video capture, online learning, engagement

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A critical challenge for online instructors is the design of high-tech, high-touch activities and experiences to promote student engagement and motivation in learning (Intentional Futures, 2017; Robinson et al., 2017). The number of U.S. students taking at least one online class increased from 5.4 million in 2012 to 7.4 million in 2019, with 37.2 percent of students enrolled in an online course by 2019 (Seaman & Seaman, 2021). The challenge to improve online learning outcomes became particularly germane in spring, 2020, as the Covid-19 pandemic forced 90 percent of U.S. colleges and universities to move to emergency online instruction (Johnson et al., 2021, p. 10).

To a great extent, Covid-19 produced a teachable moment for faculty members by creating an opportunity to expand their teaching repertoires to include more digital tools and more varied methods of engaging learners synchronously and asynchronously in the content. In a recent national survey, 97 percent of institutions reported assigning some faculty members with no prior online teaching experience to staff some of their online courses, and 63 percent of instructors reported that they changed the kinds of assignments and assessments used in their courses to better achieve meaningful online learning (Seaman & Seaman, 2021).

Meaningful online learning can be facilitated using instructional strategies that require learner articulation. Dabbagh et al. (2018, p. 105) have explained this potential as follows: “When learners articulate their knowledge to one another, they share multiple perspectives, enable feedback and commentary, engage in collaborative and conversational activity, and enhance their knowledge and understanding so that it becomes applicable to different contexts.” They noted that collaboration and communication tools are the primary vehicles for facilitating articulation.

Learning management systems and Web 2.0 tools provide almost limitless opportunities for instructors to promote student engagement in the online learning process. The typical mainstay of online discussion has relied on text-based forums. However, video-based tools may have greater potential for developing communities of inquiry (Clark et al., 2015). VoiceThread and Flipgrid are two available Web 2.0 tools with the potential to increase collaboration and dialogue. One additional tool that remains largely unexplored from a research perspective is Bongo, an online learning platform that integrates with the learning management system to allow synchronous virtual classroom meetings and a variety of asynchronous video recording assignments (individual project, Q&A, group project, and interactive video).

The Bongo student video capture tool has a unique potential to engage learners in synchronous and asynchronous online learning activities, both independently and in group collaboration. These features include virtual classroom, independent and group projects, four kinds of video capture assignments, immediate feedback of audio transcript through auto analysis, peer and instructor video and text feedback, and rubric-based assessment. In addition, Bongo offers opportunities for the development of soft skills such as communication, presentation skills, collaboration, team building, and critical thinking. In light of these potential benefits, the research described in this study focuses on determining the effectiveness of Bongo in promoting student engagement, comprehension, and retention of concepts in online learning.

Review of Literature

The growing popularity and prevalence of online instruction in higher education has led to the need for instructors to identify and incorporate a variety of evidence-based strategies for engaging learners in the content. The development of online pedagogies has also necessitated the use of varied assessment strategies that promote interaction with content as well as dialogue among students and with instructors. Although text-based discussions have dominated online instruction in the past (Legon & Garrett, 2017), emerging video technologies have shown promise for personalizing instruction and increasing cognitive engagement (Ching & Hsu, 2013; Fox, 2017; Kirby & Hulan, 2016). Both text-based and video-based technologies can provide scaffolding to help students unpack the details of textbooks and supplementary readings. Despite the obvious potential of video-based discussion and assessment tools, a dearth of research exists that investigates their impact on student learning

Text-Based Discussion

Online instructors have traditionally relied heavily on text-based discussions as a means of creating dialogue around important topics and concepts. Threaded, text-based discussions have historically been the standard method of communication among students and instructors (Legon & Garrett, 2017). One meta-analysis of 51 papers revealed that, although text-based discussions are among the preferred modalities of online instructors, these forums tend to promote low levels of cognitive engagement (Martono & Salam, 2017).

Often, text-based forums promote a narrowed learning focus in which students examine a slice of the content and post cursory responses that require little critical analysis. Further, these posts typically receive high praise from peers and instructors, reinforcing the practice of skimming the surface of readings and lectures. Jung and Gilson (2014) reported that one disadvantage of online threaded discussions is that students often relied on others' posts as opposed to completing readings. Similarly, Lieberman (2019) noted that faculty and students in general have become tired of the monotony of text-based discussions when overused as a form of assessment.

Comparisons of Text-Based and Video-Based Discussions

Researchers have only recently begun to study the relative effects of text-based versus video-based discussions in online learning (Clark et al., 2015; Swartzwelder et al., 2019). These studies have focused solely on student perceptions of the value of the two methodologies and have not yet explored their direct impact on student learning. Clark et al. (2015) compared the effects of asynchronous and synchronous video vs. text-based discussions in an online teacher education course. Through the use of participant interviews, the researchers determined that video-based discussions led to higher student perceptions of social and teaching presence. In one recent study, graduate nursing students preferred text-based discussions over video discussions as a means of promoting engagement, although investigators acknowledged that the results may have been skewed by the students' familiarity with text-based forums (Swartzwelder et al., 2019).

Video-Based Discussion Tools

Several Web 2.0 tools and web-based platforms have become increasingly popular as alternatives to text-based discussion for promoting collaboration and engagement in online learning. These tools use multimodal communication (text, voice, and video) to promote

dialogue in the online classroom setting (Saçak & Kavun, 2020). VoiceThread is a cloud-based application that allows students and faculty to build online presentations by adding images, documents, videos, and other media to which other users can add comments for discussion. The use of VoiceThread in higher education has been extensively researched and found to be effective in promoting collaboration and engagement (Ching & Hsu, 2017; Fox, 2017; Kirby & Hulan, 2016).

Flipgrid is another popular tool for engaging students in video-based discussions. This Web 2.0 tool allows teachers to create "grids" to facilitate video discussions. Each grid is like a message board where teachers can pose questions, called "topics," and their students can post video responses that appear in a tiled grid display. Research on Flipgrid has shown that students respond positively to the tool and develop increased confidence in their learning through vocal practice assignments (McLain, 2018). Flipgrid has demonstrated potential for developing a social community for online learning (Stoszkowski, 2018). In addition, Flipgrid was shown to improve student reflection (Stoszkowski et al., 2020) and connectedness (Bartlett, 2018) as well as to offer benefits as an alternative to journal writing (Sebach, 2020).

Bongo, first introduced in 2011, combines video and audio capture with several assignment options. These options include individual presentations, group projects, Q&A, and interactive videos. In addition, the platform provides virtual classroom experiences that can be set up by the instructor or students. Students can simultaneously record with their webcams while sharing the desktop (typically a PowerPoint) to create presentations. An Auto Analysis feature provides immediate feedback to the students on their lesson delivery and use of key terms. In addition, the platform incorporates rubrics for expedited grading and allows instructors to record text and video feedback.

The nature of Bongo facilitates deep processing of information as students prepare and deliver their own scripts. This form of assessment is generative in nature in that the process of constructing the response tends to promote learning as opposed to simple regurgitation (Fiorella & Mayer, 2015). The novelty of the task seems to interest the students and encourage them to dig deeper into the content. Bongo assignments also increase student accountability for learning by requiring them to provide detailed evidence of their learning. This study represents an initial effort to empirically test the value of Bongo as a tool for promoting robust learning.

Methods

Research Design

This combined quantitative-qualitative study examined the effectiveness of Bongo student video capture in promoting retention (recall) of content (key concepts), as well as student perceptions of the efficacy of Bongo in enhancing their learning. Specifically, the study compared the effects of Bongo student video capture with and without Auto Analysis features to independent reading without video capture. The context of the study was an online undergraduate course on adolescent development. Data collection and analysis entailed both quantitative and qualitative measures, including a quantitative analysis of open-ended video assessments of student retention of key concepts, and a qualitative analysis of video-based surveys of student perceptions of the value of Bongo student video capture and Auto Analysis features.

It was assumed that the process of student video capture would promote deeper engagement in readings, and additionally, that the reiterative process of completing multiple video capture presentations with immediate feedback through Auto Analysis would increase student learning and retention. The study addressed four research questions, as follows:

1. Which of the three assignment types would produce the greatest level of retention of content information (key concepts)?
2. To what extent do students perceive the value of Bongo video recording as a contributor to their learning?
3. How do students perceive that the Auto Analysis features of Bongo influenced their learning?
4. What particular features of Bongo do students perceive as most influential to their learning?

Participants

Participants in the study consisted of 27 undergraduate students in an online general education course at an urban California university. In addition to meeting the general education requirement, the course also serves as a pre-requisite for admission to the secondary education teaching credential program. Therefore, most participants were future teachers. The course on adolescent development consisted of 15 weekly modules of textbook readings, instructor video lectures, supplemental readings, online activities, and various assessments. Researchers designed three of the weekly modules as experimental modules to explore the efficacy of student video capture. A total of 24 subjects completed all 3 modules designated for data collection.

The sample consisted of 7 males and 20 females with a mean age of 22. Participants were racially, ethnically, and linguistically diverse. The majority of students (52%) were Hispanic or Latino, while the remainder were white (24%), Asian (16%), and Black or African American (8%). In terms of linguistic background, 72% of the students identified English as their primary language, 20% identified English and Spanish equally as primary languages, and the remaining 8% were non-native English speakers.

Measures

Quantitative Assessment of Retention

In order to assess student retention of concepts contained in the readings, researchers designed a Bongo Q&A assessment for each of the three readings. Students in all three treatment conditions completed the same retention quiz two weeks subsequent to the completion of each of the three modules. Each of the three Q&A assessments presented a series of three content-specific questions to which the students responded by recording with their web cameras. Following the presentation of each question, students were given one minute to prepare their thoughts followed by one minute to record their responses. The same rubric was used to score the responses for all three treatment groups and for all three modules. Traits measured in

responses to each of the three questions included relevance to the article, specificity of details, and accuracy. Appendix C contains a copy of the retention quiz rubric.

Qualitative Assessment of Student Perceptions of Bongo and Auto Analysis

Researchers also used the Bongo Q&A activity to survey students on their perceptions of the value of Bongo and Auto Analysis in promoting their learning. Students responded to three questions in this survey, as follows: 1) How did the process of creating your own Bongo presentations help you to master the content of our course, 2) In particular, how did the Auto Analysis features help you to improve your presentation skills and content knowledge?; and 3) What other aspects or features of Bongo did you find influential in your learning?

Treatment

Subjects were randomly assigned to three groups that rotated through three treatment conditions of Independent Reading, Bongo Video Capture, and Bongo Video Capture with Auto Analysis. Experimental modules took place in weeks 7, 9, and 11 of the semester. On each of these weeks, students read an assigned journal article and completed activities specified according to the treatment condition. The topics of the reading assignments for the designated modules were the teen brain (week 7), teen depression (week 9), and inclusive education (week 11). Students in two groups completed assigned interventions (Bongo video screen capture, and Bongo with Auto Analysis). Students assigned to independent reading for the given modules did not complete a video presentation.

With the web-based Bongo platform students can simultaneously record a PowerPoint and record themselves via webcam. They then submit their videos to receive personalized feedback and coaching. Bongo video presentations allow instructors and peers to record feedback as video comments, synchronized text, and rubric-based scoring. In addition, Bongo offers an Auto Analysis feature that provides immediate feedback on delivery (clarity, filler words, speaking rate) and content (key terms). Students may make multiple recordings and receive immediate feedback as many times as desired before submitting their final recordings for grading.

Over the course of the three experimental modules/topics, students rotated through the three treatment conditions, which included independent reading, Bongo, and Bongo with Auto Analysis. Table 1 describes the sequence of subject rotation through the three treatments in relation to the three modules and topics. Table 2 describes the Flesch-Kincaid reading levels (approximate grade level) of the three assigned readings.

Table 1*Subject Rotations Through Treatment Conditions*

Group	Experimental Module	Topic	Treatment
1	1	Teen Brain	Independent Reading
2	1	Teen Brain	Bongo (w/o Auto Analysis)
3	1	Teen Brain	Bongo Auto Analysis
1	2	Inclusive Education	Bongo (w/o Auto Analysis)
2	2	Inclusive Education	Bongo Auto Analysis
3	2	Inclusive Education	Independent Reading
1	3	Teen Depression	Bongo Auto Analysis
2	3	Teen Depression	Independent Reading
3	3	Teen Depression	Bongo (w/o Auto Analysis)

Table 2*Reading Levels of Assigned Readings*

Article Title	Number of Words	Flesch-Kincaid Reading Ease Score	Flesch-Kincaid Reading Level
Teen Brain	7719	38.4	13.4
Inclusive Education	7990	16.5	12.8
Teen Depression	6597	42.8	10.4

Bongo Video Capture Assignment.

For each of the three modules, students assigned to either of the Bongo treatment groups (without Auto Analysis/with Auto Analysis) were asked to create a video presentation including 5 PowerPoint slides and a script. The task required students to summarize their understanding in relation to a set of prompts, and additionally, to incorporate several key concepts and important terminology from the reading. Students recorded their narration of the PowerPoint by simultaneously capturing their webcam and desktop through the Bongo application. Table 3 summarizes the prompts and assigned readings for each of the three module topics

Table 3*Assignment Prompts for Bongo Presentation Required Readings*

Topics	Prompts
Teen Brain	Explain why brain researchers believe there is a mismatch in the development of brain regions. Discuss how this developmental mismatch can affect adolescent thinking and behavior and might predispose the teen to risky behavior.
Inclusive Education	Describe and contrast the two perspectives and situate them in the historical context of education in the United States. Discuss how legislation has shaped these two perspectives.
Teen Depression	Describe the nature and prevalence of teen depression. Discuss several other topics such as signs and symptoms, risk factors, treatment, and prevention.

Bongo Auto Analysis

The treatment of Bongo with Auto Analysis required students to make use of a built-in platform feature that allowed them to obtain immediate feedback on their delivery (clarity, use of filler words, and speaking rate) as well as content (number of keywords). Students also see a verbatim transcript of their presentation with keywords highlighted. The goal of Auto Analysis is to engage students in repeated practice and facilitate improvements in delivery and content. Students can practice their recordings repeatedly, with immediate feedback, and then submit their presentation when they are satisfied with the result.

Clarity is determined by the percent of clear (audible/transcribed) words. Auto Analysis also provides a percentage of filler words (um, ah) contained in the recording. The speaking rate consists of the number of words per minute, with an ideal rate of 135 to 185 words per minute. For each of the metrics, Bongo Auto Analysis provides a color-coding of red, orange, or green as targeted feedback for the desirable range. Figure 1 provides an illustration of a sample Auto Analysis report with a transcript, highlighted keywords, and color-coded ratings for delivery and content.

Rubrics for the Bongo assignments were available to students in the module instructions, and general attributes (duration of recording, content development, relevance and coherence, inclusion of key terms, and accuracy) were assessed consistently across the three topics. For the Auto Analysis group, the traits of delivery (clarity, use of fillers, and speaking rate) were also assessed. Descriptors for each trait allowed a rating of 0 (not established), 1 (developing), 2 (established) 3 (approaching excellence), or 4 (excellence).

Appendix A illustrates the traits, descriptors, and point allocations for the Bongo (without Auto Analysis) scoring rubric created for the purposes of this study. Appendix B illustrates the scoring rubric used for the Bongo with Auto Analysis treatment.

Figure 1
Sample Auto Analysis Report



Data Analysis

Quantitative Analysis of the Data

An analysis of variance (ANOVA) was conducted to determine whether there were significant differences in Retention by Treatment and Topic. The assumption of normality was assessed by plotting the quantiles of the model residuals against the quantiles of a Chi-square distribution, also called a Q-Q scatterplot (DeCarlo, 1997). The ANOVA was examined based on an alpha value of 0.05. Table 4 presents the Analysis of Variance for Retention by Treatment and Topic. The main effect Treatment was significant, $F(2, 76) = 16.57, p < .001$, indicating there were significant differences in Retention by Treatment levels. The main effect Topic was also significant, $F(2, 76) = 5.56, p = .006$, indicating there were significant differences in Retention by Topic levels.

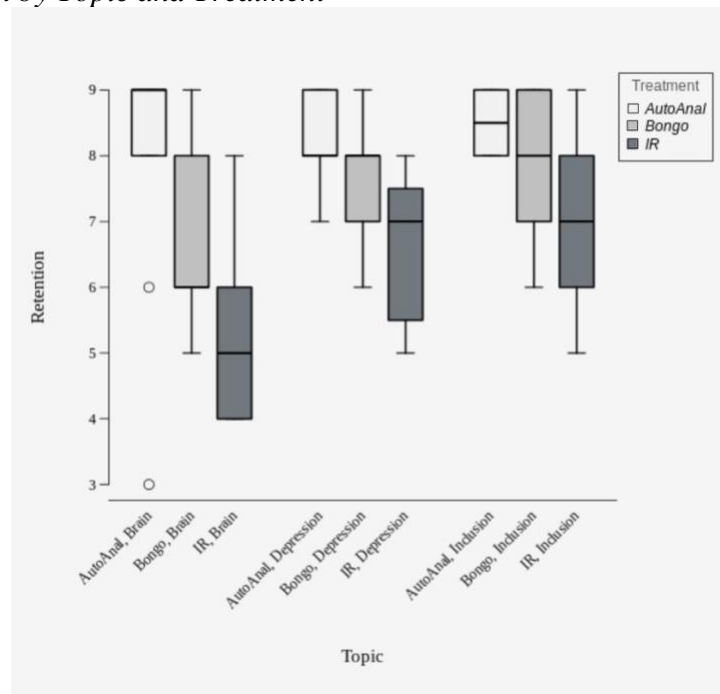
Table 4

Analysis of Variance Table for Retention by Treatment and Topic

Source	df	Sum of Squares	Mean Square	F Value	p-value
Treatment	2	49.951	24.975	16.566	1.0683e-06
Topic	2	16.755	8.3773	5.5567	0.0055937
Residuals	76	114.58			

Figure 2

Boxplot of Retention by Topic and Treatment



Post-hoc

Figure 2 presents a boxplot for Retention by Topic and Treatment. Based on this figure, on average Retention for Auto Analysis is higher compared to Bongo and IR. This is confirmed with multiple comparisons based on Paired *t*-tests between each pair of measurements to further examine the differences among the variables. Table 5 presents Tukey's HSD pairwise comparisons of Treatment means based on an alpha of 0.05. For the main effect of Treatment, the mean of Retention for Bongo ($M = 7.5185$, $SD = 1.1887$) was significantly larger than for IR ($M = 6.2593$, $SD = 1.4031$), $p < .001$. For the main effect of Treatment, the mean of Retention for Auto Analysis ($M = 8.1481$, $SD = 1.2921$) was significantly larger than for IR ($M = 6.2593$, $SD = 1.4031$), $p < .001$. These significant findings can be interpreted to indicate that the use of Bongo, both with and without Auto Analysis, produced greater recall of new concepts than independent reading alone.

Table 5

Table of 95% Family-wise Confidence Level for Treatment Means

Difference Levels	Mean	Lower Limit	Upper Limit	Adjust p-value
IR-Bongo	-1.2593	-2.0581	-0.46041	0.00093213
IR-Auto Analysis	-1.8889	-2.6877	-1.09	7.856e-07
Bongo-Auto Analysis	-0.62963	-1.4285	0.16922	0.15026

Table 6 presents Tukey's HSD pairwise comparisons of Topic means based on an alpha of 0.05. For the main effect of Topic, the mean of Retention for Brain ($M = 6.7037$, $SD = 1.8977$) was significantly smaller than for Depression ($M = 7.5556$, $SD = 1.1209$), $p = .040$. For the main effect of Topic, the mean of Retention for Brain ($M = 6.7037$, $SD = 1.8977$) was significantly smaller than for Inclusion ($M = 7.6667$, $SD = 1.2403$), $p = .006$. A likely factor in the effect of Topic on learning retention is the novelty and complexity of the text material. The teen brain article contained many references to unfamiliar scientific and neuroanatomy terms, and Flesch-Kincaid estimates of reading level were highest for the teen brain article.

Table 6

Table of 95% Family-wise Confidence Level for Topic Means

Difference Levels	Mean	Lower Limit	Upper Limit	Adjust p-value
Depression-Brain	0.82853	0.029686	1.6274	0.040314
Inclusion-Brain	1.0562	0.25739	1.8551	0.006327
Inclusion-Depression	0.22771	-0.57114	1.0266	0.77501

Qualitative Analysis of the Data

Of the total sample of 27 subjects, 24 completed the Bongo Q&A survey. Responses to the survey produced 72 minutes of recorded video, which were then converted to verbatim transcripts using the Bongo transcription tool. The process of analytic induction began with the researcher's reading and re-reading of transcripts to identify theoretical categories of phenomena (Goetz & LeCompte, 1981). Once salient themes were identified from the transcribed data, the interview data units were sorted into categories using the method of constant comparison (Glaser & Strauss, 1967). To further scrutinize the data, HyperRESEARCH™ computer software was used to code all responses to the 4 questions according to themes identified through inductive

analysis. HyperRESEARCH™ allows for the computer-assisted analysis of qualitative data through the processes of coding data, retrieving coded text, testing propositions, testing hypotheses, and analyzing statistics (Hesse-Biber & Dupuis, 2000). As a result of this analysis, the researcher interpreted and modified categories of emergent themes to adjust for negative cases (Lincoln & Guba, 1985) and revise hypotheses. The use of multiple sources (24 subjects) and multiple investigators (two researchers to conduct peer debriefings) provided two methods of triangulation (Lincoln & Guba, 1985). To accomplish peer debriefing, the primary researcher conducted analytic discussions with a colleague who had examined all the raw data and developed some interpretations. In these debriefings, the investigators probed and clarified the bases for their initial assertions, determined the extent to which the assertions matched the depth and breadth of the data, and explored working hypotheses regarding general themes.

Overarching Themes in the Data

Table 7 provides a summary of frequency counts for frequently coded categories in response to each of the three questions. Analysis of the qualitative data showed that students strongly endorsed the use of Bongo presentations as a tool for increased engagement, comprehension, and retention. They recognized the importance of focused reading and reiterative practice in mastering content as opposed to skimming the surface. Students valued the experience of presenting to the instructor and peers, and this sense of audience provided increased accountability and an imperative to analyze the reading. The process of teaching and articulating ideas helped to solidify learning and retention. Students also valued the Auto Analysis feature of Bongo and felt it helped them to improve presentation skills that would be essential in their future roles as teachers.

Analysis of the Data in Response to Specific Survey Questions.

A number of themes emerged in response to the initial research questions. The ordering of themes and subthemes are presented below in relation to the three research questions. The order of presentation of these themes and subthemes for each question represents their relative rankings in terms of importance, as determined by the frequency of coded units. These frequencies are also included in Appendix A. It is important to note, however, that the frequencies were affected by such factors as nesting of categories within coded segments and varying lengths of discourse within given coded units. In some cases, the subthemes identified had low frequencies of coded units, but the content of the categories was deemed to be particularly informative or salient.

Question 1: How did the process of creating your own Bongo presentations help you to master the content of our course, *Adolescence*?

In responding to how the process of creating Bongo presentations helped promote mastery of the course, inductive analysis revealed several dominant themes that could be categorized according to processes (deep processing/engagement/focus and reiteration/practice) and outcomes (comprehension, retention, and improved presentation skills). Students recognized that they remembered more of the concepts and understood them better as a result of the process of creating their own slides and script and recording them repeatedly until the presentation met the standards of the rubric and their own personal standards. This reiterative process of drafting/recording/revising led to deeper engagement in the content as well as a clearer focus on

key concepts and terminology. They discovered that the process of reading course content is not cursory, but rather, involves concerted effort. It is likely that this increased metacognitive awareness of reading demands will transfer to other assignments and courses as well.

Question 2: In particular, how did the Auto Analysis feature help you to improve your presentation skills and content knowledge?

In explaining how the Auto Analysis feature helped to improve presentation skills and content knowledge, students noted the importance of a sense of audience, increased confidence, greater awareness of filler words and speaking rate, increased focus on key terminology, and improved clarity. Presenting to an audience of peers and instructor, students felt compelled to do their best work and make sure they clearly understood the content. The process of articulating or giving voice to their thoughts helped students to better understand the material as well. Virtually all students overcame their initial reticence and became increasingly confident in their presentation skills. They became conscious of, and worked on, improving their speaking rate and reducing their use of filler words. By checking the frequency of their use of key terminology, students also became more astute at filtering their presentations to focus on important ideas and eliminate extraneous details.

Question 3: What other aspects or features of Bongo did you find influential in your learning?

Responses to this question were quite varied, but among the noted influential features were 1) simultaneous web camera and desktop recording, 2) Q&A assignment, 3) Auto Analysis feedback, 4) instructor feedback, 5) playback and self-analysis. Students felt that the reiterative process of creating a PowerPoint, recording themselves and the slides, watching themselves and revising/re-recording before submitting helped them to anchor their learning. They particularly valued the Auto Analysis feedback provided on their attempts, as well as the instructor's video and text feedback. The Q&A assignment also led to increased accountability for reading and learning by articulating (“saying it aloud”) led to more learning. Several students mentioned that Bongo provides a novel alternative to traditional assessments. In addition, recording time limits forced students to be succinct and precise in their presentations and to limit extraneous and redundant verbiage.

Table 7
Frequency Counts for Bongo Survey Response Themes

Question	Theme	Frequency	Selected Quote
Question 1: Promoting Learning	Deep processing Engagement Focus	14	“I think it's easy for students to say they read and just skip to, like quizzes and just try to guess their way to the answers. But having created a Bongo presentation allowed me to actually read and analyze a text so I can better understand it, ‘cause I want to make sure when I do the presentation that the people on the other side understand what I'm trying to convey as well, and so it was a really great process for me.”

Learning by teaching Articulation	10	“I feel like, personally, the most important thing about the Bongo presentations and just assignments, in general, are more so the idea of teaching the content back to someone so learning and memorizing and knowing a certain concept. The topic is good. But, while I have the ability to teach it back to someone or [repeat] it back to someone and try to explain it, I feel like that helped me really master the contents for me.”	
Reiteration Practice	8	“For each assignment that had a do a Bongo presentation, I spent significant amount of time doing the presentation or the PowerPoint and also practicing many times through creating a script and it really helped me memorize and really just understand information better because even now when I go back and re-watch some of my Bongo presentations, I still remember the information, like to this day. So, I really liked it. It really helped a lot in my opinion and helped a lot with the confusion I was having, cause I had to kind of go out and research more and flush it out for myself. So that helped a lot.”	
Retention	8	“This was the first course I've had that I had to use Bongo and honestly, it really helped me like engrave the information into my brain.”	
Comprehension	6	“The process of creating our own Bongo presentations helped me to learn more about the content in our course. It really was like an effective study tool because, um, I actually had to, like, think deeper about the topic and put it into, like, an effective PowerPoint. So, that helped me in that sense to actually, like, fully learn it.”	
Question 2: Auto Analysis	Reducing Filler Words	9	“It was really helpful for me because I say a lot of ‘uhs’ and just words that are not necessary and so really helped me improve on it.”
Improved rate of speech	8	“The Auto Analysis feature helped me, um, improve in, um, my speed. I tend to speak quick and a lot of the time what I say, you know, the point doesn't quite get across.”	
Focus on key words & concepts	8	“It shows you if you said some of the key terms correctly, like vocabulary, and it highlights how many times you use that. So, in a way, it helped me become a	

better writer knowing that . . . it just helped my content be more thorough over time.”

	Clarity	7	“It made me be a little more cautious with thinking before speaking and coming out with more clean and crisp sentences and words and how to formulate what I'm saying in a good way.”
Other Influential Features	Simultaneous webcam and desktop recording	4	“I most definitely liked this screen share that you were able to do with the Bongo presentation recording; how we were able to share our laptop screen or computer screen, as well as the front facing camera. So, in a way, it, you know, even though this is an online course, it reinforces the same way in an in class setting where you would have to maintain eye contact, where you would have to go through your PowerPoint slides and learn how to present yourself in front of people.”
	Auto analysis feedback	4	“I think it was really cool how I could, um, see my spoken words per minute or, um, how much vocabulary I was using, or if there was any repeated words, which really helped me be able to give a good a good response to the prompts of the presentations, and that really helped my learning and well speaking in general.”

Discussion of Findings

This study examined the efficacy and utility of Bongo student screen recordings as a tool for enhancing student retention of content knowledge. The research questions were:

1. Which of the three assignment types would produce the greatest level of retention of information?
2. To what extent do students perceive the value of Bongo video recording as a contributor to their learning?
3. How do students perceive that the Auto Analysis features of Bongo influenced their learning?
4. What particular features of Bongo do students perceive as most influential to their learning?

Results of both the quantitative and qualitative aspects showed support for Bongo as a valuable and popular tool. In response to question 1 (which of the assignment types produced the greatest level of retention), results demonstrated significant differences in levels of retention for both Bongo treatments (without and with Auto Analysis) as opposed to the treatment of Independent Reading. Bongo with Auto Analysis produced the highest level of content retention across topics (teen brain, inclusion, and teen depression), and this was likely due to increased

attention to keywords required to meet criteria of the rubric, as well as the reiterative aspect of practicing and repeating the presentation until a satisfactory level of performance in delivery and content was achieved.

Two factors may limit the interpretation and generalizability of these findings. First, the constraint of small sample size ($n=24$) was necessitated by the selection of one intact online class for inclusion in the study. Second, the inclusion of primarily preservice teachers might limit the generalizability of the findings to students in other academic disciplinary areas. Further research is recommended to include larger sample sizes and varied disciplinary areas to explore the potential value of Bongo more fully as a tool for promoting online learning and engagement.

Faced with the demands of balancing school and work lives, students often resort to a cursory reading of course materials such as textbooks and supplementary resources. One study of undergraduate finance majors indicated that only 24% of students read their textbooks prior to coming to class (Jones, 2011). In addition, some evidence suggests that the amount of textbook reading decreases as the semester progresses (Phillips & Phillips, 2007). A recent review of literature indicated that these patterns of college reading behavior are common across the disciplines (St Clair-Thompson et al., 2017).

The current study helped students to internalize the need for careful analysis and rigorous study of course materials, particularly those that are content dense and include many complex ideas. It is likely that this improved metacognitive ability and self-regulated learning will enhance student reading generally, not just for the duration of this experiment.

Students were virtually unanimous in the support for the value of Bongo, and especially the features of Auto Analysis. As future teachers, these students were motivated to improve their delivery skills and gain confidence in their speaking abilities. They were receptive to repeated practice to achieve levels of excellence in both delivery and content. They appreciated both the immediate feedback provided through Auto Analysis and the rubric-based and video-recorded feedback of the instructor. Students expressed a favorable orientation toward the use of an alternative to the typical reliance on text-based discussions they had experienced in previous online courses. In fact, one student recommended to a professor in her speech class that Bongo would be a valuable tool for this content area, particularly in light of the rapid shift to online instruction experienced during the initial months of the pandemic.

The results of this study provide strong support for the value of Bongo video presentations as a digital tool to enhance student learning and retention. They support the notion that multisensory learning is superior to unisensory environments, and greater resolution and retention is evident even twenty years later (Medina, 2008). And it appears that Bongo assignments can promote deep processing and sustained engagement with course materials.

Video-based assessment provides an alternative to overreliance on text-based discussion forums and contributes to the development of a collaborative and constructivist classroom. In addition, it helps students to anchor learning through repeated practice with immediate feedback. Students' comprehension is likely enhanced through the process of verbally articulating their understanding, an elaborative process that helps the brain to integrate new information with prior

knowledge. And finally, the potential for online learning is greatly enhanced through multisensory media.

Previous research has shown that video-based discussion tools such as VoiceThread and Flipgrid can promote collaboration and student satisfaction with the online learning experience. This study extends the current research base on student video capture to provide evidence of improved learning in addition to positive learner perceptions. This study demonstrated that, for this group of students, Bongo was useful in increasing content retention. The Auto Analysis feature that provides immediate feedback on the use of key terms can encourage students to hone their content focus and spend more time interacting with the target text material and concepts. Auto Analysis feedback on delivery (clarity, use of fillers, and speaking rate) can help students to become aware of their communication skills and to present their content more effectively. These skills have application in a wide variety of academic disciplines in higher education.

The use of Bongo as a discussion and assessment tool might be especially valuable in helping students to gain more meaning from their textbooks and other course readings. By spending more time with the material, crafting their own presentations, and rehearsing their understanding of the text through repeated practice, students may develop learning strategies that they can apply generally to their online and classroom readings.

Because peers and instructors can provide text and video feedback, Bongo can promote valuable collaboration in learning. The ability to hear and see the speaker should help students to feel more connected to their online learning experience, their peers, and their instructor. This study used the individual project assignment of Bongo, but future research could explore the value of group project, Q&A, and interactive video features as well.

Ultimately, it makes sense for online instructors to use a variety of discussion and assessment tools. Text-based discussion forums and varied video platforms can increase interest and engagement with online content. This study has provided support for the use of Bongo as an effective tool for helping students to reinforce their learning, as the assignments could be used to support both classroom and online learning. As an alternative to text-based discussion, Bongo has a unique ability to improve student learning and presentation skills.

Declarations

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

The authors assert that approval was obtained from an ethics review board (IRB) at California State University, Fullerton, USA.

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Appendixes

Appendix A

Scoring Rubric for Bongo Presentation without Auto Analysis

	Not Established	Developing	Established	Approaching Excellence	Excellent
Duration	There is no presentation	Video is less than 3 minutes or more than 5 minutes	Video is 30 seconds under or over the time limit	Video is 15 seconds under or over the time limit	Video is between 3 and 5 minutes
Content Development on Slides	There are no slides	1 or 2 slides, but the content is cluttered or unclear	3 slides logically organized	3 to 4 slides, clearly organized, or 5 slides with less than substantive content	5 slides, well organized, and the content is substantive
Relevance and Coherence	Content has no relationship to the article	A tangential relationship can be inferred	A general relation is apparent	A specific relationship is apparent	The content is explicitly related to the article and is coherent
Inclusion of Key Terms	The presentation contains no references to key terms in the article	There are several references to key terms, but these are simply mentioned and not explained	There are numerous references to key terms, but there is no explanation	There are 7-9 references to key terms and these are clearly explained	The presentation includes and illuminates at least 10 key terms
Accuracy	The presentation is largely inaccurate	There are numerous inaccuracies and factual errors	There are several inaccuracies and factual errors	The majority of the content is accurate and informed	All the content is accurate, informed, and sufficiently paraphrased

Appendix B*Scoring Rubric for Bongo Presentation with Auto Analysis*

	Not Established	Developing	Established	Approaching Excellence	Excellent
Duration	There is no presentation	Video is less than three minutes or more than 5 minutes	Video is 30 seconds under or over the time limit	Video is 15 seconds under or over the time limit	Video is between 3 and 5 minutes
Content Development of Slides	There are no slides	1 or 2 slides, but the content is cluttered or unclear	3 slides logically organized	3 to 4 slides, clearly organized, or 5 slides with less than substantive content	5 slides, well organized, and the content is substantive
Relevance and Coherence	Content has no relationship to the article	A tangential relationship can be inferred	A general relation is apparent	A specific relationship is apparent	The content is explicitly related to the article and is coherent
Inclusion of Key Terms	The presentation contains no references to key terms in the article	There are several references to key terms, but these are simply mentioned and not explained	There are numerous references to key terms, but there is no explanation	There are 7-9 references to key terms and these are clearly explained	The presentation includes and illuminates at least 10 key terms
Accuracy	The presentation is largely inaccurate	There are numerous inaccuracies and factual errors	There are several inaccuracies and factual errors	The majority of the content is accurate and informed	The presentation includes and illuminates at least 10 key terms
Clarity (percent of clear words)	NA	NA	Auto Analysis score is in the red range	Auto Analysis score is in the orange range	Auto Analysis score is in the green range
Use of filler words (avoiding use of "um", "ah")	NA	NA	Auto Analysis score is in the red range	Auto Analysis score is in the orange range	Auto Analysis score is in the green range
Speaking Rate	NA	NA	Auto Analysis score is in the red range Red: score <120 or >200	Auto Analysis score is in the orange range Orange: score is 120-135 or 185-200	Auto Analysis score is in the green range Green: Score of 135–185 (ideal is 160)

Appendix C*Scoring Rubric for Retention Q&A Quiz*

	Not Established	Marginal	Developed	Expanded
Question 1	Not answered	Vague, inaccurate, or irrelevant response	Accurate and relevant response, but lacking specific detail	Germane and relevant response that contains references to specific terminology and concepts
Question 2	Not answered	Vague, inaccurate, or irrelevant response	Accurate and relevant response, but lacking specific detail	Germane and relevant response that contains references to specific terminology and concepts
Question 3	Not answered	Vague, inaccurate, or irrelevant response	Accurate and relevant response, but lacking specific detail	Germane and relevant response that contains references to specific terminology and concepts