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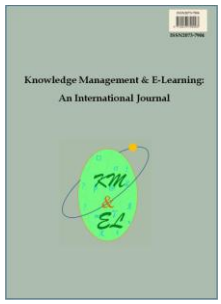
Knowledge Management & E-Learning



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Collaborative learning using VoiceThread in an online graduate course

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Abstract: Collaborative learning enables participants in a learning community to externalize and share knowledge, experiences, and practice. However, collaborative learning in an online environment can be challenging due to the lack of face-to face interaction. This current study examined twenty graduate students' experiences of using VoiceThread for a collaborative activity in an entirely online course to explore students' perceptions of using multi-modal communication for collaboration and knowledge sharing. The results of this study revealed that graduate students had very positive experiences toward using VoiceThread for collaborative learning. The participants found VoiceThread easy to learn and use, and reported that audio and video interaction on VoiceThread helped connect them with their peers. More than half of the participants interacted with peers using audio, followed by text and then by video. Half of the students felt they were more connected to peers; however, feeling more connected did not result in more participation as most of the students only participated at the level that met the course requirement. Participants identified benefits and drawbacks of using VoiceThread for collaboration as compared to using text-based discussion forums. The most frequently mentioned benefit of using VoiceThread for collaboration exemplifies its multi-modal affordance that enables learners to communicate emotion, personality, and other non-verbal cues conducive to better understanding and interpretation of meanings. About half of the participants indicated that they preferred VoiceThread to text-based discussion forums for collaborative learning activity. Challenges and implications for future research are also discussed.

Keywords: Collaborative learning; VoiceThread; Web 2.0; Higher education; Online graduate course

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1. Introduction

Collaborative learning has been widely used as an active learning strategy that engages learner interaction and idea exchange to develop shared meaning through solving common problems (Stahl, Koschmann, & Suthers, 2006). Conducive to a learner-centered learning environment, collaborative learning promotes social interactions and the development of learning communities for knowledge sharing. Adult learners in higher education usually bring into their classes valuable and sharable knowledge, skills, and perspectives accumulated from their life and work experiences. According to andragogy theory, adult learners prefer to engage in learning activities that involve solving real-life problems such as those in their professional contexts (Knowles, Holton, & Swanson, 2011). Hence, they may be particularly motivated to participate in a learning community where they can collaboratively solve authentic problems. The interaction among community members while solving problems can catalyze the exchange of expertise and tacit knowledge that are not usually openly discussed without specifically applicable contexts.

In an online learning environment, learner interaction is an essential aspect to ensure successful learning experiences. Research found that the interactivity positively correlates with learner satisfaction and performance (Durrington, Berryhill, & Swaffor, 2006) and increasing interaction positively affects learner achievement as revealed in a meta-analysis of online interaction (Bernard et al., 2009). Collaborative learning designed to increase student interaction enhances social presence among participants and helps motivate and sustain learning. However, collaboration and communication online can be difficult due to the lack of face-to-face interaction or immediate access to the collaborators. In the past, asynchronous discussion forums featuring text-based discussion have been used extensively as a means for online collaboration where learners exchange ideas and provide feedback. However, text-based discussions present barriers for students who are poor typists (Girasoli & Hannafin, 2008) or students who have weak reading or writing skills (Bowe, 2002). Students may also limit their contribution in the discussions because constructing a post to communicate complex concepts takes too much time (An & Frick, 2006; Hew & Hara, 2007). Without verbal cues, text-based discussions may also increase the risk of misunderstanding among discussants (Hew & Hara, 2007).

The versatile Web 2.0 technologies for collaboration, communication, and interaction provide possible technology-enhanced solutions to overcome the difficulties of online collaboration. The characteristics of easy publishing, sharing, and communication of technologies lower the technological skills required for participating in online collaboration and peer interaction (Hsu, Ching, & Grabowski, 2009). Learners can use multimedia to express ideas, share thoughts with peers by publishing artifacts on the Web, and discuss their creation synchronously or asynchronously with collaborators. The

affordances of these technologies also make online collaboration a smoother process through seamless participation and interactive multi-modal communication, which are essential for engaging learners in knowledge creation activities or peer-driven mutual learning and knowledge sharing.

2. VoiceThread

A variety of Web 2.0 technologies providing multi-modal communication channels, including text, voice, and audio, have great potential to extend and foster learning in online environments. For example, VoiceThread, featuring text, audio and video comment sharing, can add authenticity and smooth the asynchronous online communication and collaboration processes. It allows collaborators to make audio or video presentations, and to comment on individual or group video clips, images (e.g., flow charts and concept maps) through text, audio files, video, and drawings. With the assistance of these multimedia artifacts, learners can build and refine individual as well as group understanding of the learning materials (Hsu, Ching, & Grabowski, 2014). Because of the multimedia capacity, online collaboration using VoiceThread enables learners to see and hear their collaborators and helps make the collaboration process more engaging by emulating the face-to-face interaction.

VoiceThread has been used with learners in higher education for different types of learning. For example, McCormack (2010) explored how to use VoiceThread to help 25 pre-service teachers reflect in-depth on shared learning experiences and found that the development and implementation of VoiceThread assignments increased pre-service teachers' reflective response, engagement, and Web technology literacy. Chan and Pallapu (2012) studied undergraduates' attitudes toward using VoiceThread in a business policy course. Among the 22 participants, 64 percent would like to use VoiceThread for future learning activities, and 74 percent would like to recommend VoiceThread to their peers for delivering presentations. Augustsson (2010) investigated collaborative social interaction when using VoiceThread in a university course. He found that the use of VoiceThread supported the collaboration processes because it revealed students' individual efforts, allowed the creation of "task ownership" for students, and strengthened students' identification with the group. Kidd (2012) examined the effect of using VoiceThread as the primary means of content delivery in a graduate course. She found that graduate students liked using VoiceThread and considered it beneficial for learning course content and creating connections with peers and the instructor. Kidd (2013) also found that using VoiceThread to deliver course content promoted teacher presence in her online course. Together, previous research seems to suggest that VoiceThread has great potential for motivating and engaging learners in higher education, fostering higher-order thinking, and supporting collaboration processes. However, little research has been conducted to investigate how VoiceThread can aid collaboration in an online environment.

This current study examined graduate students' experiences of using VoiceThread for a collaborative activity in an entirely online course. It is our goal to understand and evaluate students' perceptions of using multi-modal communication for collaboration and knowledge sharing in an online environment.

3. Theoretical framework for collaborative learning using VoiceThread

Synthesizing socio-cultural theory (Vygotsky, 1978), distributed cognition (Pea, 1993; Bell & Winn, 2000) and situated cognition (Brown, Collins, & Duguid, 1989; Lave, 1988), Ching and Hsu (2011) developed a framework to guide the design of collaborative activities enabled by Web 2.0 technologies (See Fig. 1 for the graphic representation of the framework). A collaborative activity using Web 2.0 technologies would engage learners in representing and organizing their knowledge for knowledge construction, and in actively interacting with other people using available tools in an authentic and meaningful environment.

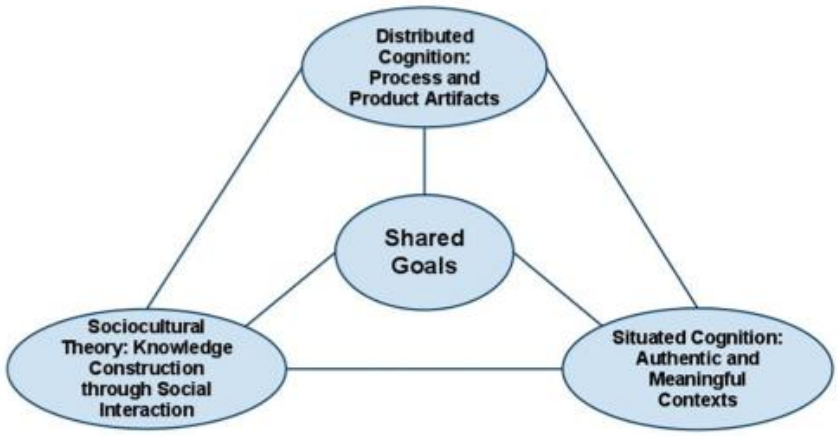

Fig. 1. A synthesized framework for Web 2.0 activity design and assessment (Ching & Hsu, 2011)

Based on this framework, the synergy of technological and pedagogical affordance of VoiceThread makes it a powerful tool with great potential to enhance collaborative learning activities. For example: 1) VoiceThread not only supports social and interpersonal interactions through their interactive affordance/functionality (e.g., commenting function), but also supports the use of a powerful mediation tool - language in various formats (text/audio/video); 2) VoiceThread can serve as the host of the distributed cognition of collaborative individuals and groups by recording the individually or collaboratively created artifacts; 3) VoiceThread provides an environment to build authentic learning contexts in which learners engage in collaborative knowledge construction through situated participation.

Considering its pedagogical affordance, VoiceThread may assist the collaborative learning process by allowing learners to provide formative feedback on peer work prior to formal assessment, as it gives users the capability of posting asynchronous written/audio/video comments (Burden & Atkinson, 2008). Peer feedback refers to a communication process through which learners discuss the strengths and weaknesses of peers' work with the purpose of improving learning and performance (Falchikov, 1996; Liu & Carless, 2006), and can be considered a form of collaborative learning (Gielen, Peeters, Dochy, Onghena, & Struyven, 2010). Peer feedback is mostly formative in nature with no grades involved. When students mutually provide feedback, they participate in collaborative learning where they construct their knowledge through social exchange (Gunawardena, Lowe, Constance, & Anderson, 1997) during the process of providing and receiving feedback. Using audio and video comments, learners may feel

more engaged in the discussions and provide more frequent and useful feedback to their peers, which in turn, facilitates and deepens learning.

4. Audio/Video-based discussion

One powerful feature of VoiceThread that is particularly promising to aid online collaboration is its capability for audio or video-based discussion. Audio-based asynchronous discussion has been suggested to have the potential to enhance discussion in a more coherent and understandable way because audio can reveal the nuance of spoken language that can be missing in text-based discussion (Girasoli & Hannafin, 2008). Hew and Cheung (2013) conducted a study exploring Asian post-secondary students' perceptions of audio-based discussion and identified six perceived affordances compared to text-based discussions. For example, they found audio discussion permits participants to be more expressive, to detect emotions and understand someone better. It also provides a more realistic environment that encourages participation and affords spontaneity that ensures originality of ideas. Interestingly, students reported that they actually preferred to use text discussion if given a choice because text-based discussion allows more time to structure responses and is more convenient to use. Students were also found to be self-conscious about how one sounded in the audio, which prevents them from choosing audio as the preferred medium. While Hew and Cheung found that students preferred text-based discussion despite the benefits of using audio-based discussion, their study context was conducted in a face-to-face learning environment where students had regular meetings with each other. In a fully online environment where there is no face-to-face interaction among students or between students and instructors, audio discussion may be particularly useful (Hew & Cheung, 2013) to create engaging learning experiences. In addition to audio-based discussion, VoiceThread also allows for video-based discussion that helps emulate face-to-face interaction and may lead to more authentic and realistic discussion experiences.

5. Research purpose and questions

This study aims to understand and evaluate graduate students' experiences of using VoiceThread for a collaborative learning activity in an online learning environment. Specifically, the study answers the following research questions:

1. How easy is it to use VoiceThread for the collaborative learning activity?
2. What do learners like or dislike about the collaborative learning activity using VoiceThread?
3. How do learners use different modes of interaction provided by VoiceThread to interact with their peers during the collaboration?
4. How do audio and video interactions impact students' engagement in the activity and connection with their peers?
5. What are learner-perceived benefits and drawbacks of VoiceThread discussions compared to those of text-based discussions on Moodle?

6. Research method

6.1. Participants and context

Participants were adult graduate students in an online master's program in a northwestern state university in the United States. Twenty of the 39 students in an online Instructional Design course participated in this study on a voluntary basis. One percent of the course grade was provided as incentive for participation. Most of the enrolled graduate students were K-12 teachers, with some college instructors, technology coordinators, and instructional designers. Forty five percent of the participants were males and 55% were females. Fifty percent of the participants aged between 41 to 60 years old. Thirty percent of the participants aged between 31 to 40 years old and 20% were 30 years old or younger.

This online course was hosted on the Moodle learning management system (LMS). Most of the students in this study were familiar with taking an online course on the Moodle LMS. The course instructor posted course materials, and made regular announcements regarding course requirements and reminders on Moodle. Every other week, students posted their assignments to and provided peer feedback for each other regarding their instructional design work in the designated discussion forums.

6.2. Materials and procedure

One of the course activities required that students participated in a collaborative learning activity that asked them to analyze an instructional design (ID) case individually, present the case analysis to the class learning community, provide peer feedback to each other, and revise one's own original analysis. Three ID cases representing scenarios in different contexts were provided and the students chose a case relevant to their professional contexts to work on. After individually analyzing the case, the students created a video presentation to showcase their analysis and posted the presentation on VoiceThread for peer feedback. Students shared the URL's to their VoiceThread presentations in a designated discussion forum on Moodle, and then used the posted URL's to review peers' presentations and made comments on their analyses on VoiceThread. Each individual was asked to provide to at least three peers constructive feedback that could help improve the case analysis. Fig. 2 shows a screenshot of the VoiceThread presentation created by a participant in this study. This presenter's avatar is on the upper left and four peer commentators provided feedback on the presentation of the case analysis. After receiving peer feedback, students modified their original written analysis accordingly and submitted it to the designated discussion forum on Moodle for grading. The whole activity took four weeks to complete.

6.3. Data collection

This mixed-method study collected quantitative and qualitative data to answer the aforementioned research questions. A survey with open-ended questions was administered one week after the end of the collaborative learning activity to solicit participants' experiences of using VoiceThread for collaborative learning, their perceived benefits using VoiceThread for collaboration, and preference of using VoiceThread for collaborative activity. The responses to the survey questions were then examined using the constant-comparative approach espoused by Lincoln and Guba (1985). We initially examined the survey responses to group similar comments into themes and then we

evaluated the fit between each student response and the theme. We then gave each theme a suitable label and selected and reported representative statements for each theme. We also examined the peer comments that participants provided to each other and tallied the numbers of comments that came in different modes (text/audio/video).

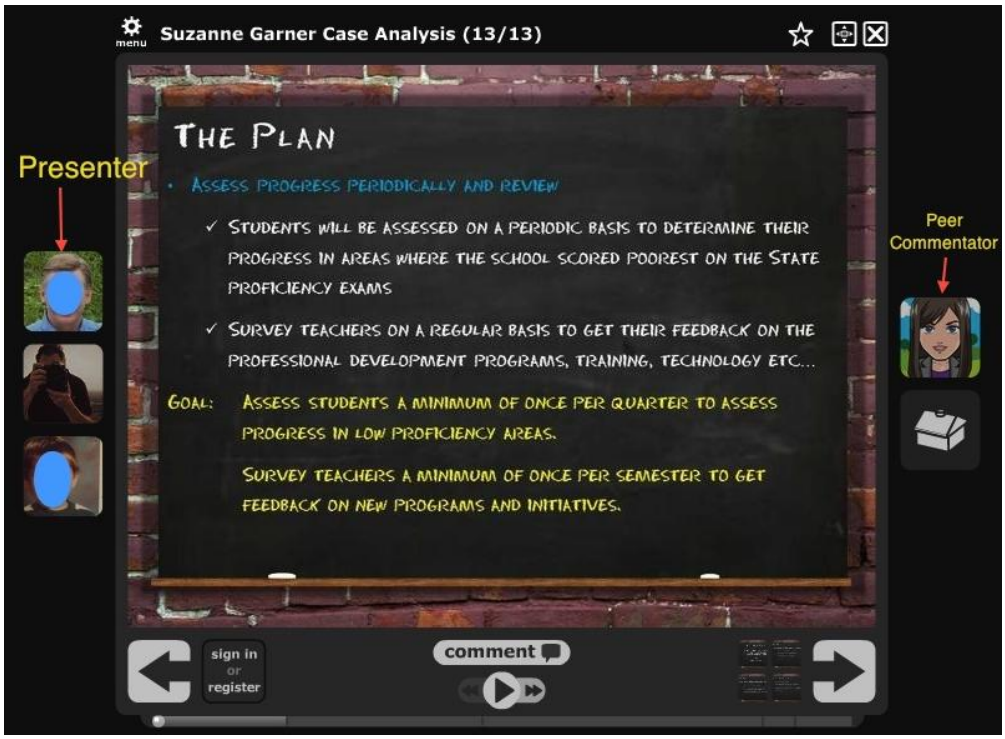

Fig. 2. An example of student collaboration on VoiceThread

7. Results and discussions

This section presents and discusses the results of the study by answering each aforementioned research question.

1) How easy is it to use VoiceThread for this collaborative learning activity?

The results showed that VoiceThread is easy to learn and to use. The data revealed that, on average, students spent one hour to learn VoiceTheard. Thirty percent of students spent less than one hour to learn it, 55% spent an hour, and 15% spent more than an hour to learn it. The average, standard deviation, and range of the time spent on learning to use VoiceThread is presented in Table 1. The responses indicated that VoiceThread is user friendly and easy to learn. This finding echoes the previous research noting that VoiceThread is an uncomplicated tool to foster learning (McCormack, 2010).

To understand how much effort students devoted to this collaborative learning activity with VoiceThread, we inquired into their time spent on different tasks. After students conducted the Instructional Design case analysis, they spent about 3 hours to create a VoiceThread presentation that showcased their analysis. It is worth noting that students could spend as little as half an hour or as many as 16.5 hours creating their

presentation. By inspecting students' VoiceThread presentation, we found that the length and quality of presentations varied to a great extent. The PowerPoint presentation pages on VoiceThread range from 5 to 27 pages (M = 9.95 pages; SD = 5.34 pages). This may offer an explanation for the wide range of time participants spent on creating the VoiceThread presentations.

When asked about the time spent on collaborating with peers on VoiceThread, students, on average spent 1.89 hours (SD = 1.33) to provide peer feedback. The reported collaboration time ranges from 0.3 to 5.5 hours. Through examining students' responses on VoiceThread, we found that some students commented on every presentation page of their peers' presentation with constructive feedback and suggestions, while others only made a one-time comment for the entire presentation with very general comments. The extent to which the feedback is provided may account for the wide range of the time spent on collaboration. As this collaborative learning activity using VoiceThread was designed to be accomplished in about 9 to 12 hours, overall, the data revealed that most of students spent a reasonable amount of time on this activity.

Table 1
Time spent on using VoiceThread for the collaborative learning activity

Time Spent	Mean (Hours)	Standard Deviation (Hours)	Range (Hours)
Learning to use VoiceThread	1.01	.65	.2 to 2.5
Creating VoiceThread presentation	2.98	3.49	.5 to 16.5
Providing peer feedback on VoiceThread	1.89	1.33	.3 to 5.5

2) What do learners like or dislike about the collaborative learning activity using VoiceThread?

Participants were asked to share their opinions about this learning activity. Since comments were openly solicited, one participant could list multiple comments about the learning activity. Table 2 provides a list of the aspects that students liked about the activity, the percentage of students mentioning the particular aspect, and some sample responses.

Overall, students responded very positively regarding what they liked about this collaborative activity. Eighty-five percent of students responded with aspects they liked about the activity. One student specifically commented that "This has been my favorite activity so far in class…this project really brought the process to life and brought the pieces of the puzzle together for me. I wish there were more projects like these." After categorizing the responses, the most frequently mentioned aspect (25%) is that the collaborative activity using VoiceThread connected participants to their peers through audios and videos. For example, student A commented that the activity helped "connect with other students in new way through voice." Student J explained that the activity helped "put a voice to some of my peers." Student M stated that being able to "hear my

classmates work without having to read it. It felt more real." Being able to hear and see peers is usually lacking in an online course where students mostly rely on texts to communicate thoughts and emotions. As such, participants especially appreciate the opportunities to interact with peers through audios and videos. The other frequently mentioned aspects included "be able to express ideas without writing a paper," "give direct feedback on certain aspects of the presentation by responding to individual slide," and "have control over the tool for recording or playing video." Each of these aspects was mentioned by 20 percent of the participants. Because this Instructional Design course is a writing-intensive course, being able to express ideas using multimedia in addition to text, gives students choices and variations that may help enrich learners' interaction experiences.

VoiceThread, as a collaborative tool, provides several great features that help make the collaborative process easier. For example, it gives users the control to make comments on a specific point of the presentation so the comments can be more directed and useful. In addition, users could record their audio on VoiceThread or using other recording tools and then uploading the resulting audio to VoiceThread. It is these features that make the collaborative process easier and less unwieldy for learners.

Table 2
Aspects that students liked about the activity

Aspects	Percentage of students mentioning this aspect	Sample Responses
Connect with other students through audio and video.	25%	The ability to actually hear the comments of peers rather than just reading it in discussion forums brought that face to face element in online collaboration. I enjoyed the interactive nature of the project.
Be able to express ideas without writing a paper.	20%	I really liked the option of simply explaining my analysis as opposed to having to write another paper to turn in.
Give direct feedback on certain aspects of the presentation by responding to individual slide.	20%	I liked the ability to specifically insert comments at any particular point during the conversation to maintain the flow of thought.
Have control over the tool for recording or playing video.	20%	You don't have to record your narration all at once. You can analyze and record one slide at a time.

Among the 20 participants, only three (15%) identified the areas they disliked about the collaborative activity using VoiceThread. One stated that he found the experience intimidating because he was shy and did not like to speak publically. Creating a public presentation took him additional time. He explained, "I had to do multiple "takes" until I finally felt ok with my presentation…having to do VoiceThread I probably

spent 1.5-2 additional hours just doing the presentation." Being self-conscious about one's audio presentation was found to be a reason that prevents learners from using audio-based discussion (Hew & Cheung. 2013). Another student commented on the technical aspect of VoiceThread and said that "the controls for making the VoiceThread public need to be more obvious," and another student explained that the voice response made receiving feedback and the revision process more cumbersome than did the text response.

3) How do learners use different modes of interaction provided by VoiceThread to interact with their peers during collaboration?

VoiceThread allows for different modes of interaction, including text, audio, and video. Among all the participants, 19 of them interacted with peers on VoiceThread and one participant viewed the presentations on VoiceThread but only provided his feedback in the designated discussion forum on the course LMS. Among the 19 participants who participated in the activity on VoiceThread, more than half of them interacted with peers using audio, followed by text and then by video. The fact that almost 70 percent of messages posted on VoiceThread were in audio or video formats (See Table 3) supports the learner-reported finding that they appreciated VoiceThread helping them connect with others through audio and video (See Table 2). Interestingly, all individual participants consistently used the same mode to interact with their peers. This could suggest that when learners are comfortable using a particular mode of interaction, they tend to stick with it.

Table 3
The percentage of students using different interaction modes on VoiceThread

Mode of interaction on VoiceThread	Text	Audio	Video
Percentage	32%	53%	16%

As VoiceThread allows for providing feedback at different points of the presentation, some students took advantage of this feature and provided immediate and specific feedback at different points in the presentation. Sixty percent of the participants provided feedback at multiple points in the presentation, while 35% of the participants only provided feedback at one point in the presentation, usually at the very beginning or at the very end. The reason why some participants did not take the advantage of providing feedback at the specific points in the presentation is unknown. Future research may want to explore this further.

4) How do audio and video interactions impact student's engagement in the activity and connection with peers?

Based on the survey responses, 80 percent of the participants provided feedback to only 3 peers as required. They did not invest additional effort on collaborating with more peers. This finding seems to suggest that being able to interact using audio or video does not promote student participation in the collaborative activity beyond the requirement. This result does not agree with the finding by Kidd (2012) that graduate students posted many more responses to the instructor's lecture on VoiceThread than the required two posts. However, in Kidd's (2012) study, VoiceThread was used as a content delivery tool where students responded to the instructor lecture whereas VoiceThread was used for

collaboration with peers in this current study. Based on the number of posts made by the participants, we cannot conclude that audio and video interactions have an impact on increasing student engagement. However, it should be noted that most of these participants are working adults who usually do not have the privilege of time to engage beyond the course requirement.

Fifty percent of the students felt they were more connected to other learners because they were able to interact with peers with different modality. Hearing others' voice or seeing others' faces made learners feel more connected with their peers, which aligned with findings from previous studies (Kidd, 2012, 2013). Participant X and Y in this study made the following comments respectively.

> *"Personality is portrayed well through the voice—it helped me to connect with them on a more human level than in Moodle."*

> *"it was nice to receive feedback on certain slides and information provided and by seeing the Avatar used for the feedback, it creates more of a connection, especially when voice is used."*

On the other hand, twenty five percent of the students did not feel they became more connected with their peers after this collaborative learning activity. This could be due to several reasons. For one, learners have already participated in the course discussions on Moodle every other week throughout the semester. So these learners probably felt they were already connected to the peers and this activity did not make them more connected. One learner stated that "I don't feel that this made me any "closer" to my peers than I was before the activity." Two learners stated that there was no real conversation in addition to the peer feedback and therefore, they did not feel there were connections. Being able to hear and see other peers did not help building the connections for some learners. One learner felt the experience is about the same as commenting in discussion modules. Still, one person noted that she did not want to connect with her peers all that much due to other commitments in her life.

5) What are learner-perceived benefits and drawbacks of VoiceThread discussions compared to text-based discussions on Moodle?

The results pertaining to the perceived benefits and drawbacks of VoiceThread discussions compared to text-based discussions on Moodle are summarized in Table 4. The perceived benefits of VoiceThread discussions echo some of the aspects students liked about the collaborative learning activity using VoiceThread (See Table 2). The most mentioned benefit exemplifies VoiceThread's affordance that enables learners to communicate emotion, personality, and other non-verbal cues conducive to better understanding and interpretation of meanings. Some learners believed that audio/video discussions saved them time because they could speak faster than they could type.

One drawback of VoiceThread discussions is that the discussions on VoiceThread are not collected in one place. Learners were instructed to post the URL to their VoiceThread presentation in a discussion forum on the Moodle LMS to share with their peers. To visit peers' presentations, learners need to exit the LMS and make comments on VoiceThread. It can be difficult to track one's own comments or take several clicks to revisit one's own comments.

While some learners believed VoiceThread discussions saved them time, other learners perceived discussions in the audio/video mode as more labor intensive and time consuming when listening and watching responses on VoiceThread. This perspective was also revealed in the previous study that using VoiceThread can be time-intensive for

learners (McCormack, 2010). Learners' working habits and cognitive styles may account for learners' preference of audio/video discussion. Some learners prefer to provide their immediate thoughts by making audio/video comments on the fly. However, other learners prefer to contemplate and structure their ideas prior to making their ideas public. As such, they may create a draft before making audio/video comments, which takes more time to complete.

Table 4
Benefits and drawbacks of VoiceThread discussions compared to text-based discussions

Benefits	Percentage of students mentioning this benefits	Sample Responses
Hearing the voice gives the discussion personal touch, makes it easier to communicate emotion, and helps interpret meanings accurately.	40%	The threads can communicate emotion, personality, hesitation, and certainty far better than text-based discussions. They feel more authentic and are easier to interpret.
Be able to use multimedia for expressing ideas.	15%	Having different choices on how you want to share your discussions as a positive.
Be able to provide feedback to a specific section of work.	10%	You can leave feedback directed to more specific parts of the work completed.
Be able to participate in the discussion more efficiently.	10%	I was able to voice my ideas and elaborate much more compared to typing. Recording things was also much faster than typing all my ideas.
Drawbacks		
Text-based discussion is more convenient for revisiting and provides more structured discussion experiences.	15%	Text is useful because we can all go back and re-read it, make corrections and so forth. It is often more structured than VoiceThread.
The discussions on VoiceThread are not collected in one place.	10%	The drawback is that not all of the VoiceThread are located in one place. I had to go to each one individually
Discussing on VoiceThread is more work intensive and listening and watching responses on VoiceThread takes more time.	10%	It takes me more time to listen and watch each person's response.
Technical issues: equipment issues, and lack of full control over one's own comments.	10%	Think carefully and then save your comments. You cannot delete your comments once saved. Only the person who is the owner of the VoiceThread can delete the comment.

When students were asked whether they prefer using VoiceThread or text-based discussion forums for collaboration, more students prefer VoiceThread to text-based discussion forums for collaboration. Table 5 below summarized the results. Forty-five percent of students preferred using VoiceThread, and 25% preferred text-based discussions. Meanwhile, some students saw the benefits of both VoiceThread and text-based discussion forums so they preferred a mix of these two tools or their preference was depending on the nature of the tasks. These findings differ from those of an earlier study concluding that more college students prefer the text-based discussions when compared to audio-based discussion (Hew & Cheung, 2013). This result also contradicted with the findings of a recent study on VoiceThread. Kidd and Beaudry (2013) found that college and graduate students have a strong preference for posting text rather than audio or video comments because these students felt making audio or video comments awkward and anxious. A possible explanation for the inconsistent results can be that the current participants are adult students pursuing their Master's degrees in an Educational Technology program who may have more experiences or skills in using multimedia tools for self-expression.

Table 5
The type of discussion students preferred

Type of discussion	Frequency	Percent
VoiceThread	9	45%
Text-based	5	25%
Both/Mix/It depends	6	30%

8. Implications, challenges, and future research

Overall, the results of this study revealed that graduate students in an online master's level course had very positive experiences toward using VoiceThread for collaborative learning and knowledge sharing. As such, we would recommend that educators and instructional designers in higher education consider incorporating VoiceThread as a learning and collaboration tool in their online courses to provide multi-modal interaction opportunities that aid learners to communicate emotion, personality, and other non-verbal cues conducive to better understanding and interpretation of meanings when collaborating online.

Despite the mostly positive perceptions of participants on collaborative learning using VoiceThread, several challenges emerged for using VoiceThread as a learning and collaboration tool. One challenge identified by the participants represents the access issue. First, the discussion on VoiceThread is not embedded in the course learning management system. Students had to switch from the LMS to VoiceThread when they were working on this collaborative learning activity. They had to use specific URLs posted on the LMS to locate, access, and watch peer's presentation and make comments. Second, the discussions on VoiceThread are not collected in one place. If participants want to view or participate in several discussion threads, they have to identify the multiple URLs in order to access the presentations and to post messages. As such, participating in the VoiceThread discussion is not as convenient compared to discussion in the LMS.

The distributed nature of the artifacts created with VoiceThread also poses challenges for course instructors when tracking student interaction and assessing learning

performance. Unlike the LMS, VoiceThread system is not able to log or track student contributions or provide a report of the summary of learner activities for the course instructor. In addition, as VoiceThread allows learners to comment on the specific point of the peer presentation, assessing learning activities on VoiceThread can be more time consuming because instructors have to go through each student presentation to locate and track peer contribution when grading. It would be more helpful for course administration if collaborative learning tools like VoiceThread could provide visual or textual reports that summarize the collaboration activities on the system.

Examining the peer comments posted on VoiceThread, infrequent "discussion" among participants indicated that participants only provided their feedback to each other but did not follow up or respond to the peer comments. As such, there were no further "interactions" or series of discussions per se. Interestingly, while many students reported that they felt more connected with their peers, the connection did not lead to further discussion or conversation. There could be several explanations to this finding. First, the course requirement asked students to provide peer feedback on other's work and did not ask students to create a series of discussion. Second, students did not feel motivated enough to carry on further discussion. Future research should explore how VoiceThread could foster other types of collaborative learning or online discussion in addition to the peer feedback activity that is explored in this study. However, it should be noted that VoiceThread does not allow for threaded discussion like a discussion forum usually does and the sequence of the discussion cannot be shown. Future research needs to explore how VoiceThread can be used effectively for a series of discussion that can display the flow of the discussion posts. In addition, future research can analyze the content of student messages posted on VoiceThread to evaluate learning outcomes or to explore whether the mode of interactions would affect the quality of the posted messages.

9. Conclusion and limitations

Collaborative learning enables participants in a learning community to externalize and share knowledge, experiences, and practice. However, collaborative learning in an online environment can be challenging due to the lack of face-to-face interaction. This current study examined twenty graduate students' experiences of using VoiceThread for a collaborative activity in an entirely online course to explore students' perception of using multi-modal communication for collaboration and knowledge sharing. The results of this study revealed that graduate students had very positive experiences toward using VoiceThread for collaborative learning. These graduate students found VoiceThread easy to learn and use. They also reported that audio and video interaction on VoiceThread connected them with their peers. More than half of the participants interacted with peers using audio, followed by text and then by video. Half of the participants felt they were more connected to peers; however, feeling more connected did not result in more participation as most of them only participated at the level to meet the course requirement. Participants identified benefits and drawbacks of using VoiceThread for collaboration as compared to using text-based discussion forums. The most mentioned benefit of using VoiceThread for collaboration exemplifies its multi-modal communicative affordance that enables learners to communicate emotion, personality, and other non-verbal cues conducive to better understanding and interpretation of meanings. About half of the participants indicated that they preferred using VoiceThread to text-based discussion forums for collaborative learning activity.

Based on the highly positive experiences of graduate students reported in this study, we would recommend that educators and instructional designers in higher education consider incorporating VoiceThread as a learning and collaboration tool in their online courses. Using such collaboration tools helps connect learners to their peers and alleviate the difficulty of communicating in an online environment because audio/video discussion can convey emotion, personality and non-verbal cue better than text-based discussion. We used rich qualitative and quantitative data to reveal adult students' perceptions of collaborative learning using VoiceThread. However, the findings of this current study should be interpreted with caution due to the limited number of participants and specific learning contexts and tasks. First, the participants of this study were students pursuing an online Master's degree in Educational Technology, who tended to be more adaptive to and appreciate new technology. Adult learners in other learning settings who are not as technology savvy may find recording their comments in audios or videos format intimidating or they may have a steep learning curve. Second, based on andragogy theory, adult learners prefer to engage in discussion topics involving solving real-life problems (Knowles, Holton, & Swanson, 2011). The discussion topics in this study were all structured around real-life instructional design problems. As such, they may be more motivated to participate in these discussion topics compared to other discussion topics that may not be as applicable to their lives or work. Future research is encouraged to replicate this study in different learning contexts with learners of different characteristics. Future studies can also use appropriate research design to rule out possible disturbance variables to yield research results that can be generalized to broader educational contexts.

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