



WERKLUND SCHOOL OF EDUCATION

# Flipped Learning Across Multiple Disciplines

Almadina Language Charter Academy

Research Brief

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## Introduction

The second year of this design-based study at Almadina Language Charter Academy focused on supporting students in elementary and junior high classes across multiple disciplines by implementing a flipped learning model. Flipped learning is defined as a pedagogical approach where learning moves from the group to individual space and there is an increase in interactivity for students through, in this case, technological applications situated across math, science, and social studies learning (Bredow et al., 2021; Mazur, 2015). As the research indicates, flipped learning can support higher degrees of engagement, increased knowledge acquisition and conceptual understanding when the pedagogical design is focused on moving from a group to a student focus (Bredow et al., 2021; Cesare et al., 2021; Griffiths et al., 2021). This level of personalization is accomplished through the use of videos that are aligned with the curriculum and program outcomes for students. Students in studies have commented on the self-pacing advantages and ability to access the video's and content when they need to and, in the timeline, they personally set (Burse & Cengelci, 2020; Muir, 2021; Zupanec et al., 2022). For example, students in a high school math study reported that the flipped learning approach developed their sense of autonomy by allowing them to work through topics and videos at their own pace (Muir, 2021). English Language Learners (ELL) reported enjoying the structure of flipped-learning courses more than those in traditional classrooms due to increased motivation, finding the flipped approach more effective, and improving their English writing skills (Graziano & Hall, 2017).

Additionally, personalization of learning can relate to independence, subject specific literacy development, collaborative learning, and facilitating learning outside of the direct classroom, in order to support student development at home as well (Camiling, 2017; Jong et al., 2019; Lo, 2017; Mischel, 2019; Ofgang, 2021a; 2021b). Moreover, the role of student agency and regulation in relation to choose completion of work in the flipped classroom context, and agency around the learning are key facets of the student lens in this type of instructional method (Sun et al., 2018). In the classroom or small group context, peer to peer collaboration, and the data obtained through flipping the learning can provide key inputs for just in time support or instructional adaptation to support subject area conceptualization (Mazur et al., 2015; Zou & Xie, 2019). An extension to the peer-to-peer collaboration in the context of group work has a positive correlation in the flipped literature to engagement and inspiration of learning (Griffiths et al., 2021; Hao, 2016; Jong et al., 2019; Lo, 2017).

From an educator perspective, in many studies, teachers share that flipped learning helps develop relationships with students in the learning environment due to the extra time provided as students have already engaged in the pre-learning (Aidinopoulou & Sampson, 2017; Griffiths et al., 2021; Muir, 2021). From an assessment lens, the formative feedback embedded in many flipped learning applications used such as in this study, Ed Puzzle, provides an opportunity for real time feedback and context for how students are engaging in the pre-learning (Wei et al., 2020). Many teachers also observed the shifting of responsibilities from the teacher to the student and a level of increased ownership that flipped learning can afford in the learning

environment (Burse & Cengelci, 2020; Chao et al., 2016). From a student engagement lens, many teachers saw a prevalence of more high achieving students taking the opportunity to rewatch videos which is a benefit to more personalized flipped learning practices (Burse & Cengelci, 2020, Jong et al., 2019). The flipped learning approach also aided students to transition from passive to more active learning. The approach allowed for class time to be used more efficiently, which meant that there was increased time for students to actively engage in knowledge building (Aidinopoulou & Sampson, 2017; Chao et al., 2015). Teachers interviewed in a study using flipped learning in science found the resources can afford enrichment for students who want to deepen their learning (Camiling, 2017). Teachers provided a resource in another math based study, whereby students were given a weekly “roadmap” of all the readings, videos and questions for each topic (Muir, 2021).

Flipped learning is still a burgeoning concept and many schools during times of emergency remote learning have taken up elements of flipped learning within the frame of online or blended learning models. More formal flipped learning is defined as a pedagogical approach that integrates technology into student learning (Bredow et al., 2021). The definition of flipped classroom used for this study is (1) the use of audio-video materials for students’ class preparation as out-of-class activities, followed by (2) regular in-class activities that build on audio-video materials (Lo & Hew, 2017). Within this context, this design-based study used EdPuzzle videos in Google Classroom to support student learning prior to class based activities. In grade 4, 6, 7 and 9, students were encouraged to watch the video content outside of class time and in most cases respond to questions in checkpoints embedded in the video as a way to attain introductory or midpoint knowledge of the material and to self-check understanding of processes for lab based learning. This ‘at home’ or ‘out of class time’ support and approach was used to help equalize the learning by harnessing technological applications such as EdPuzzle to mitigate initial discipline specific conception and process learning (i.e., lab) challenges, increase disciplinary literacy, and serve to help students that may not have the parent or guardian resources at home (Shelby & Fralish, 2021).

### KEY IDEAS IN THE LITERATURE

- Studies show an increase to engagement and motivation when using a flipped classroom approach across disciplines
- Flipped learning approach aids students to transition from passive to more active learning and have greater agency in their learning
- Video length and quality is an important element of the flipped classroom approach (teacher voice included and using language understandable to students)
- ELL students appreciated the flipped model more than traditional approaches and were able to develop greater relationships within small groups
- Instructional design from the pre-learning to the in class activities are essential considerations when using a flipped learning model as it relates to real-time feedback outside of class time, personalization of learning, and enrichment opportunities

## Background

Almadina Language Charter Academy has a unique emphasis on meeting the needs of English language learners (ELL) and has a commitment to conducting research in the school. This study is an extension of the previous year's pilot in math classes and was designed as a research partnership project and a collaboration among researchers from the Werklund School of Education at the University of Calgary and practitioners from Almadina Language Charter Academy including learning coaches and teachers. The focus of the research was to engage and support students in science, math, and social studies classes in the elementary and junior high campuses in using flipped learning. Over these two years, the application of a flipped learning model has been timely given it has occurred during the COVID-19 pandemic and considered to be a good choice as a medium to support students at home as well as in the classroom.

Additionally, this year, teachers indicated there were constraints that existed at home for students to attain help in learning in various subject areas outside of the regular school hours. As a result, embedding a flipped learning model with the primary use of videos for previewing discipline-based concepts prior to the classroom instruction and activities were the primary approaches for the second year of this study.

The Ed Puzzle platform provided students with opportunities to rewatch any sections of a video multiple times if they needed this support. The research was affirmed by educators as well related to multiple ways of representing the learning whether through video, activities, in class delivery, and extended opportunities for learning with relation to multi-modal approaches. Given this background, the study focused on exploring the perceptions of teachers and students when using a flipped learning approach to teaching and learning across multiple disciplines. In both years, other areas explored through this study included:

- Benefits of flipped learning
- How flipped learning supported learner responsibility and agency
- How flipped learning supported learners in strengthening questioning skills to clarify their understanding of key concepts
- Challenges of flipped learning (e.g., accessibility- close caption)
- Changes that took place in the classroom when flipped learning was used as an instructional approach (e.g., student confidence)
- How data analytics from videos can inform instructional designs across disciplines

## Purpose

The purpose of this study was to explore how a technology-enhanced pedagogy, such as a flipped classroom intervention, can support students across multiple disciplines.

## Executive Summary

This design-based research project explored how technology enhanced pedagogy, such as flipped learning, can support students across multiple disciplines. The data collection methods included teacher reflections, student surveys, and video analytics from the EdPuzzle online application. Five teachers were invited to reflect on a series of prompts from the inception of flipped learning to the end of the year. Six classes participated in the study, which were comprised of a grade 4 math class and junior high math, science and social studies classes. Overall, 174 student surveys were completed, with parent consent and student assent given for 78 students. Through this data, themes around the initial research intentions of course satisfaction, active learning, and willingness to communicate were transcribed to reflect literature based themes which included student engagement as a result of the flipped learning model, student agency within flipped learning, and the utility of the video themselves. We utilized aggregate data to represent the results.

## Key Findings

### *Student Engagement with Flipped Learning Model*

- Small-group discussions were helpful for students, as they felt more comfortable sharing their ideas in these situations compared to whole-class discussions
- Disciplinary literacy was supported in the videos for each content area
- Students benefited from front-loaded supports embedded in the videos, as well as follow-up from their teachers
- Teachers emphasized the importance of students establishing ownership of the flipped learning process as early as possible to encourage student agency and shared accountability
- As complexity of content increased, students watched and rewatched more readily; this was especially evident in high-achieving students who further leveraged the videos and asked for a reset to retake embedded checkpoint questions
- By engaging with flipped learning, students felt more prepared coming to class
- Teachers expressed that multimodal approaches to teaching and learning enriched overall student learning experience

### *Perception of the Videos*

- Video content and approach is important to student utility—teacher created videos were appreciated as well as shorter videos with animation.
- Watching multiple times resulted in higher confidence of understanding related to complex areas
- Completion rates at times varied due to perhaps previous knowledge or level of complexity
- As teachers indicated, the videos helped students that had limited support at home and this was reflected in the student feedback as well
- Videos can help students understand initial concepts across any discipline
- Students' abilities to watch the videos and complete associated tasks varied; however, the alignment of the teaching design and outcomes may have mitigated against distractions.

### *Student Agency*

- Student confidence in math, science and social studies was a determinant of student engagement for students in this study as shared within the student surveys and teacher reflections
- Building trust with students for taking responsibility for pre-learning from teachers to students was essential
- Flipped learning approaches offered accountability for both teachers and students
- Ownership of the flipped learning happened once students understood why Edpuzzle was being used
- Even though some videos did not have corresponding questions, students took the time to watch the sections to gain a better understanding

### **Qualitative Results**

Within the study, teachers were asked to reflect on their application of flipped learning throughout the year in their disciplinary areas. The reflection parameters included how the model was working, what were some of the constraints and benefits, observations on student engagement as well as any other key considerations the teachers had as it pertained to implementing this approach in the classroom. Below is a visual representation of the themes and concepts using the application, Tableau pointing to the lens of the teachers at a 5:1 scale of frequency the words or themes occurred within the teacher reflections.

**Figure 1**

*Teacher Reflection: Thematic Representation for Flipped Learning*



*Note.* Tableau representation of teacher reflections at a 5:1 scale.

## *Themes*

The reflections in the above figure represent 26 themes that arose during interviews with teachers during this year's study. These indicate teachers' considerations as they integrated flipped learning into disciplinary areas which included math, science, and social studies. These themes were representative of conceptions discussed in the teacher reflections and then distilled with an application to highlight a visual representation. Facets such as engagement, personalization, accessibility for the learning in an online capacity and represented in different ways, equity of access in relation to the technology, multimodality, and student-centered methods were highlighted frequently by the teachers. Interestingly, the degree to which students watched the videos, completed the formative assessments, and rewatched sections reflected greater personalization as teachers observed students taking ownership of their learning. Additionally, the design of the method highlighted a more student-centered pedagogy which teachers relied on to ensure students were prepared for in-class content; for example, this was seen in the science classes in relation to lab based activities and centers. Furthermore, teachers expressed that examining data on EdPuzzle helped them discern deficiencies or areas of struggle for specific students, which enabled them to be more inclusive during class time by making any necessary accommodations.

Agency in the learning process and confidence were effective ways in which flipped learning and technology enhanced methods supported students at multiple learning entry points. Teachers shared that students clearly connected with the video content and the pre-learning supported increased confidence in class activities. Additionally, all the teachers indicated that flipped learning provided more in class time to engage with groups, one on one supports, and extended the learning in an inquiry-based way (i.e., creative and innovative planning and approaches), which ultimately made students more excited to learn the content. A teacher shared for math that when complexity of the learning increases, the frequency of rewatching the video content also increases. Another teacher exclaimed, there was a positive relationship in science for the difficulty and time used in watching the video and revisiting sections as in the rotation versus basic angles; students rewatched more as concepts increased in difficulty, illustrating that the flipped learning model is helpful for students, especially when content becomes more complex.

Formative assessment built into the videos helped inform teachers about what methods to use for the in class activities to support learning and how the lesson could be extended within the context of the learning sequence. For example, the teachers shared that in the science classes, students were able to engage in the processes of lab assignments when viewing the videos and answering questions to open space for deeper learning and increased analysis and comprehension of the content during class time. One teacher said that students are making connections more readily in class when they engaged with flipped learning beforehand. In the social studies class, the teacher used her understanding of the challenges students felt in the previous year to inform the videos' chosen as well as discussion areas embedded within the class activities. The teachers' reflections inculcated the elements of pedagogy across all of the disciplines in this study (i.e., math, science, and social studies) as well as in relation to how



students engaged in their learning in general. Although classes were in-person during this year's study, teachers still expressed struggling with circumstances pertaining to the COVID-19 pandemic. Multiple teachers discussed that, without these precipitating factors, there would have been more opportunities to create routines surrounding flipped learning, which they felt would be beneficial to students and overall participation efforts.

## **Quantitative Results**

For our quantitative results, the student data was obtained and analyzed by utilizing the EdPuzzle's learning analytics feature. As such, areas that were the focal point included number of assignments completed, number of sections rewatched, percentage of video watched, and the overall time spent watching each video. Time, unit content, and previous knowledge all seemingly influenced the ways in which students engaged in the pre-learning videos. Parent consent and student assent was given for 78 students, and as such, quantitative data analysis is based only on these students.

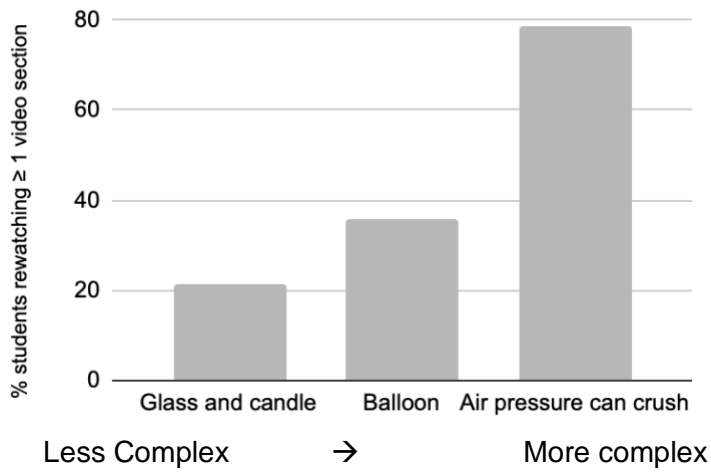
On average across the disciplines, assignment completion rates for all classes reflected 81.7% completion across ten assignments. In some classes the minimum completion was close to 60% with a maximum of 100% completion rate for some videos and accompanying quizzes. There was less fluctuation (still existed) throughout the academic year in terms of student participation and engagement in the flipped learning process. It is important to note the different rates of completion could possibly be due to the way the EdPuzzle videos were used in classes and different units. In some units the videos were assigned and, in some units, they were optional and not required.

Additionally, video usage was observed to increase slightly as the year progressed (possibly due to increased student comfort level with the process). Looking at the opportunity to replay, the sections of videos watched multiple times generally reflected higher results on assessments. Moreover, although multiple video sections did not have an associated assessment question to test student progress, many students still took the time to view and review those sections more than once, presumably intending to increase their understanding or confidence level in the topic being introduced prior to participating in the subsequent in-class learning activities. The latter is a powerful example of the students' commitment to advancing their learning independently.

In math and science, teachers engaged in content-based and lab-based pre-learning and the findings showed that students engagement with EdPuzzle videos was a function of topic complexity. The percentage of students rewatching video sections increased with increasingly complex concepts. In the "Air and Aerodynamics" science unit, student engagement increased as lessons on EdPuzzle became more complex as shown in Figure 2.

**Figure 2**

*Percent of students rewatching sections of science experiment videos*

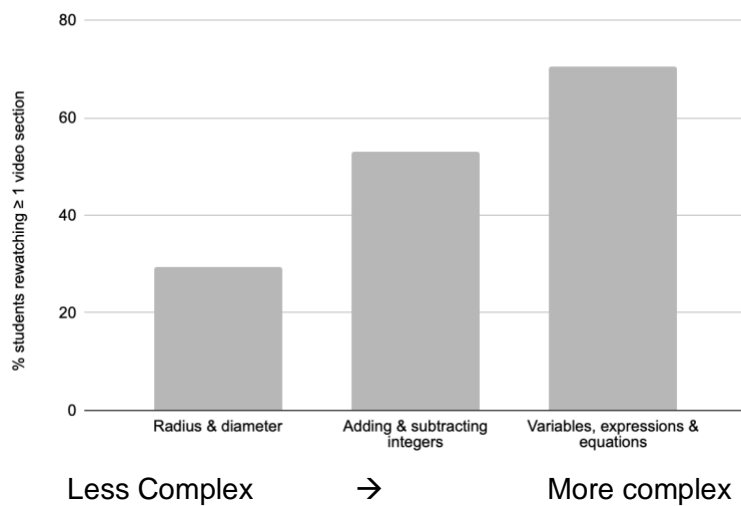


*Note.* Students assenting to sharing video analytics data (n = 14)

Similarly, in math, there was an increase of students rewatching more than one video section when transitioning from less complex to more complex topics as shown in Figure 3.

**Figure 3**

*Percent of students rewatching video sections versus concept complexity in math*



*Note.* Students assenting to sharing video analytics data (n = 15)

It was evident that students exhibited more rewatching when concepts became increasingly challenging, which can be seen in both math and science. In our analysis, we examined a variety of activities on EdPuzzle for math, science whereby skill development encased in content understanding was more applicable and range in complexity. In subjects such as social studies, content, understanding, and recall were prioritized in the pre-learning process. Thus, as the difficulty of mathematical and scientific processes or concepts increased, students more readily used the videos and activities on EdPuzzle to support their learning. Furthermore, student engagement was higher when teachers prescribed newer concepts in EdPuzzle as opposed to videos and activities that were dedicated to reviewing previous knowledge.

## **Student Survey Analysis**

Another data set was gathered through a student survey. The student survey consisted of 16 questions that was electronically administered to all grade seven and nine students as a class activity. One hundred and seventy four (174) valid surveys were completed and returned. Based on the comparative analysis between video analytics and aggregate / individual student survey data the questions posed to students were grouped into three major themes:

- Student engagement with the flipped learning model
- Students' perception of how watching videos using EdPuzzle impacted their learning
- Student agency

### *Student engagement with the flipped learning model*

The majority of the students surveyed across disciplines (i.e., math, science, and social studies) indicated the flipped learning model supported their learning processes in particular to pre-learning. There were 90.9% of students who were satisfied with the flipped learning approach and 86.4% of students were in support of video usage to help improve their understanding in varying subject areas. There was a proportion of students (< 20%) who would have appreciated videos which were more contemporary and had further step by step processes but overall, students were satisfied with the approach. The vast majority of students self-reported that they were satisfied with the flipped learning approach, with only 9.1% saying they were not satisfied (Survey, Question 5). In multiple student survey anecdotal responses, students shared that when teachers made their own videos, satisfaction levels increased.

### *Students' perception of how watching videos using EdPuzzle impacted their learning.*

The students across the disciplinary areas of science, math, and social studies in the study indicated that the video usage, content, and ability to rewatch all helped them come to class prepared with questions whether for teacher to student engagement or within small groups. The ability to review concepts in EdPuzzle prior to in-class activities was helpful as an instructional method and provided more time for teachers to work individually with students who needed support. In summary, as an aggregate and in relation to the theme of video use in flipped learning, 86.4% of students indicated the videos were easy to understand and were beneficial to

their learning. In science class, 95.45% of students indicated they appreciated viewing sections of the video more than once. Students felt the topics presented in the videos when created by the teacher helped support greater interest due to the alignment of the content areas. A reality for many teachers using flipped learning, can be that making videos takes time; however, a consideration of using stock video offerings and a mix of teacher created videos can also be very beneficial as indicated in this research.

### *Student agency*

Students' self-reported level of engagement with EdPuzzle videos seemed to have been reflected by their own individual perception of the quality and entertainment value of the specific video introducing the math concept. Most students in math and science classes indicated that watching introductory videos on topics which would be engaged with in classes helped to inform the follow-up questions they would come to class prepared to ask. Students indicated a mix of preference in answering teacher driven questions but more willing to ask their peers questions. There is also a representation of a strong preference to collaborate in small groups or paired with peers for in-class activities with a much greater comfort level than with full-class discussion.

### *Student confidence in small group participation*

According to student survey responses, the flipped learning approach resulted in students asking their teachers and peers more questions about concepts they were learning, and also answering more questions. The majority of students felt they were coming to class more prepared and with questions in mind. They were able to engage at their own pace, understand the pre-learning by having multiple opportunities to rewatch videos, and were able to redo sections on the assigned questions. Additionally, the content given gave further context to the learning and informed student inquiry more readily as the students were able to use their pre-learning and engage in for example post lab discussions. Based on the survey results and anecdotal responses from students, flipped learning methods supported increased collaboration within class activities.

#### **Participant Quotes**

- *"I think this was an easy way to know what experiments we are gonna do in class it helps me to understand what we will be learning."*
- *"The flip is really useful to me I understand much more when I am watching the videos."*
- *"It helps with my learning and makes me come to school more prepared. Also, it is very interesting and fun!"*
- *"I am able to focus more when I watch videos and when I can rewatch them."*
- *"It is helpful and is even better when it's not that long" (related to video length)*

## Research Implications

- Choice of video length, content, depth of formative questions, and variation in number of videos per unit impacted student engagement.
- Relative difference in number of video's chosen per unit across subject areas.
  - Depth of learning and teacher scaffolding resulted in variance
- Teacher planning for in class activities supported progression in the program of studies
- Awareness of platform and ease of use influenced familiarity and integration fluency
- Videos in the initial sections of the unit focused on disciplinary literacy which included introduction to vocabulary and key concepts which helped provide richer pre-learning for students
- ELL students benefited from teacher using vocabulary and highlighting key concepts in the videos, as well as their teacher reviewing the Ed Puzzle platform
- Most units taught across the disciplines embedded ample opportunities for meaningful formative feedback which was used within the in-class learning
- Willingness of students to ask questions and discuss with the teacher depended on level of difficulty, understanding of the pre-learning, and amount of time dedicated for small group questioning periods
- Due to increased comfortability, more participants were willing to engage in paired discussion or small group approaches when they could collaborate, share, and discuss ideas
- More time in class to support students through and engage in high level thinking exercises (i.e., inquiry)
- Students that experienced challenges with engagement benefited from 1:1 support and receiving help to identify areas of growth in the content
- Relationship between difficulty of videos and students rewatching and leveraging the platform Ed Puzzle
- Students are more willing to engage with flipped learning when videos are not limited to reviewing prior concepts (especially if the title has "Review" in it)

## Research Partnership Lessons Learned

- In disciplines where skill development is articulated in accompaniment with content, the video usage helped support process learning (i.e., lab skills) more readily.
- A student strong in a disciplinary area may find their own agency to obtain desired learning outcomes using strategies outside the flipped learning method
- Teachers were afforded more opportunities to engage with students during class time
- Instructional design of the flipped learning approach extended from the planning and choices of the videos to the in-class activities, to the showcase of learning in the assessments
- The data analytics provided information for teachers to ascertain student engagement, areas of challenge, and areas for creating scaffolding opportunities.

- The digital tool (Ed Puzzle) afforded the ability to use formative assessment to inform the in-class approaches to learning.
- Flipped learning provided a consistent and adaptive approach.
- Transparency of the benefits of flipped learning from a student and teacher lens were integral to applying this method with success not only from the application of online tools but how this related to the in-class processes or design.
- Teachers reflected on the research and literature and appreciated the positive aspects of flipped learning and benefits for student learning experience.

## **Conclusion**

In this year of the research, the findings from this university-school research partnership indicated that the majority of students felt that flipped learning supported disciplinary-specific learning processes for applying concepts and understanding introductory content. The level of satisfaction was quite high as most students felt the flipped learning process was beneficial. Given the differences between teacher-created videos and videos chosen from Ed Puzzle, both teachers and students recognized the importance of using engaging videos to spur curiosity and inform learning; however, students prefer teacher-created videos.

The flipped learning method offered an entry point for students to be introduced to preliminary concepts and helped to increase disciplinary literacy prior to the in-class work. This instructional strategy also helped to enrich and solidify the overall learning of both cognitive and analytical skills through a multimodal approach (viewing video and answering interactive online quiz questions). In this last year of the study and from the perspective of practicality and equity, teachers provided opportunities to help students with limited access to help outside of school through providing devices to sign out or giving time before school, at the noon hour, and after school to use a device and access the flipped learning content.

Throughout the study, a key area which was noted was that the percentage of time students watched and re-watched videos increased as the complexity of the topics increased opportunities to watch before school, after school, or during the noon hour in particular in science and math. Students' abilities to watch the videos and complete associated tasks varied; however, the alignment of the teaching design and outcomes is clear. It is imperative to establish students' ownership and accountability in the flipped learning process early in order to encourage student agency and shared responsibility. In context with this two years of research, even further study is recommended to apply lessons learned from this design-based study and to continue following the progression across various disciplines. This would provide greater insight with even more participants, across all disciplines, and related to technology enhanced practices for teaching and student learning.

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