Using a Design Thinking Approach for an Asynchronous Learning Platform during COVID-19

Lori Severino
Drexel University
USA

Mark Petrovich
Drexel University
USA

Samantha Mercanti-Anthony
Drexel University
USA

Samuel Fischer
Read by 4th
USA

Abstract

The COVID-19 pandemic abruptly shut down schools in an urban based school district in the Spring of 2020. As the closures persisted over months, an immediate educational need arose for online curricula that could help alleviate the learning gaps caused by the shutdown. The purpose of this study was to create a process and model for the development of a fully asynchronous online learning environment for prekindergarten through 2nd grade students that could help other districts implement similar projects. Since the turnaround time for development and implementation was a matter of weeks the project team used an iterative process to solve a "wicked problem" and identified solutions to create an improved user experience. A modified design thinking model approach was developed through the process of developing this six-week, theme based virtual curriculum that included interactivities in early literacy, writing, reading comprehension, science and math. This adjusted model includes 6 stages: discover, interpretation, ideation, experimentation, implementation, and evolution. This research focuses on the processes involved during each of the stages and the resulting use by the intended audience. The curriculum was used by over 5,800 prekindergarten through second grade students during the 6-week period of the summer of 2020. The online platform continues to be used by students presently.

Keywords: asynchronous, COVID-19, curriculum, design-thinking model, early grades

Out-of-school summer learning differences substantially account for achievement gaps related to family income levels, commonly termed as the "Summer slide" (Alexander et. al., 2007). However, recent research takes advantage of advances in vertically scaled tests to clarify that the bulk of 9th grade student achievement inequity is present in kindergarten. Therefore, summer learning, while not the source of inequity, may still be a valuable and effective strategy at remediating inequity if it is targeted at the early grades (von Hippel et al., 2018). With the surge of cases of COVID-19 and the abrupt in-person school closures in the Spring of 2020, schools began rethinking summer programming. Many policy makers approached the sudden shift to online learning, and disconnection from traditional instructional time, through the lens of summer learning loss. In the late spring of 2020, predictions about the COVID learning loss were widely publicized (Dorn, 2020). Investments in summer learning and remediation were stressed, and investments and programs followed. However, despite research that underlines the importance of early learning, many summer programs were targeted at children 3rd grade and up. This was true for a large urban school district in the Northeast United States that planned to offer an online summer learning curriculum for 3rd through 12th grades in response to the COVID-19 school closures; however, the district did not have the capacity to create virtual programming for kindergarten through 2nd grade students. The importance of early grade summer learning, exacerbated by a national pandemic, prompted the Read by 4th Campaign (a non-profit coalition of organizations and individuals, with a strategic mission of ensuring all children in their city are reading on grade level by the 4th grade) to convene its partners around the shared goal of making a self-guided PreK through 2nd-grade virtual curriculum. All activities in the developed curriculum were to be aligned with the school district's English Language Arts standards and science/social studies themes from the Spring 2020 quarter. The goals were to make up for lost learning from March through the end of the school year and strengthen the reading skills for students completing grades PreK - 2. Named "The Ultimate Summer Learning Adventure", the curriculum was made available for free to all starting June 28, 2020.

The purpose of this study was to create a process and model for the development of a fully asynchronous online learning environment for prekindergarten through 2nd grade students that could help other districts implement similar projects.

The project team consisted of both the curricular and design teams as well as representatives from the local school district, city library, and the local public television station. The curriculum team included content experts in literacy and mathematics from the local university, The Philadelphia Writing Project, Teach Plus and First Up, and their primary responsibility was to develop content for each grade level band and identify resources for curriculum lessons. The design team was made up of two instructional design specialists and one media specialist with the primary responsibility for the transformation of the curriculum team's content to an interactive web-based learning environment. Through their work together, the curriculum team and the design team realized that while much was known about the content that ought to be learned in the curriculum, there was not a large body of knowledge about the appropriate design of the website that would carry it, or the right process for realizing the work. The design team therefore took an iterative process approach to implement the online learning curriculum. This manuscript explores the design process for the Ultimate Summer Learning Adventure and the patterns of use that resulted. The authors believe it will be valuable for the field as it has valuable lessons about an iterative team design approach from process and product for early grades.

Through this rapid iterative design process, a new model for a design thinking approach to instructional design emerged. The questions below guided the work as we explored a new model that illuminates how a team-based approach, with various feedback loops, can create design that improves the virtual user experience and subsequent learning practices:

1. How did the team create this online learning platform?
2. What challenges did the team face when creating this online learning platform?
3. How did user data (from Google site) and feedback influence the design process?

Literature Review

Effects of COVID-19 on Teaching and Learning

A core finding from global education research over the past three decades has focused on the educator's impact on student learning in the classroom. Despite several variables, what teachers do in the classroom has been shown to have the largest single impact on student learning outcomes (Muijs et al., 2014). In March 2020, the COVID-19 pandemic introduced unprecedented challenges in teaching and learning from the traditional classroom format. Across the globe, educators were required to adapt to distance education as schools observed social distancing protocols and limited face-to-face interaction. This prompt transition offered little time for educators to adapt existing lesson plans, learn best-practices in distance education, or develop proficiency with now-required educational technology. Studies administered since the onset of the COVID-19 pandemic have demonstrated that teachers believe they were not prepared to teach in remote settings (DeWitt, 2020). One such survey of 908 teachers and district leaders across the US found that teachers reported spending up to 71% less time on student instruction while 87% of teachers reported an increase in the amount of time spent troubleshooting problems with technology (Herold & Yettick, 2020). As a result, teachers voiced concerns about the sudden expectations that had been asked of them (Comanducci, 2020). They were concerned with the difficulties caused by their unfamiliarity with remote teaching and learning tools as well as a lack of immediate feedback offered while in traditional face to face classrooms.

A survey of more than 12,000 teachers from South Carolina was conducted in June 2020, just 3 months after country-wide school closures in the US (Berry, 2020). While teachers reported being deeply committed to making a successful shift to remote instruction, many felt they struggled to reach their students during this period of "emergency instruction". Despite this, when presented with the reality of no high stakes testing or assessment, many teachers saw possibilities to integrate creativity, leadership, and the opportunity to cultivate engagement within students' homes. In considering key findings from remote education during COVID-19, the Education Endowment Foundation's (2020) rapid evidence assessment on remote learning found that: teaching quality is more important than how lessons are delivered; ensuring access to technology is key, particularly for disadvantaged pupils; peer interactions can provide motivation and improve learning outcomes; supporting pupils to work independently can improve learning outcomes; and different approaches to remote learning suit different tasks and types of content. While schools sought ways to adapt to the challenges of emergency remote education, educators struggled to keep students engaged with the learning opportunities they had become accustomed to in the classroom. As a result of struggles with remote education, many educators reported that students did not participate in online environments to complete assignments (DeWitt, 2020; Herold & Yettick, 2020). Dorn and colleagues (2020) suggest that this type of learning slowdown could hinder students in ways that equate up to eleven months of lost schooling when compared to traditional face-to-face modalities. Those

numbers increase to almost fourteen months of lost schooling when students do not participate in any remote instruction, depending on when face-to-face instruction resumes. To remediate the effects of emergency remote instruction, schools, educators, and researchers sought a variety of methods to approach the pandemic's new normal. New educational programs, instructional methods, and guiding frameworks emerged as a response to education during COVID-19.

Remote Learning Opportunities During the COVID-19 Pandemic

In Spring 2020, countries worldwide were presented with the necessity of emergency remote education in response to the COVID-19 global pandemic. Given the lack of preparation or planning for this transition to remote education, schools, educators, and researchers sought new approaches to teaching and learning in this "new norm". In a survey of more than 1,000 K-12 librarians in the United States, over three-quarters of respondents were provided emergency or supplementary training in online learning (Rodgers, 2020). Librarians reported offering remote support in the form of readers' advisory, research or project assistance, and story time/read aloud opportunities. Over 80% of all respondents planned to offer summer reading programs, many of whom sought to integrate web-based tools such as the reading system Beanstack for the first time. A study of 45 preservice school librarians in Spring 2020 sought to identify the effectiveness of online environments designed by school library candidates (Burns, 2020). Overall, preservice librarians were largely successful in designing effective online environments supported by instructional design models and appropriate online pedagogy. These lessons were not without their shared problems, however, as the difficulty of synchronous learning experiences necessitated the implementation of additional asynchronous offerings as well.

While educators developed new remote programs, parents were also asked to improvise and provide educational supports for students in new ways. In examining mathematics teaching and learning during COVID-19, some parents reported improvising by using household items, finding links to online interactives, or using statistics/graphics about the pandemic to aid learners in mathematical understanding (Khirwadkar, 2020). Parents also reported several ongoing challenges related to educational supports in the home including their own lack of knowledge or pedagogy, the need for increased teacher communication, or lack of accessible technology or Internet quality (Garbe et al., 2020). A predominant challenge discussed by parents was the struggle to meet disability-related or gifted and talented needs of children now studying remotely. Smith and Colton (2020) detailed the creation of a YouTube channel for Deaf/Hard of Hearing (DHH) students. Prior to the pandemic, there existed limited online teaching resources accessible to DHH students. The transition to online education coupled with a lack of home resources necessitated the construction of a channel which provided instructional videos to parents and students which was freely accessible throughout the COVID-19 pandemic. Parents also struggled with the difficulty of the material assigned to their children in a remote schooling environment. Parents cited spending additional time attempting to differentiate between their child's educational needs and remote assignments at home while under normal circumstances these special considerations would fall to an educator (Garbe et al., 2020).

In response to the pandemic, research sought to provide novel approaches for understanding and supporting learning in emergent crises. Whittle and colleagues (2020) introduced the emergency remote teaching environment (ERTE) framework to provide support for those familiar with pre-planned online instruction. ERTEs differ from more online or distance education experiences as they offer rapidly developed and temporary instructional support in a

crisis without pre-planned resources or infrastructure (Hodges et al., 2020). The ERTE framework comprises three steps: inquiry, classifying available resources into constants and variables, and designing educational experiences. The steps in ERTE are nonlinear and iterative as the needs presented during a crisis require constant re-evaluation (Whittle et al., 2020). Despite these contributions from educators, parents, and researchers, the COVID-19 pandemic represents a "wicked problem" in that the problem is ill-defined and information is often confusing or unknown (Rittel & Webber, 1973). As a response to "wicked problems", design thinking has been utilized to assess fit for all remote stakeholders (e.g., students, teaches, and parents) while offering opportunities to redefine problems and offer alternative approaches to non-traditional problems.

Design Thinking as a Response to COVID-19

Design thinking has been defined as an analytic and creative process that provides opportunities to experiment, prototype, gather feedback, and redesign (Razzouk & Shute, 2012). It has been described as both process and mindset which can be characterized by a number of attributes: ambiguity, collaboration, constructiveness, curiosity, empathy, holism, iteration, non-judgmental way, and openness (Baeck & Gremmett, 2012; Luka, 2014). Dunne and Martin (2006) suggest that design thinking models represent a cyclical process to solve "wicked problems". From their perspective, design thinking is a process of induction, abduction, deduction, and testing. Brown (2008) contrasts this perspective by suggesting that the design thinking process consists of a system of spaces as opposed to a series of steps. These spaces are inspiration, ideation, and implementation. Most notably, Plattner, Meinel, and Weinberg (2009) present a model of design thinking that has been viewed as both stepwise and cyclical. This model is separated into two halves comprised of three individual steps each. The first phase, *problem*, consists of understanding, observing, and providing a point of view. The second phase, *solution*, involves ideation, prototyping, and testing. This model encourages interaction between the phases of problem and solution which become linked, either directly or indirectly, through their unique steps.

Though its foundations reside in engineering, design thinking has steadily grown into the field of education. Welsh and Dehler (2012) detailed a design thinking approach to the creation of a student-centered learning curricula. Their narrative surrounding this process identified design thinking as a crucial element which encouraged critical analysis for both students and teachers alike. Luka (2014) presented a discussion on the merits of design thinking (also referred to as design-based learning in the field of education) and its merits for pedagogy. Though abundant in education broadly, there has been limited research that details the use of design thinking as a response to COVID-19. One example in medical education utilized a rapid design thinking strategy to develop a response to challenges in medical education and training throughout remote learning (Thakur, Soklaridis, Crawford, Mulsant, & Sockalingam, 2020). Their model shows that the educational response to the COVID-19 pandemic may provide an opportunity for educators and students to adapt towards positive and sustained change. To design and develop an online curriculum for PreK-2 students amidst the COVID-19 pandemic, the team sought to build on the success of prior curriculum development using a design thinking approach. The following sections will detail our adapted design thinking model and our steps in moving towards the creation and teaching of an online curriculum.

Method

In March of 2020, the K-12 community encountered a "wicked problem" and was forced to quickly adapt to a virtual learning environment. While some schools developed an immediate

plan, others were delayed with the assumption that the face-to-face closure would be in effect for only a few weeks. An urban district in the northeast section of the United States shut down their district from March 16th to 27th in response to the outbreak of COVID-19 cases in the United States. This shutdown was meant for a deep cleaning of facilities, but the district quickly pivoted to offering remote instruction. This emergency remote teaching environment was in response to the pandemic crisis and did not have the infrastructure of a pre-planned learning environment (Whittle et. al, 2020). In addition, students lacked the necessary hardware and internet access to learn remotely; therefore, the district delayed remote instruction until Chromebooks were distributed and internet access areas were established.

This Prekindergarten – grade 2 (Prek-2) online learning project used an iterative, design-thinking process in a quick turnaround time due to the impact of COVID-19. In this study, an exploratory sequential mixed method research design was utilized in order to aid us in reflecting on our own design practices, experiences in creating the virtual course, and the students' experiences in utilizing the course over a six-week period. In an exploratory design, qualitative data is collected and analyzed in order to drive the analysis and interpretation of quantitative data (Creswell & Plano Clark, 2017; Teddlie & Tashakkori, 2009). At the beginning of each week, the project team would track progress through weekly meeting notes, agendas, and content reviews to identify key areas for improvement. For example, the pipeline for the creation of weekly content and its publication to the interactive web-based application was developed using this iterative process. Subsequently, Google Analytics user data guided analysis in how students were using and navigating the application. These descriptive statistics enabled the project team to gain insight into statistics such as student geographic location and their point of access to the web application. For example, the project team was able to make design decisions on web application font sizes and amount of content presented per slide due to the high usage rate of mobile devices (tablets and phones). This iterative process was utilized throughout the project duration in order to build out the web application and to give insight into our own design process. Due to the immediacy of the problem and the time constraints, the team became pragmatic researchers (Onwuegbuzie & Leech, 2007). Since society has not had the issue of school closures due to the pandemic in over 100 years, this study used an exploratory approach. The iterative model developed here may be helpful to other designers and early grade content developers focused on independent virtual learning. The research team received Institutional Review Board ethics approval through the university.

The structure of a design thinking approach (Luka, 2014) is outlined within the process below. The six-phase design thinking stages – discover, interpretation, ideation, experimentation, implementation and evolution – highlight how the project team developed the PreK to 2nd grade web-based curriculum. Variances to our design-based curriculum model were a result of the guiding questions and interpretations that emerged through project team discussions, instructional development and indirect user feedback. This section will explore how the process of developing a web-based PreK-2nd grade curriculum resulted in an amended design- based model for development.

Discover

In the *discover* phase of the project, understanding the problem and interpreting the issue were key. The team needed to determine the immediate curricular needs of rising Kindergarteners, 1st and 2nd graders that would offset the learning gap that occurred due to the COVID-19 shutdown and subsequent remote instruction that followed. A curriculum team was assembled to include seasoned teachers in Reading, Early Literacy, Writing, Math, and Science. This team would become the Subject Matter Experts (SME) for the project.

The instructional design team along with the SMEs were tasked by an Educational Non-Government Organization in consultation with the school district of the city, with developing a six-week curriculum that consisted of three days of instruction for each week. Each day would consist of lessons for the following subjects: Reading Comprehension, Early Literacy, Writing, Math and Science to total a time of 1 to 1½ hours for each grade level.

Inspiration for the design process came from the multitude of teachers that were quickly adapting to the online environment and creating Bitmoji classrooms full of lessons and activities (Gewertz, 2020). Additionally, the continued development of interactive online software that gamifies and engages the learner inspired both designers and subject matter experts to develop the project in a way that would attract young learners in the summer months. Quickly, a team of potential partners that included school district administrators, local library partners, subject matter experts and graphic designers was assembled (virtually) to determine the project's feasibility and the roles individuals could fill.

Interpretation

Within the *interpretation* stage, an understanding of the audience and interpretation of the work is developed. The driving questions of "how do I interpret it" and "who will be the audience" frames the design approach. In this instance, the "it" is the process of bringing curriculum to life for the user in a web-based approach. The results of these questions result in the team developing a persona analysis and a framework to develop the curriculum to teach the newly defined user based on the persona analysis.

Initially, a meeting of potential partners and contributors included literacy experts, school district officials, funding partners, and community educational partners such as WHYY (Wider Horizons for You and Yours) the local PBS station, and the public library helped to determine the audience and provide guidance on what should be included in the curriculum.

Virtual pre-project meetings were held with the school district in the Northeast to discuss the grade level bands and the content standards of the project which would constitute the audience. It was decided the content would focus on the Spring 2020 standards in the hopes of alleviating the Fall 2020 learning divide, and potentially filling the gaps of instruction from the school district's closures due to COVID-19. As parents were tasked with working either at home or in person in essential positions while their children were at home for the summer, the need to offer a virtual learning opportunity that was designed so the student would be able to access and perform the activities without the help of an adult was paramount. There is evidence to support the idea that student learning outcomes can be improved through this independent work (Educational Endorsement Foundation, 2020). Except for the pre-kindergarten students, the development team decided to proceed with this expectation in mind.

Project team partners determined the use of themes for each grade level module. Each module would include content that focused on one theme over a two-week period. A total of three themes for each grade level were decided. Books needed to be selected to be included for read-alouds. In the beginning, the content experts planned to use online books through a variety of companies that responded to the pandemic with free resources for teachers; however, due to copyright issues this was not permissible. In response, it was decided to include content-lead selected read-alouds that were readily available on YouTube. The read-alouds were chosen based on relationship to the theme, grade level, and were culturally responsive. The books were chosen and shared with the larger partner group. Some books were changed due to lack of rigor for the grade level and some books were changed to more culturally responsive text. The

themes were also shared with our partner, WHYY to develop television programming for one hour each day during the six weeks. The WHYY schedule was distributed with literacy activity packets at *Meal on the Go* locations across the city so they could reach students who might also be struggling with internet access.

Ideation

Within the *ideation* stage, the design-based approach focuses on the question "What do I create?" Although this question adequately addresses a single-based curriculum design for a grade specific user an additional question, "How do I create the learning experience" was added due to the multiple subject areas and grade levels being addressed in a specific week with variant web-based interactive approaches. The ideation process unfolded in two iterative and interrelated phases as the project team design discussions and tool availability emerged.

Initially, the project team discussed hosting all the curriculum on a website. Each page of the website would hold individual Reading Comprehension, Early Literacy, Writing, Math and Science segments for the day and week. This would result in lessons being produced and operated on each page at each grade level. The lessons would be produced on Google Slides with embedded video and hyperlinks for the students to navigate.

Instructional designers, however, suggested the use of Articulate 360: Storyline to create the digital content. This software had advantages, they argued, in creating more interactive content, and in allowing more compact and user-friendly website architecture. Articulate 360: Storyline allows for the branching of subjects in one produced lesson instead of having multiple lessons for each Week, Day and Subject (WDS) activity (see Figure 1). This approach would allow for greater control of audio, interactive elements, and a more streamlined user experience since the user would be navigating within one produced lesson in lieu of having six produced lessons on a page, and therefore the risk of audio playing for two subject lessons while on one webpage would no longer exist. The use of Articulate 360: Storyline also allowed interactive elements to be incorporated into each lesson shifting the learning experience from passive to active. Lastly, the website would broadcast each WDS activity on its own page (see Figure 1).

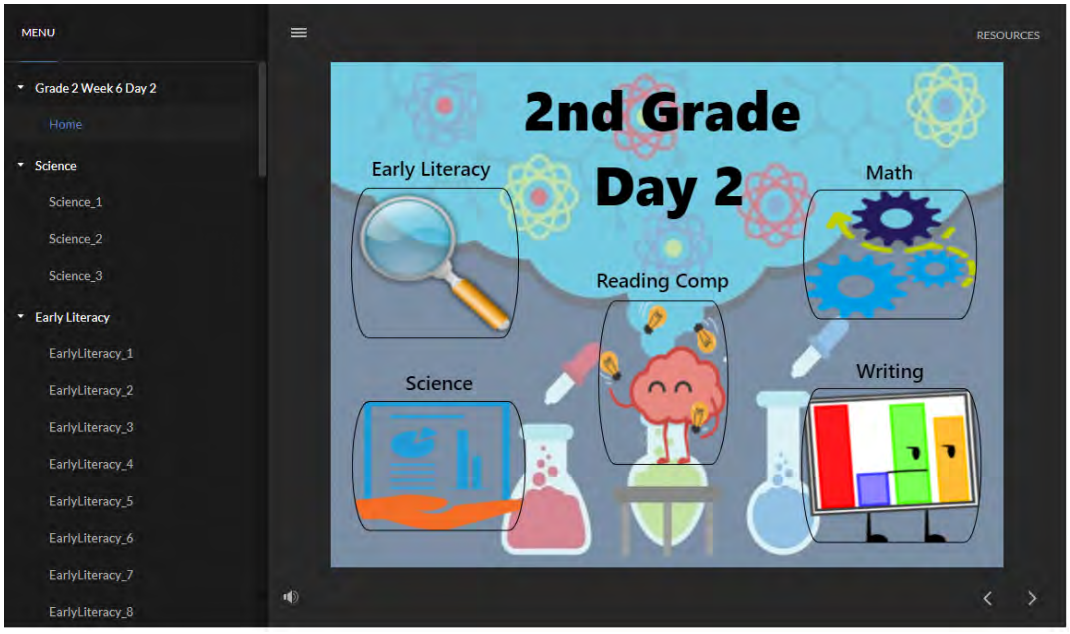

Figure 1: Sample activities page for grade 2 day

Experimentation

In the *experimentation* stage, a prototype is built, tested, and feedback is obtained. Ideally, the experimentation phase lends itself to testing a prototype and refining it based on various feedback loops. Unfortunately, many programs, including the Ultimate Summer Adventure program, run on an expedited timeline where a multi-feedback loop prototype is not feasible. The instructional designers had a one-week window to design the content that would be released during the first week of the program.

With the timeframe in mind, the designers constructed the prototype so that the user could engage with various activities for each of the subject areas. One content area for a grade level may have two or three activities resulting in approximately 40-60 activities for all four levels for all five subject areas.

Once the prototype was complete, one content expert, one funding partner and one district administrator tested the learning activities. Notes were taken (see Figure 2) and adjustments were made by the instructional designers over a two-day period. The prototype was then launched on the website as Week 1's learning adventure.

The central question of the experimentation stage was "how do I build it?" Through trial and error and the project team working together, we were able to produce an array of learning modules that had different interactives suitable for each grade level.

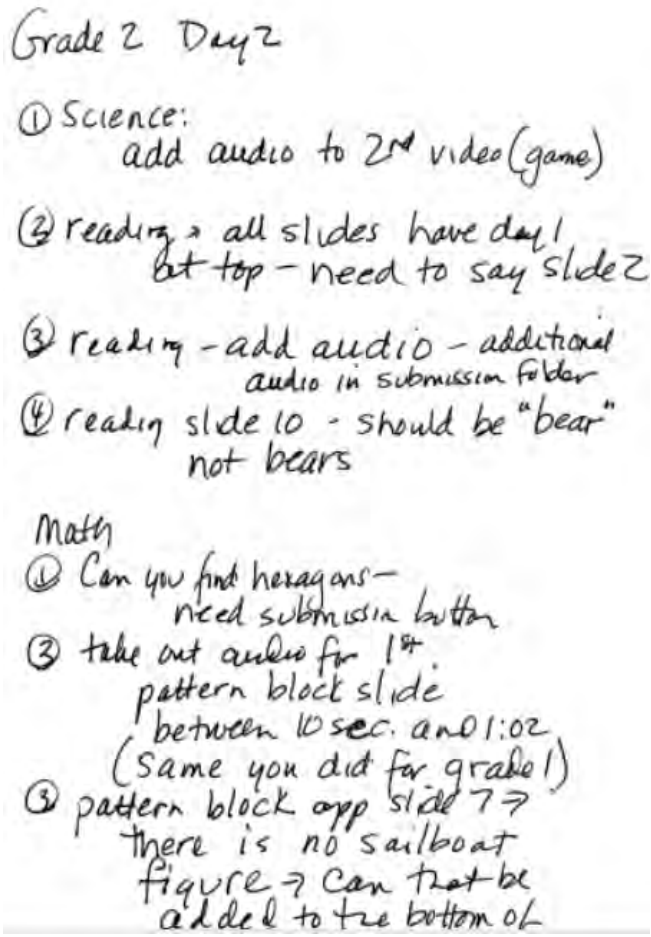

Figure 2: Notes from content expert to instructional designers on weekly build

Implementation

In the *implementation* stage, the team needed to identify what was and was not working and revise as needed. After the first week of production, the project team developed a more streamlined means of submitting the content for design in hopes of streamlining the process and assisting with identifying missing or repetitive areas of development.

After the first week, the project team met and identified the need for more audio in each lesson to clearly articulate to the learner how to proceed. For example, for kindergarten students who are just developing reading skills, all directions and words on the screen were read aloud.

For Pre-K specifically, after the first week, the design team in conjunction with the SMEs decided to not embed Word documents within their lessons for fear of the user not being able to access such documents. The designer would move ahead in week two with embedding Google documents that were viewable by the user.

Evolution

The *evolution* phase is time to get external feedback. In this project, the feedback came after week two when the instructional design team was able to report technical user data. In this phase we assessed the fit of our curriculum model and delivery with the user stakeholders.

The data showed most users were accessing the media through mobile and tablet devices. Originally, the design was geared toward the Chromebook environment because of the district's Chromebook distribution initiative. With this new data, the designers proceeded with making both navigational buttons bigger on the slides and increasing the font size. Additionally, the interactive elements were paired down. For example, an eight-set matching game would be decreased to a four or five set matching game to increase the picture and text sizes.

The SMEs, during weeks five and six, added content data collection by embedding Google Forms in the interactives. As students answered questions, the responses were recorded anonymously on a spreadsheet. This process allowed content developers to understand if and how users were taking part in the activities.
Through the evolution stage, the content and design team made various tweaks to improve the user experience including:

- Written directions for adults/caregivers of PreK students were moved from Google Docs to a layer within Articulate 360: Storyline so that the adult would not be taken out of the lesson and have difficulty returning to the site. (Week 3)
- Written directions for adults/caregivers of PreK students would have audio elements added to them. (Week 4)
- Produced video would be added to Kaltura (an inhouse video platform) and then embedded into Articulate 360: Storyline. This allowed the Articulate 360: Storyline file size to remain relatively low.

Discussion

Research Question 1: How Did the Team Create this Online Learning Platform?

After meetings to discuss grade level bands and content areas, decisions were made as to which content experts were needed. Additional meetings determined the platform to host the content and which software would make the content interactive. Following those decisions, the content

experts met with the design team weekly to clarify making content more user friendly and interactive. Each week the team used an iterative process that served to make changes to content and improve functionality for the end user. As discussed earlier, there are other models of design thinking that could have been applied to this project. The 2009 model from Platter et al. suggests understanding and observing in the first phase of the cyclical process. This project did not allow the luxury of complete understanding of the problem, nor the time to observe; therefore, the Platter model did not meet our needs. Through our iterative process, a new model was created that details the process used (see Figure 3). In the *discover* stage, the team created a shared understanding of the challenge, quickly and effectively designing a multi-grade curriculum to be used asynchronously. The second stage, *interpretation*, enabled the team to determine the standards and themes. With set interpretation of the discovered problem, the team could progress into the third stage, *ideation*. Here, the team generated multiple ideas and received feedback from stakeholders. Stage four, experimentation, took the team through developing a prototype and getting feedback from students, parents, and team members. The project learning environment was revised iteratively over the course of six weeks during the *implementation* stage as student data became available. The last stage, *evolution*, would bring the team back to the *interpretation* stage each time we received feedback or data to support a change.

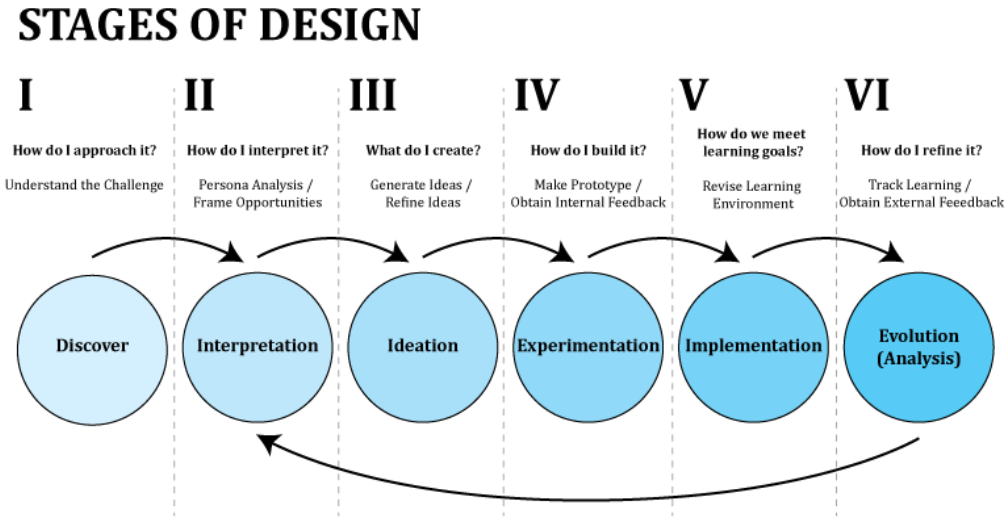

Figure 3: Iterative Design Model for Ultimate Summer Learning Adventure

Research Question 2: What Challenges did the Team Face?

The team faced many challenges in the development and implementation of the project. The timeframe from idea to implementation was a hurdle that had to be addressed. The team determined the serving the needs of the students far outweighed the long days the team would work to get this project off the ground. Another challenge was finding the content experts for the curriculum that had the necessary expertise and the time to commit to the project. The one benefit was the many partners involved in Read by 4th.

An additional challenge was experienced while the platform was in use. Many users were using cell phones to access the platform. The instructional design team had to adapt the content and size of items on a page. While internet connectivity did not appear to be an issue when students were using the platform, not all households in the targeted district had internet access. To address that challenge, printouts of materials that addressed the same themes were provided at meal centers across the city.

Research Question 3 How and When was the Curriculum Used?
Analytics from the Google site were studied to identify the most active time periods (see Table 1) and the locations of students where the site was accessed (see Table 2). The site was promoted at the beginning of the summer through emails, advertising through social media, local grassroots champions, and radio ads. June through August brought 5,848 unique users who viewed an average of 3.13 pages per session. In September, the site was renamed, but was still active and students could continue to use the activities. September through November brought an additional 434 unique users with less pages per session when compared to summer.

The program was developed for a region in Pennsylvania. The intent was to reach students from the region. In the summer session, 4,515 of the users were from Pennsylvania, 251 from New Jersey, followed by 163 from District of Columbia. Six other states rounded out where the users were located during the summer. In the Fall, Pennsylvania again hosted the highest number of users (n=230) followed by New Jersey (n=27) and a surprising number of users all on the same day from Utah (n=230). The analytics suggest a teacher(s) may have discovered the site and assigned some activities to their students. It is important to note that there was no advertising for the site after August.

Table 1: Use of ultimate summer learning adventure across time periods

Time period	Users	Sessions	Page Views	Pages per Session
June-Nov (All)	6,190	6,202	11,238	3.10
June-Aug (Summer)	5,848	5,848	10,404	3.13
Sept-Nov (Fall)	434	354	834	2.66

Table 2: Users by location and timeframe

US Locations	June-Aug (Summer)	Sept – Nov (Fall)	June-Nov (All)
Pennsylvania	4,515	230	4,677
New Jersey	251	27	277
D.C.	163	4	167
Utah	51	23	74
Iowa		21	
Texas	37	21	58
Wyoming		13	
New York	98	3	101
Virginia	81		86
California	77	12	89
Washington		12	
Ohio		11	
North Carolina		6	
Delaware			51
Massachusetts			44

Initially, activities were designed based on the assumption that students would use their newly distributed Google Chromebooks. In the implementation phase, the developers realized

students were mostly using mobile phones which was approximately 77% in the first weeks of the summer program. The content experts and developers adapted activities for students to easily access the content on mobile phones, which was not considered at the beginning of development. When the design features were changed to have less words on a page, less choices on a page, and larger navigational buttons and font sizes, the intent was to provide a better user experience for the students using mobile devices.

Over the course of the summer programming, 57.96% of users were accessing the content on mobile devices, followed by desktops at 36.88% (See Table 3). It is interesting to note that in the Fall, after the summer program advertising ended, the content was still available for use; however, desktops were the device of choice at 80.41%. The team hypothesized that teachers may be using the curriculum activities in their virtual learning assignments.

Table 3: How users accessed the curriculum

Device	June-Aug (Summer)	Sept-Nov (Fall)	June-Nov (All)
Mobile	57.96	14.98	55.54
Desktop	36.88	80.41	39.48
Tablet	5.16	4.61	4.98

This project was started and implemented in two weeks. The iterative design-thinking process occurred throughout the six-week curriculum offering. The team learned valuable insights on how to create curriculum-based content with asynchronous online activities for the early grades. The team had to adjust content for grade level by adding additional audio to any written material; amount of content on a page and larger response buttons for mobile phone use; and increase knowledge capacity of technology for the content experts. The instructional designers and content experts learned from each other and had to work together under high stress circumstances due to the time constraints.

At the time of the project implementation, many households did not have either the internet connection or the bandwidth to access the platform. This is an ongoing issue across the country and is slowly being addressed. Lack of access may have affected the results of this program. The project team attempted to address this issue by providing physical copies of materials and including themed programming through public television (WHYY); however, families that could have benefitted from the program may not have had the access to participate.

Recommendations

Designing and implementing an asynchronous virtual learning curriculum for preschool through 2nd grade was a challenging task. Much was learned during the process that can be considered as recommendations for others with similar aspirations.

While the goal of this project was to allow students to access the curriculum without a log in, it is recommended that students would log in to the system. This would allow for better data tracking and would improve the changes made in real time. It could also provide a way to assess student learning.

Another recommendation concerns accessibility. It may prove best to design activities with mobile devices in mind. When the design is planned for the smallest screen, the material will be accessible on all devices. As the team learned through this iterative design thinking process,

audio support was a necessity. If words are written, audio needs to be provided to support universal design for learning. It is also critical in a project like this to have buy- in from all the stakeholders and to be open to their feedback. Scheduling time and having a process for the feedback from the beginning would allow for timely iterations. Ultimately, it was feedback from a variety of stakeholders throughout the process that contributed to the content and design changes that improved the user experience.

Conclusion

COVID-19 has placed many challenges on schools and student learning. The Ultimate Summer Learning Adventure was one response to the spring 2020 in person school closures. While it was initially developed to help students recover or master skills that were presented virtually in the spring, this virtual curriculum is still being used by students. The project was a quick response to a "wicked problem" and was used by the students it was intended to support. One limitation of this study was the intentional choice of not having students log into the system did not allow for analysis of student learning. The iterative design process that was instituted may prove helpful for others intending to support asynchronous, virtual learning for the early grades.

The development of this project was graciously funded by William Penn Foundation, Philadelphia School Partnership, Philadelphia Emergency Fund for Stabilization of Early Education (PEFSEE), and The Philadelphia Foundation.

References

Alexander, K.L., Entwisle, D. R., Steffel Olson, L. (2007) Lasting consequences of the summer learning gap. *American Sociological Review, 72*(2): 167–180. https://doi.org/10.1177/000312240707200202

Baeck, A., & Gremett, P. (2012). Design thinking. In: H. Degen, & X. Yuan (Eds.), *UX best practices: How to achieve more impact with user experience* (pp. 229–233). McGraw Hill.

Berry, B. (2020). Teaching, learning, and caring in the post-COVID era. *Phi Delta Kappan*, *102*(1), 14–17. https://doi.org/10.1177/0031721720956840

Brown, T. (2008). Design thinking. *Harvard Business Review, 86*(6), 84.

Bubb, S., & Jones, M. A. (2020). Learning from the COVID-19 home-schooling experience: Listening to pupils, parents/carers and teachers. *Improving Schools*, *23*(3), 209–222. https://doi.org/10.1177/1365480220958797

Burns, E. (2020). School librarians online: integrated learning beyond the school walls. *Information and Learning Sciences*, 121(7/8), 631–644. https://doi.org/10.1108/ILS-04-2020-0107

Creswell, J. W., & Plano Clark, V. L. (2017). *Designing and conducting mixed methods research*. SAGE.

DeWitt, P. (2020). Teachers work two hours less per day during COVID-19: 8 key EdWeek survey findings. *Education Week*. Retrieved from https://www.edweek.org/ew/articles/2020/05/11/teachers-work-an-hour-less-per-day.html

Dorn, E., Hancock, B., Sarakatsannis, J., & Viruleg, E. (2020). *COVID-19 and student learning in the United States: The hurt could last a lifetime*. McKinsey & Company.

Dorst, K. (2011). The core of 'design thinking' and its application. *Design Studies*, *32*(6), 521–532. https://doi.org/10.1016/j.destud.2011.07.006

Dunne, D., & Martin, R. (2006). Design thinking and how it will change management education: An interview and discussion. *Academy of Management Learning & Education, 5*(4), 512–523. https://doi.org/10.5465/amle.2006.23473212

Education Endowment Foundation. (2020). *Remote learning rapid evidence assessment*. Education Endowment Foundation

Garbe, A., Ogurlu, U., Logan, N., & Cook, P. (2020). Parents' experiences with remote education during COVID-19 school closures. *American Journal of Qualitative Research*, *4*(3), 45–65. https://doi.org/10.29333/ajqr/8471

Gewertz, C. (2020). Bitmoji classrooms: Why teachers are buzzing about them. *Education Week*. July 30. https://www.edweek.org/ew/articles/2020/07/30/bitmoji-classrooms-why-teachers-are-buzzing-about.html

Herold, B., & Yettick, H. (2020, May). This is what teachers want us to now about pandemic learning. *Education Week*. Retrieved from https://www.edweek.org/ew/articles/2020/05/11/teachers-work-anhour-less-per-day.html

Hodges, C. Moore, S. Lockee, B. Trust, T. & Bond, A. (2020). The difference between emergency remote teaching and online learning. *EDUCAUSE Review*. https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teachingand-online-learning.

Khirwadkar, A., Khan, S. I., Mgombelo, J., Obradovic-Ratkovic, S., & Forbes, W. A. (2020). Reimagining mathematics education during the COVID-19 pandemic. Brock Education: *A Journal of Educational Research and Practice*, *29*(2), 42–46. https://doi.org/10.26522/brocked.v29i2.839

Luka, I. (2014). Design thinking in pedagogy. *The Journal of Education, Culture, and Society, 5*(2), 63–74. https://doi.org/10.15503/jecs20142.63.74

Muijs, D., Kyriakides, L., Van der Werf, G., Creemers, B., Timperley, H., & Earl, L. (2014). State of the art–teacher effectiveness and professional learning. *School Effectiveness and School Improvement*, *25*(2), 231–256. https://doi.org/10.1080/09243453.2014.885451

Onwuegbuzie, A.J., & Leech, N.L. (2005). On becoming a pragmatic researcher: The importance of combining quantitative and qualitative research methodologies. *International Journal of Social Research Methodology*, *8*(5), 375–387. https://doi.org/10.1080/13645570500402447

Razzouk, R., & Shute, V. (2012). What is design thinking and why is it important? *Review of Educational Research, 82*(3), 330–348. https://doi.org/10.3102/0034654312457429

Rittel, H. W., & Webber, M. M. (1973). Dilemmas in a general theory of planning. *Policy Sciences*, *4*(2), 155–169. https://doi.org/10.1007/BF01405730

Rodgers, L. (2020). Distance learning: Supporting K-12 learners *Library Journal*, *145*(6), 26.

Ross, S. M. (2020). Technology infusion in K-12 classrooms: a retrospective look at three decades of challenges and advancements in research and practice. *Educational Technology Research and Development*, 1–18. https://doi.org/10.1007/s11423-020-09756-7

Smith, C., & Colton, S. (2020). Creating a YouTube channel to equip parents and teachers of students who are deaf. *Journal of Technology and Teacher Education*, *28*(2), 453–461.

Smith, L., & Riley, D. (2012). School leadership in times of crisis. *School Leadership & Management*, *32*(1), 5771. https://doi.org/10.1080/13632434.2011.614941

Stefaniak, J. (2020). The utility of design thinking to promote systematic instructional design practices in the workplace. *Tech Trends, 64*: 202210. doi.org/10.1007/s11528-019-00453-8

Teddlie, C., & Tashakkori, A. (2009). Foundations of mixed methods research: Integrating quantitative and qualitative approaches in the social and behavioral sciences. SAGE.

Thakur, A., Soklaridis, S., Crawford, A., Mulsant, B., & Sockalingam, S. (2020). Using rapid design thinking to overcome COVID-19 challenges in medical education. *Academic Medicine*. https://doi.org/10.1097/ACM.0000000000003718

von Hippel, P.T., Workman, J., & Downey, D.B. (2018). Inequality in reading and math skills forms mainly before kindergarten: A replication, and partial correction, of "Are schools the great equalizer?" *Sociology of Education, 91*(4): 323–357. https://doi.org/10.1177/0038040718801760

Welsh, M. A., & Dehler, G. E. (2012) Combining critical reflection and design thinking to develop integrative learners. *Journal of Management Education*, *37*(6), 771–802. https://doi.org/10.1177/1052562912470107

Whittle, C., Tiwari, S., Yan, S., & Williams, J. (2020). Emergency remote teaching environment: A conceptual framework for responsive online teaching in crises. *Information and Learning Sciences*, *121*(5/6), 311–319. https://doi.org/10.1108/ILS-04-2020-0099

Corresponding author: Lori Severino
Contact email: las492@drexel.edu