Rapid Cycle Pilots: Improving Ed-Tech Products through Feedback

Case Study Reports

Report to Digital Promise by
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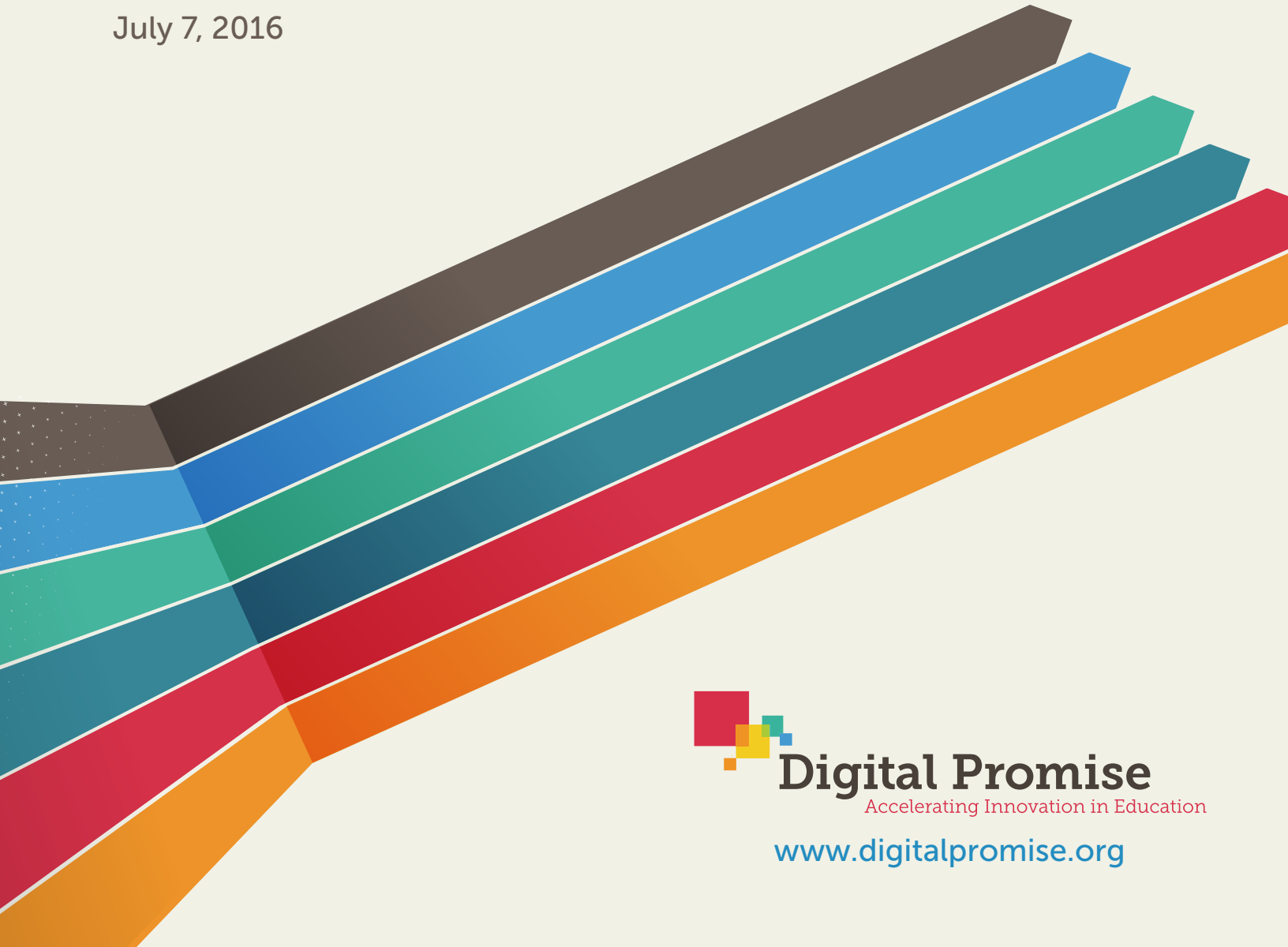
July 7, 2016



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Executive Summary

Technology offers an opportunity for schools to personalize learning for each student; however, choosing the best products to use in schools can be challenging. In addition, districts are now spending a sizable portion of their budgets on ed-tech products. In 2015, U.S. elementary, middle, and high schools spent $6.6 billion on ed-tech[1]. With support from the Bill and Melinda Gates Foundation and Digital Promise, three Pittsburgh, PA area school districts partnered with researchers from the Learning Media Design Center at Carnegie Mellon University to conduct ed-tech product efficacy research during the 2015-2016 school year.

In this report, case-studies are described from the three school districts — Avonworth, Elizabeth Forward, and South Fayette, all of whom are part of the Digital Promise League of Innovative Schools, a network of school districts across the nation committed to pioneering innovative learning and leadership practices that lead to improved outcomes for students. Each school district chose 1-2 digital courseware products to pilot, based on their unique instructional and learning goals, because they recognized the need to gather evidence of an ed-tech product's effectiveness before making a purchasing decision. Our product efficacy studies across five products in the three school districts included over 700 students and 30 teachers.

Key findings related to these studies relate to both the pilot process and outcomes. In terms of process, districts that conducted a thorough needs-analysis and chose a product well suited to their goals and objectives had a more meaningful pilot and improved results. In addition, goal alignment between a district's instructional or curricular needs and the product's intended use is essential to conduct meaningful evidence. Small to medium-sized pilots that involved only one grade-level or one subject area were likely to be more targeted, and resulted in successfully identifying suitable products, compared to pilots that tested products over a multitude of grade-levels and subject areas. Product implementation, and consequently pilot success, was inhibited by technological issues, timely roll out of products, and device limitations in some cases.

Because of the wide range of products chosen, the stage of product development (e.g., early stage vs late stage), curricular and instructional goals of the school district, age-groups of users, subject areas targeted by the products, and school contexts, deploying common measures to assess product efficacy was not possible. As a result, the research team relied on multiple sources of qualitative and quantitative data to study product efficacy, using a mixed methods approach. Consequently, careful attention to context would be warranted before extrapolating findings from this research to other situations.

[1] http://www.centerdigitaled.com/higher-ed/US-Education-Institutions-Spend-66-Billion-on-IT-in-2015.html

Introduction

The U.S. ed-tech market is flooded with a multitude of instructional and software products. While many school and district leaders recognize the potential of these products to help personalize learning for each student, they report high levels of uncertainty about how to select the right products for their needs[2].

Existing evidence about ed-tech product effectiveness is scarce and school district leaders struggle to access, validate, and apply findings to their unique settings. Faced with limited reliable information, many districts would prefer to conduct local pilots as a way to generate useable product efficacy evidence. However, few school districts have the research capacity to conduct high-quality evaluations that yield the evidence district decision makers need to purchase a new ed-tech product.

Through support from the Bill and Melinda Gates Foundation, three school districts in the Pittsburgh, PA area were able to access research support from Carnegie Mellon University to pilot five different ed-tech products. The three main goals of this project were as follows: 1) to provide guidance and information for participating schools to use when planning pilots, 2) to provide useful measures and practices to support current and future educational technology pilots, internal decision-making, and adoption processes, and 3) to provide developers a valuable, external reflection on their products-in-use.

Each school district included in the study had specific teaching and learning goals with particular curricular needs, which we outline in detail in individual case studies. The products targeted a range of subject areas and age groups. Avonworth school district piloted two products — *Puzzlets*, a hybrid learning game with a tangible programming interface targeted at developing early computational thinking and problem-solving in Digital Literacy classrooms in grades K-2, and *eSpark*, a personalized learning platform that provides students opportunities for enrichment based on their mastery of common core standards in 1st grade ELA classrooms. Elizabeth Forward school district piloted the entire suite of *Amplify* STEM and ELA games in twenty-four 6th - 8th grade classrooms to provide an engaging alternative to non-educational games for use in extra-curricular time, and to explore integration of games into the classroom curriculum. South Fayette piloted two products — *INVENTORcloud* curriculum and 3D printer hardware package to support a creative entrepreneurship course in the technology education class for 8th graders, and *Microsoft OneNote*, a platform to facilitate seamless creation and sharing of instructional content between teachers and students, as well as foster collaborative exchanges among students in 7th grade science and social studies classrooms. See Table 1 for a snapshot of school districts, technologies piloted, numbers of participants, and overarching pilot goals for each product.

[2] http://digitalpromise.org/wp-content/uploads/2016/02/IDEO-Digital-Promise-Report-Evolving-Ed-Tech-Procurement-in-School-Districts.pdf

Methodology

The research team focused on four dimensions of product efficacy as outlined in the project proposal — student learning, student engagement, teacher support, and teacher satisfaction, along with an additional dimension for administrator satisfaction.

Using multiple sources of qualitative and quantitative data, such as, student, teacher, and administrator interviews, surveys, focus groups and feedback sessions, classroom observations, observations of professional development sessions conducted by the companies, and learning analytics provided by the developers, the research team synthesized insights on each of these dimensions.

Additionally, custom measures were developed to address particular questions relevant to individual sites — for example, South Fayette wanted to understand how students' levels of activation in creative entrepreneurship and innovation change over the period of the pilot, so a custom survey instrument was developed to measure that construct.

School District	**Avonworth**		**Elizabeth Forward**	**South Fayette**	
Product	*eSpark*	*Puzzlets*	*Amplify Games*	*INVENTORcloud*	*Microsoft OneNote*
Subject Area	ELA	Digital Literacy	ELA, Science, Math	Technology Education	Social Studies
Grade level	1st	K-2	6-8	8	7
Students (n)	129	56	474	60	22
Teachers (n)	7	1	19	1	1
Pilot Goal	Provide enrichment opportunities in ELA learning	Encourage early sequential thinking, problem-solving	Identify engaging educational games for out of school use; explore integration into curriculum	Integrate creative entrepreneurship module into vertically integrated computational thinking curriculum	Identify technology solution for creating and sharing of instructional content between students and teachers

Table 1:
Overview of Products, Participants, and Pilot Goals

Given the diversity of products, wide range of age-groups, and highly varied implementation goals of the schools involved, it was not feasible to develop a standardized, common set of measures to deploy across the three school districts in the one-year time frame allotted. As a result, study designs and research methods were tailored to obtain rich product efficacy data and gather targeted observations focused on the needs of each district. See Table 2 for an overview of measures used to gain insights on each of the dimensions of product efficacy for the three districts in the study.

		School District		
Dimension of Product Efficacy	Measure	Avonworth	Elizabeth Forward	South Fayette
Student Learning	Log Data	✓		
	Pre-Post Survey		✓	✓
	Post-test	✓		
	NWEA assessments	✓	✓	
	Interview / Focus Group		✓	✓
Student Engagement	Log Data	✓	✓	
	Survey		✓	✓
	Interview / Focus Group		✓	✓
	Classroom Observations	✓		✓
Teacher Support	Survey	✓	✓	
	Interviews/ Focus Groups	✓	✓	✓
	Observation of PD sessions	✓	✓	
Teacher Satisfaction	Survey	✓	✓	
	Interviews/ Focus Groups	✓	✓	✓
Administrator Satisfaction	Interview	✓	✓	✓

Table 2:
Overview of Measures used to Assess Product Efficacy

The research team synthesized findings from the various sources of data collected, and provided feedback via phone or face-to-face meetings to engage the product developers in open and frank discussions about the positives as well as the problems teachers and students encountered using the product. Design insights and suggestions for potential ways to address those issues were communicated to product developers. For some of the products, e.g., *eSpark*, our feedback cycle led to concrete proposals for design changes in order to improve the product. In others, such as *Amplify*, our feedback generated suggestions for improving the pilot process in addition to suggestions for improving the product itself. In this report, we describe the district-centric, practitioner-focused feedback loop process, and its outcomes for all products piloted.

Case Study:

Avonworth School District

Avonworth School District, a member of the Digital Promise League of Innovative Schools, is a small, suburban school district to the north of Pittsburgh.

It was ranked 61st out of 498 Pennsylvania school districts in 2012, by the Pittsburgh Business Times. The total enrollment at the district is approximately 1600 students, of which 15 percent are from economically disadvantaged households (see Table 3 for district snapshot). A partner of the Remake Learning network, a local collaborative of network of educators and innovators working together to shape the future of teaching and learning in the Greater Pittsburgh Region, Avonworth places a strong emphasis on "...collaboration, technology integration, authentic application and reflection, while inspiring creativity" (cf. remakelearning.org).

Number of Students Served	School Ranking	Percent free or reduced lunch	Products Piloted	Target Subject Areas	Grade-Levels in Pilot
1600	61/ 498	15	*eSpark*, *Puzzlets*	ELA, Digital Literacy	K,1,2

Table 3:
Avonworth School District Snapshot

The district had two distinct goals for choosing products for these pilots.

The first goal was to show sustained student achievement growth, particularly in the ELA domain. For the past three years, Avonworth Primary Center has used the MAP assessment by NWEA's measures of Academic progress (MAP) three times a year to assess student growth. The *eSpark* platform that creates a personalized learning plan for each student based on his or her NWEA score provided a promising alternative to curating individual apps, and investing in seat licenses for each student. *eSpark* also came strongly recommended by

another member of the League of Innovative Schools in the region, who had used *eSpark* with students in lower elementary grades. As a result, Avonworth chose to pilot *eSpark* in six first grade classrooms.

A second goal was to identify a product that would provide an engaging, early introduction to computational thinking concepts such as sequential thinking, reasoning, and problem solving to students in grades K-2 in their Digital Literacy classrooms. To this end, the district chose the product *Puzzlets* — a tangible learning game system focused on providing an early introduction to sequential thinking and problem solving in K-2 Digital Literacy classrooms. *Puzzlets* is developed by a local ed-tech company called Digital Dreamlabs that started out of Entertainment Technology Center at Carnegie Mellon University, and is also a member of the Remake Learning network. The lead teacher for Digital Literacy at Avonworth also acts as consultant to Digital Dreamlabs. Although *Puzzlets* in its current form is intended for the consumer market, and is in the process of being adapted for classroom use, the district felt comfortable choosing to pilot it, given the local connection of Digital Dreamlabs, as well as the strong recommendation from the lead teacher.

The research team worked closely with the school district to identify the goals and objectives of the pilot, develop assessment instruments to measure key product efficacy dimensions, collect data, and provide feedback to the product developers. The research team did not have a say in the choice of product, because the products were chosen prior to their engagement in the pilots. The primary point of contact at Avonworth for both pilots was the building principal of Avonworth Primary Center. For the *eSpark* pilot, the research team interfaced with seven teachers, one from each of the six classrooms, and one special education teacher. For the *Puzzlets* pilot, they worked with the lead teacher for Digital Literacy who taught all three classrooms in the pilot.

Given the disparate curricular goals and learning objectives of each product, the research team developed custom assessments strategies to measure key dimensions of product efficacy — student learning, student engagement, teacher support, teacher satisfaction, and administrator satisfaction. Methods used included surveys, focus groups, in-depth interviews with students, teachers, and administrators, classroom observations, and analysis of log data provided by product developers. Both products were piloted with younger students from grades K-2, so written surveys were not used to measure student learning and engagement, but classroom observations and short interviews with students conducted during classroom observations were relied on.

Table 4 provides an overview of the different measures used to study product efficacy for each of the products piloted by Avonworth, noting when a measure was deployed more than once.

See Figure 1 for a timeline for research activities at Avonworth. In addition, the research team conducted monthly check-in calls or visits for each of the products with the teachers and administrators.

		Products	
Dimension of Product Efficacy	Measure	*eSpark*	*Puzzlets*
Student Learning	Log Data	✓	✓
	Pre-Post Survey		
	Post-test		✓
	NWEA assessments	✓	
	Interview / Focus Group	✓	✓ (x 2)
Student Engagement	Log Data	✓	✓
	Survey		
	Interview / Focus Group	✓	✓ (x 2)
	Classroom Observations	✓	✓ (x 2)
Teacher Support	Survey	✓ (x 2)	
	Interviews/ Focus Groups	✓ (x 2)	✓
	Observation of PD sessions	✓ (x 3)	
Teacher Satisfaction	Survey	✓ (x 2)	
	Interviews/ Focus Groups	✓ (x 2)	✓
Administrator Satisfaction	Interview	✓	✓

Table 4:
Overview of research methods and measures used

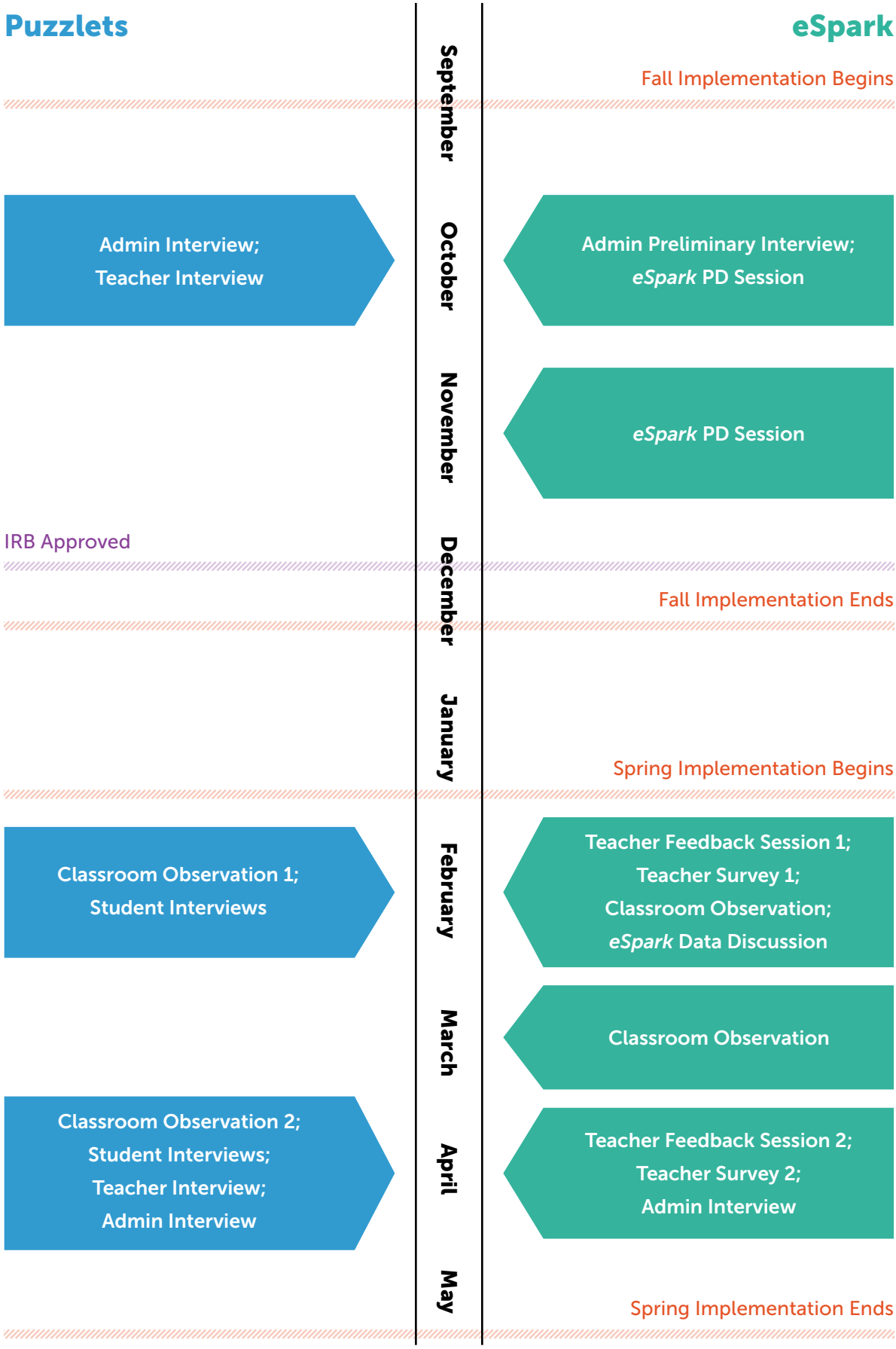

Figure 1:
Avonworth Pilots Timeline

Case Study: Avonworth School District

Product: eSpark

Product Overview & Pilot Goals

eSpark is an adaptive personalized learning platform that provides students opportunities for enrichment based on their mastery of common core standards as measured by standardized assessments. *eSpark* is not meant to replace a curriculum, but to allow students opportunities to explore material that is tailored to their mastery levels. The program curates a library of educational apps based on the desired curriculum enrichment requirements. The goal of the pilot was to test the efficacy of the platform in providing engaging personalized learning content to help students of all levels make sustained academic progress.

Curricular Need

Avonworth Primary School wanted to pilot a learning product that would support enrichment and growth, specifically in English Language Arts (ELA) curriculum in their first grade classrooms. For the past three years, their students have been taking the Measures of Academic Progress (MAP) assessment by Northwest Evaluation Association (NWEA), and the district has been seeing greater variation in ELA scores compared to math. The school district had incoming students testing in at high levels, but wanted to see more sustained growth over the course of the year. School administrators wanted a product that provided the means to offer more individualized instruction, while delivering engaging content (personal communications, email and admin interviews).

Product Implementation Process

eSpark was implemented in six (6) first grade classrooms for English Language Arts. Two out of the six teachers implemented a station rotation model—students used *eSpark* in groups of 3-4 in one of the iPad stations, while other students worked in stations that included more traditional reading, writing practice activities. The remaining four teachers used a whole class model where iPads were available to all students who used *eSpark* at the same time. Avonworth does not have a 1:1 iPads to student ratio, so iPads were shared on a rotating basis.

The recommended amount of *eSpark* usage for the pilot period was three times per week for 20 minutes each time. A total of 129 students participated in the pilot across six classrooms. Of these, only the 64 students who returned signed consent forms were included in classroom observations and student interviews. The implementation of *eSpark* began in the first week of September and continued until the end of the school year.

Research Questions & Study Design

For the *eSpark* product pilot, the research team examined four prescribed dimensions of product efficacy—student learning, student engagement, teacher support and satisfaction, and an additional dimension of administrator satisfaction—using a mixed methods approach. Classroom observations, student interviews, and two rounds of teacher feedback sessions

provided insights on student engagement and student and teacher satisfaction. In addition, teacher surveys were conducted at a midpoint and towards the end of the implementation, along with an administrator interview at the end of the pilot period. The research team also observed two professional development sessions conducted by *eSpark* over a videoconferencing set-up, one a few weeks after the launch of *eSpark*, and the other towards the midpoint of the implementation.

eSpark made available an anonymized dataset which provided information on key indicators of student learning, such as, number of quests completed by each student, pretest and posttest performance, and number of tries needed to attain mastery in a given level. This dataset was refreshed daily. These learning data were analyzed to gain insight into students' performance and learning over the course of the pilot.

To assess teacher support and satisfaction, a feedback elicitation activity was conducted, in which teachers were asked to reflect on the benefits and the challenges of using *eSpark* in the classroom. Teachers wrote down the benefits and challenges on warm colored and cool colored sticky notes respectively, and then the group collectively shared and discussed each comment. For the discussion, an affinity grouping technique was used to gather related comments into idea-clusters that were used to report teacher feedback to the school administration and the *eSpark* product team.

Evaluation Findings

In the following sections, key findings on the following dimensions of product efficacy — student learning, student engagement, teacher support, teacher satisfaction, and administrator satisfaction that emerged over the course of the pilot will be presented. In addition, factors such as technology issues and data insights that emerged in the analysis will also be discussed.

Student Learning

Each quest in *eSpark* is mapped to a common core standard. Before beginning a quest, students take a pre-quiz. If they score 100 percent on the pre-quiz, they directly move on to the next quest. After completing the quest, students take a post-quiz. They get three chances to obtain a mastery criterion of 80 percent on the post-quiz to move on to the next quest. If a student does not get 80 percent on the post-quiz after three tries, they are locked out of *eSpark* for 10 minutes and asked to review the material in the quest, after which they make a video demonstrating their understanding of the material in the quest, and are promoted to the next quest.

Learning data provided by *eSpark* from September 10 (when *eSpark* was first launched at the beginning of the school year) until May 6 revealed that on average, students moved up 16.1 common core standards since they first started (*SD* = 7.09).

Of all quests completed (*n* = 2078), 31 percent were at the 1st grade reading level, 32 percent each at the 2nd and 3rd grade reading levels, and about 5 percent at kindergarten level. Small outliers of less than 1 percent each were at the Pre-K and 4th grade reading levels (see Figure 2).

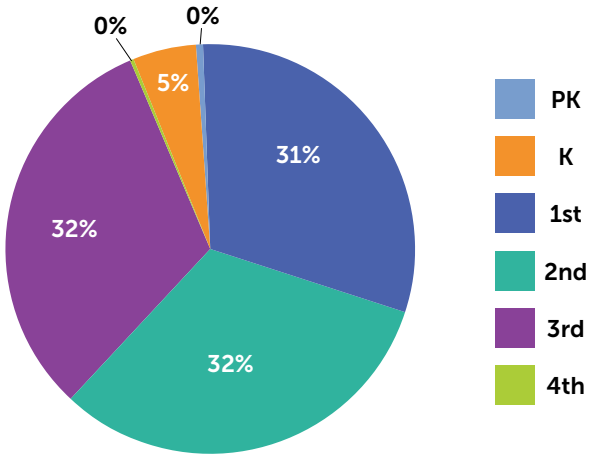

Figure 2:
Quests completed by reading level

Next, looking at the number of attempts to complete the post-quiz, it can be seen that in over 50 percent of the quests, students needed the full three attempts to complete the post-quiz (see Figure 3).

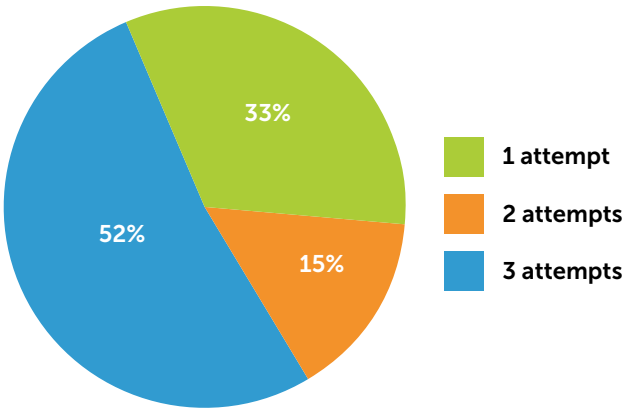

Figure 3:
Number of attempts needed to complete post-quiz

Furthermore, of those quests in which students needed three attempts on the post-test, students scored a mastery level of 80 percent or more only 14 percent of the times (See Figure 4). For the remaining 86 percent of the quests, students did not reach mastery criterion after three tries, they were however promoted to the next standard after making a video on the content of the quest. This finding suggests that the quest recommendations are not being appropriately leveled to reliably enable students to achieve mastery, and gain the satisfaction and positive affect associated with success.

The above analyses show that even though a large percentage of students are working above grade level in *eSpark*, they have not necessarily mastered the material as they move through quests. Feedback sessions with teachers corroborated these findings. Teachers reported that they thought much of the content was not at the right level for students.

Failing frequently on the post-quizzes can be demotivating, and may cause students to lose interest. Teacher feedback also captured this insight,

> "...the content is beyond productive struggle. I don't see what value they are getting because it is just too hard for them."
>
> *—1st grade teacher*

NWEA Data Analysis

One of the key objectives for piloting *eSpark* was to see sustained progress in student achievement in ELA as measured by NWEA scores. Students at Avonworth take the NWEA assessments at three time-points in the school year — fall, winter, and spring. The fall assessment was administered in October 2015, after about four weeks on instruction. The winter assessment was given in January, after 20 weeks of instruction. The spring assessment was given in May, after 32 weeks of instruction. We analyzed NWEA scores from each assessment to see how students' scores changed over the year.

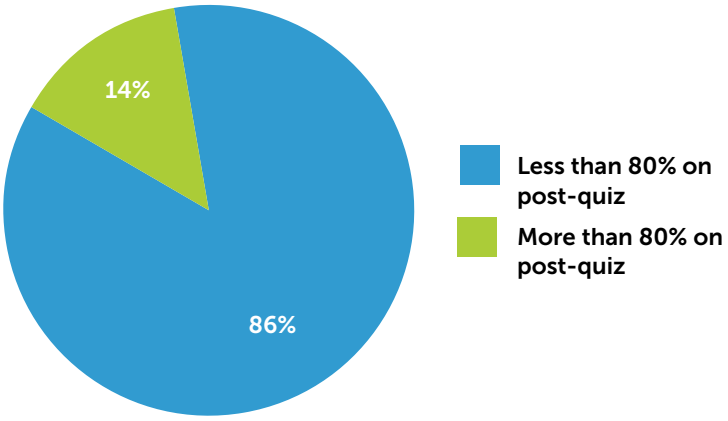

Figure 4:
Percentage of students who passed post-quiz after three attempts

Figure 5 is a histogram showing the number of 1st grade students in each percentile for reading. As is evident from the right skew of the graph, students were testing at high levels at the beginning of the school year, with a mean of 76.43, and a standard deviation of 22.49.

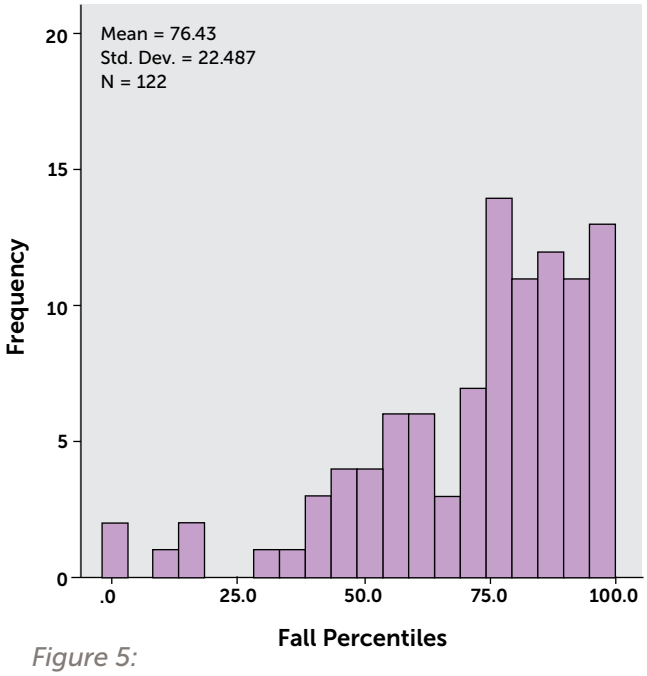

Figure 5:

Histogram showing number of students in each percentile during the fall assessment

Figure 6 is a histogram for the same cohort of students tested in the winter. On the winter assessment, students' scores on reading fell slightly, with a mean percentile rank of 71.42, and standard deviation of 27.70. The scores remained fairly steady at the spring assessment, as seen in Figure 7, with a mean of 70.74 and standard deviation of 25.85.

As this pilot was not a randomized controlled trial, any changes in scores whether positive or negative cannot be causally attributed to *eSpark* usage. Several other factors including instruction outside of *eSpark* may play a role in student achievement. Nevertheless, we do not see patterns of increasing student achievement scores in NWEA data, after eight months of *eSpark* usage.

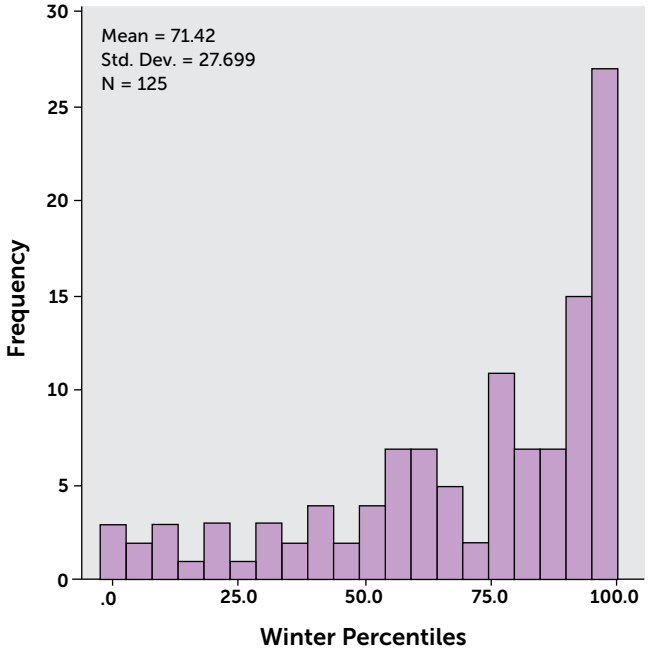

Figure 6:

Histogram showing number of students in each percentile during the winter assessment

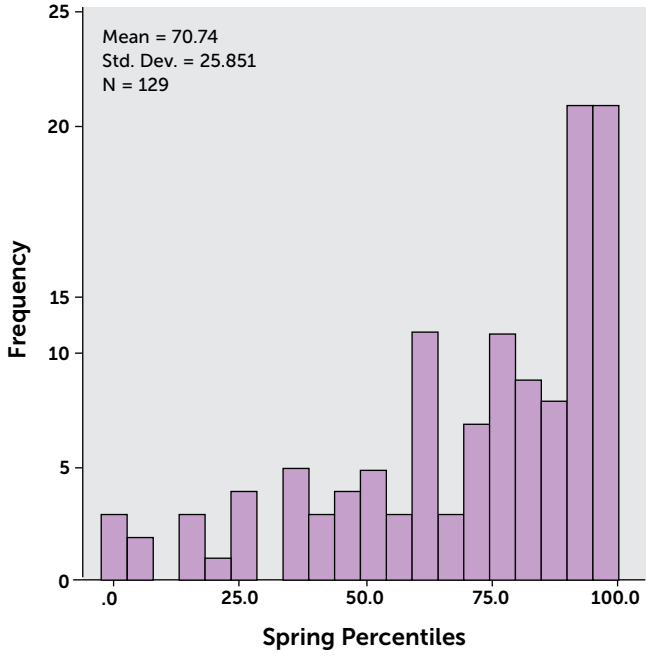

Figure 7:

Histogram showing number of students in each percentile during the spring assessment

Student Engagement

Qualitative analyses of student interviews and classroom observations indicated that students found *eSpark* engaging:

> "I like it...It's kind of like an action movie"
>
> *—1st grader about a video in* eSpark

> "... the kids do like being on the iPads, it is something they find engaging."
>
> *—Teacher comments during feedback session*

A few students commented that they did not like taking the quizzes. This finding may be associated with our data analysis results that indicated students often need three tries on the post-quiz, and when they frequently fail to get it right after three tries, it may be demotivating.

eSpark also asks students to rate each app or video after they are done interacting with it. If they like the app or video, they click the thumbs-up sign, and if they do not, they click the thumbs-down sign. In the engagement data made available to us by *eSpark*, the ratings were coded as 1 if the student liked the app or video, -1 if they disliked it, and 0 if they did not provide a rating. The average rating was 0.68, suggesting that on average, students were more likely to like the apps or video than dislike them (the average rating would have been negative, had they disliked more videos). However this rating is a very simplistic measure, and has limited validity and reliability as a measure of engagement.

Analysis of time learners spent in an individual app or video would have been a valuable measure of student engagement, however usage time could be logged because most of the apps and videos are third party, and *eSpark* did not have access to their data. As a result, time spent within an app or video segment could be used as a measure of engagement.

Teacher Support

Teacher support was assessed through teacher feedback sessions, support measures included in survey items, administrator interviews, and by observing professional development sessions conducted by *eSpark* at two time points in the implementation. See Appendix 1A: Teacher Pre-Survey and Appendix 1B: Teacher Feedback Session Protocol.

- Professional development included an initial orientation session followed by three visits during the year. Teachers comments during the feedback sessions and their responses on the surveys indicated that professional development provided by *eSpark* was helpful and adequate.

- *eSpark* provides a teacher dashboard, which allows teachers to monitor student's progress (See Figure 8 for screenshot). Teachers can see key information such as what quest each student is currently on, when they started a quest, when their last login was, their pre-quiz and post-quiz scores, etc. Upon clicking a student's name, they can see more detailed information such as the names of the quest, which videos and apps they interacted with, and the videos that the student uploaded upon completing each quest.

- If a student is struggling, or needs extra practice with a particular topic, a teacher can manually change the students' reading goal using the dashboard.

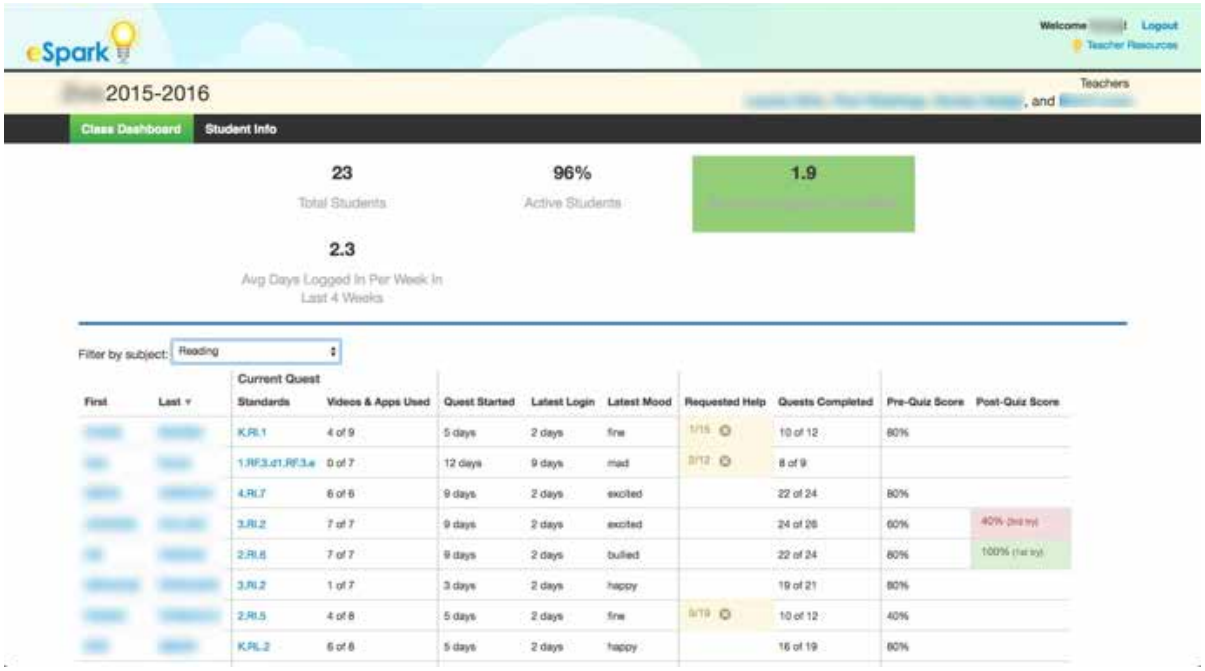

Figure 8:
Screenshot of Teacher Dashboard

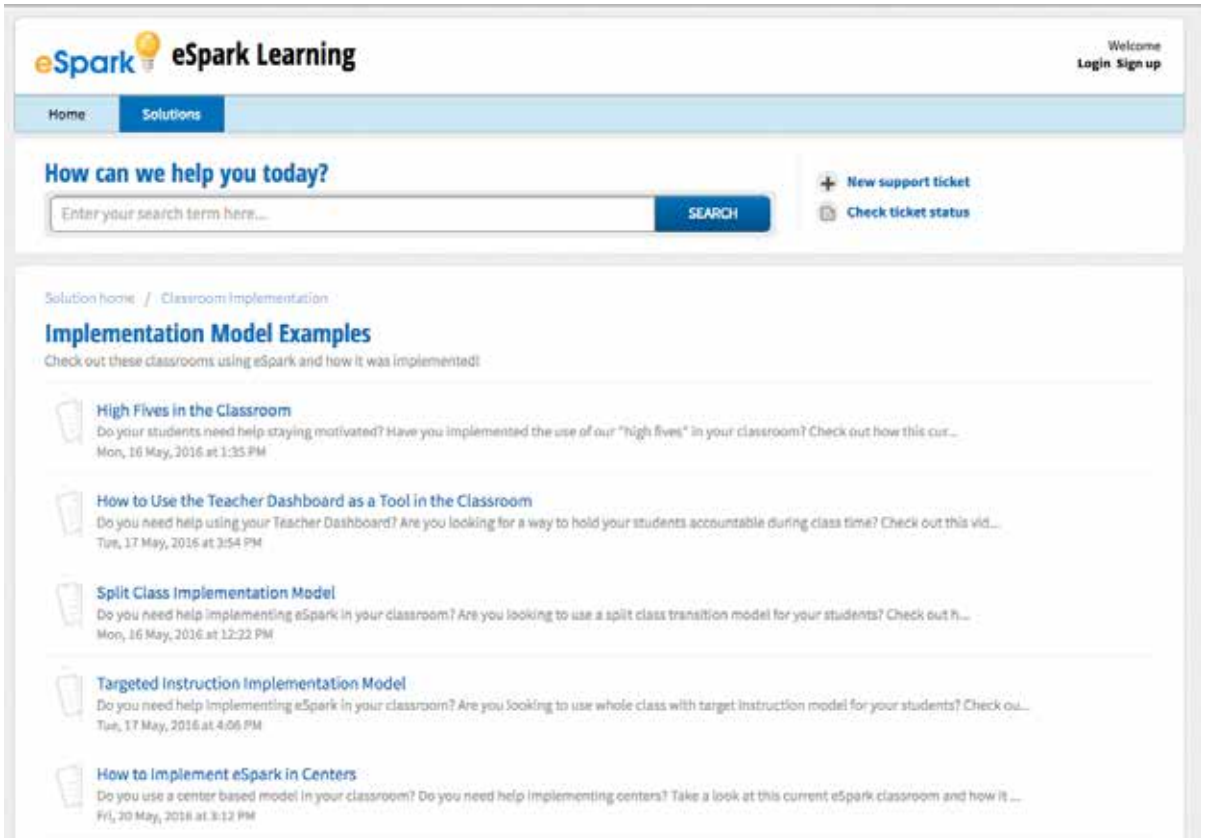

Figure 9:
Example Help Topic under Teacher Resources

eSpark provided teachers with weekly emails for each class showing a log of quests completed and which students spent too long on a quest. Teachers commented that they relied on emails more for communication rather than using the dashboard. The dashboard contained a lot of information, and it is time-consuming to review for every student. Teachers felt the emails were helpful because they gave a quick snapshot of how the class was doing.

eSpark provides comprehensive teacher resources on its website which offer how-to's and detailed information on topics such as initial set-up, classroom management ideas, video creation, iPad tips and tricks, and basic troubleshooting among others (see Figure 9 for an example of a how-to page under teacher resources).

Teacher Satisfaction

The key takeaways on teacher satisfaction based on the teacher feedback sessions and responses to surveys were as follows:

Benefits of using *eSpark*:

- Students enjoy using the iPads; they provide an engaging medium.
- *eSpark* works well for high achieving students, they seem to benefit most from using the apps.
- When used in station rotation model, it can provide an activity for students to do independently, which means the teacher can help out another student group

Challenges faced when using *eSpark*:

- *eSpark* is not well aligned with the curriculum. Some apps require students to do quests on material that is much more advanced than what is being covered in the classroom.
- Students' not passing the post-quizzes about 50 percent of the times is a concern. If a student is struggling, currently there is no way to notify a teacher, unless the student asks for help.
- Teachers felt that the NWEA scores are not a good measure for placing students in quests.
- Teachers were concerned that *eSpark* is time consuming and takes time away from other curricular activities.
- Teachers reported frequent technical challenges, particularly related to audio.
- Recording videos is hard for students. Writing scripts requires too much one-on-one teacher support and time.
- Debugging is a challenge. Teachers don't know the apps so they don't have ready answers to address student questions. First graders are too young to figure out on their own.
- Lower achieving and special-ed students struggle with *eSpark*.

In sum, while teachers agreed that *eSpark* provides an engaging learning medium for students, and can provide opportunities for enrichment, in it's current form teacher felt it was not meeting their or their students' needs. The biggest concern voiced was that the quests were not aligned with the curriculum, and were pushing content beyond the level of students' mastery. Using *eSpark* three times a week in class was time-consuming, and took away valuable instructional time. Additional challenges such as technical difficulties, insufficient numbers of iPads, and the utility of making and reviewing videos were also voiced as concerns by more than one teacher.

Administrator Satisfaction

Administrator satisfaction was assessed through semi-structured interviews with the principal (see Appendix 1C: Administrator Interview Protocol for Administrator Interview Protocol).

Analysis of interview data revealed some disconnect between the original goals and expectations for the pilot, and teachers' experiences in the classroom. The primary goal of using *eSpark* was to provide opportunities for enrichment. *eSpark* recommends that teachers use it three times a week for 20 minutes to achieve optimal learning gains. However, teachers felt this additional requirement cut into already constrained instructional time, without offering much value in return, because the quests did not map well to the curriculum, it therefore was not the right tool for enrichment. While the principal stressed that *eSpark* was to be used for enrichment and not for remediation, he was in agreement that the relatively low performance on the posttest was a concern, and was likely a result of quests not being aligned with the curriculum.

In terms of satisfaction, the principal was satisfied with student engagement in *eSpark*. He noted that he was still undecided on the student achievement aspect, and will wait to see student progress on the spring assessments to make a decision on whether to continue using *eSpark*.

Conclusion

eSpark, a personalized learning platform was chosen to improve achievement on ELA by providing enrichment opportunities for first-grade students at Avonworth. Our investigations revealed several actionable insights about the product as well as the pilot process. The company was responsive to feedback, and iterated upon the feedback by providing specific action points that would improve the experience for both students and teachers, and make it better aligned with the curricular goals of Avonworth.

Analyses of NWEA data showed that although incoming students were testing at high levels of achievement (76th percentile), their scores dropped in the winter testing to 71st percentile, and stayed plateaued at the 71st percentile in the spring testing.

In terms of pilot process, clear communications of goals and objectives with all stakeholders, as well as establishing a timeline ahead of the implementation, and ensuring buy-in by teachers and administrators alike emerge as the most salient takeaways.

Case Study: Avonworth School District

Product: Puzzlets

Product Overview & Pilot Goals

Puzzlets is a hands-on learning game system that includes 22 "*Puzzlet*" tiles that fit into a play tray, which connects wirelessly via a Bluetooth connection to an iPad game app "Cork the Volcano." Using operator (directional) and variable tiles, players are required to map out a sequence of moves that enable the character to navigate through a series of screen-based scenario challenges that become increasingly more complex as players complete levels. Based on interviews with the cognizant school administrator and teacher, the established goals for the *Puzzlets* pilot at Avonworth school district were as follows:

- Test out *Puzzlets* learning affordances for communication, collaboration, creativity, and computational thinking in K-2 classrooms (teacher interview, principal interview, grant proposal).
- Evaluate whether *Puzzlets* provided an engaging alternative to other educational technology courseware

Curricular Need

Avonworth Primary Center is engaged in developing a new curriculum for Digital Literacy, focused on bringing 21st century skills such as communication, collaboration, creativity, and to provide early exposure to learning activities that support the growth of computational thinking skills. The school wanted to pilot a product that would support the above objectives, while also being engaging to students. The former technology curriculum focused primarily on basic computer skills such as keyboarding, mouse and software tool use, which was neither very engaging for students, nor was preparing them sufficiently for future-oriented fluency with technology and computing.

Product Implementation Process

One classroom each from grades K-2 was chosen to participate in this pilot. Each class rotated through a 14-week curriculum, meeting once every six days for 45 minutes. The teacher used a station rotation model where children rotated through 3 station setups *Puzzlets*, *Type Rocket* and *Scratch Jr.*, and were able to spend approximately 15 minutes at each. After the first two weeks, the *Scratch Jr.* station was dropped as the teacher felt students mostly spent their time coloring or doing tasks that did not contribute to their learning computational skills. As a result, after the first two weeks of the implementation, students worked on two

Figure 10:
Student pairs engaged in *Puzzlets* gameplay

stations instead of three, spending between 15-20 minutes at each. They worked on *Puzzlets* in pairs, working with the same partner throughout the course of the pilot.

Only those students whose parents or guardians had provided consent participated in the study. Unconsented students engaged in classroom activities, but were not interviewed and their data was not included in the final data analysis. Sixteen (16) kindergarteners, twenty-two (22) 1st graders, and eighteen (18) 2nd graders participated in the study, for a total of fifty-six (56) participants.

Research Questions & Study Design

For the *Puzzlets* product pilot, the research examined the four pre-defined product efficacy dimensions—student learning, engagement, teacher support, and satisfaction, along with an additional dimension of administrator satisfaction—using a mixed methods approach. Two rounds of classroom observations were conducted in addition to student interviews, and semi-structured teacher and administrator interviews at the beginning and end of the pilot period. Log data made available by the developers were analyzed to examine students' progress over the course of the pilot. In addition, as this was a product initially developed for the home market and in the early stages of being adapted for classroom use, the research team conducted a standard heuristic analysis of product usability and learning affordances to generate a set of design recommendations.

Two classroom observations were conducted—one at the beginning of the implementation (first week of February), and one at a midpoint (first week of April). These observations were designed to be a window into student engagement and student learning. For the first classroom observation, two researchers visited the classrooms, and made structured observations using coding sheets to capture measures of student learning and engagement which were developed in consultation with the teacher (see Appendix 1D: Classroom Observation Protocol). Six pairs of students from each class were randomly selected. The researchers audio-recorded their interactions, and made notes about behaviors, gestures and teacher interactions on observation sheets. Additionally, at the end of a play session students were asked a series of questions about whether they liked using *Puzzlets*, whether it was easy or hard, and then they were given a choice of task to indicate their preference for playing *Puzzlets*, *Scratch Jr.* and *Type Rocket* (see Figure 11).

After each rotation was over, researchers noted whether students chose to continue playing or moved on to the next rotation immediately. We also looked for technical challenges and points of intervention by the teacher.

Figure 11:
Screenshots of interfaces of *Puzzlets*, *Type Rocket*, and *Scratch Jr.*

During the second classroom observation, students were asked to complete an additional debugging task in *Puzzlets*. The *Puzzlets* board was presented to the students with an incorrect sequence of tiles (See Figure 12), and students were asked to rearrange the tiles such that the character will move in the correct fashion.

In addition, during both classroom observations, researchers looked for evidence of collaboration, and noted technical challenges experienced.

Evaluation Findings

In the following sections, findings across each of the product efficacy dimensions — student engagement, student learning, teacher support, teacher satisfaction, and administrator satisfaction are summarized.

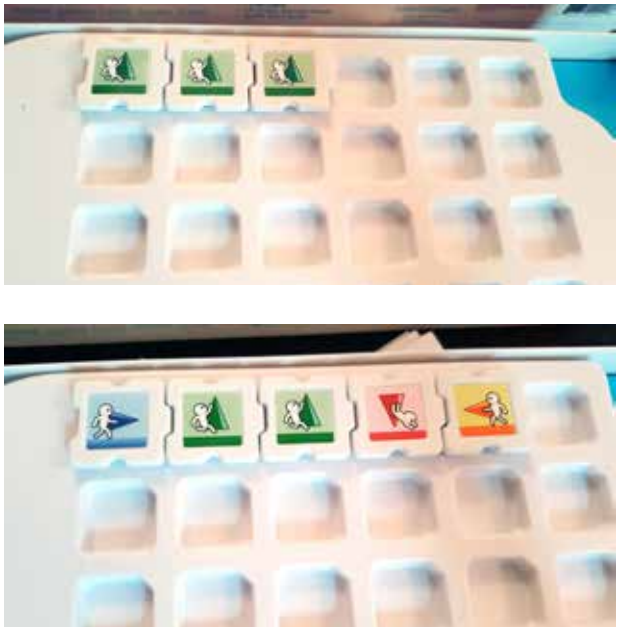

Figure 12:
Debugging tasks presented during Classroom Observation 2

To understand student learning and engagement, the research team relied on various qualitative and quantitative measures.

Qualitative measures included student interviews and classroom observations, and quantitative measures included a debugging task designed to capture students' understanding of correct and incorrect sequences, and analyses of log data provided by Digital Dream Labs. Log data provided information on event properties, such as time taken to complete a level, number of pieces used to construct a sequence, number of tries needed to complete a level, number of raindrops (additional incentives embedded in game) collected, in addition to user properties such as grade level, log in and log out times etc. The log data is at the level of student pair.

Student Engagement

Evidence from interviews and classroom observations indicated that students across the three grade levels were highly engaged and enjoyed playing *Puzzlets*. The level of engagement was sustained from the first observation (conducted on the first session of game-play), to the second classroom observation (conducted on the fifth session of game-play). Based on log data, students in each grade played *Puzzlets* for a total of approximately 60 minutes across five sessions from February to early April.

Some students commented that they liked the game-playing aspect of *Puzzlets.*

> "It's fun...it's like a little video game."
>
> —*1st grade student on* Puzzlets

Others liked the tangible interaction with the play tray

> "... the tray makes it really fun... you can make the character on the screen move."
>
> —*Kindergarten student on* Puzzlets.

For the station-choice task in our first classroom observation, 27 out of 36 students selected *Puzzlets* as their first choice, 6 chose *Type Rocket*, and 3 chose *Scratch Jr*. About a third of the student pairs continued to play *Puzzlets* even after the rotation was signaled to be over, and a few others moved on to the next rotation, but expressed disappointment about doing so.

Student Learning

Analysis of log data revealed that while all students progressed in the game since they started playing, their progress differed by grade level. All students started playing at level 1, and each level contains 7-8 sub-levels. The highest level reached by kindergartners was 2-7, by first-graders was level 3-1, and by second graders was 3-5.

The average number of tiles used to construct a sequence, and how this number can be used a proxy for complexity of sequences constructed. Figure 13 shows the average number of tiles on the final sequence for each day of game play broken up by grade. Error bars indicate standard errors. From the graph, it is seen that on day 1, students used close to three tiles on average to construct the final sequence, while on day 5, they used over five tiles on average to construct their final sequence. There was a trend of grade 2 students using slightly more tiles on average, than grade 1 and kindergarten students; however, this difference was not statistically significant.

Note that this finding should be interpreted with caution, because as students gain more expertise on the game, the number of tiles used may not be associated with complexity of sequence constructed, as they learn to accomplish the same result with a fewer number of tiles.

An alternative way of assessing complexity of final sequences constructed would be to look at how many times the operators — x2 and x3 were used. These are relatively complex operators, compared to the directional tiles. Out of 784 final sequences constructed, students used either the x2 or the x3 operator 58 times. Figure 14 shows the breakdown of frequency of use of complex operators by grade-level. Second-graders were over twice as likely as first-graders and nearly thrice as

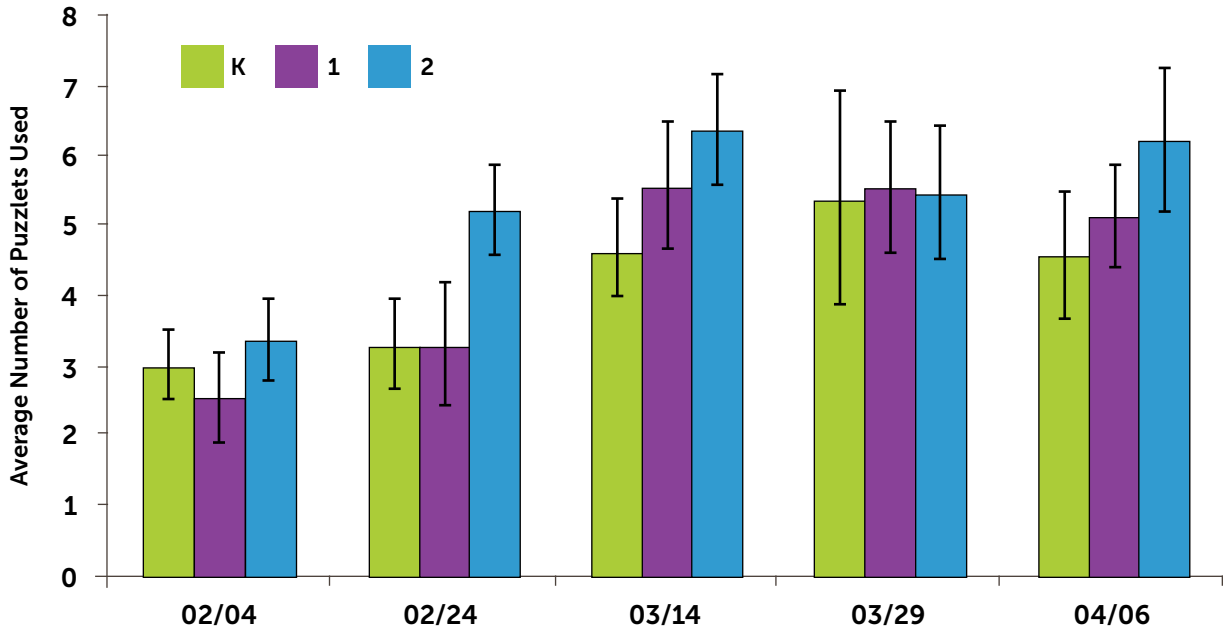

Figure 13:
Average number of *Puzzlets* used by grade

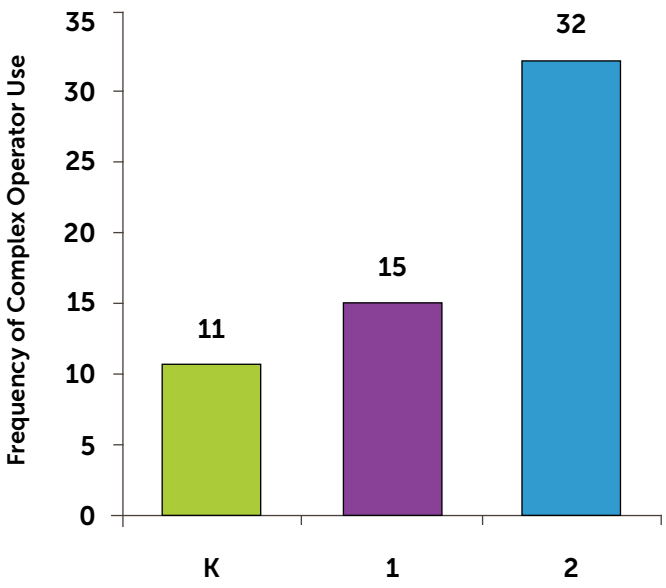

Figure 14:
Average number of *Puzzlets* used by grade

likely as kindergartners to use the complex operators in their final sequences. Thus, older children are more likely that younger ones to adopt and use the more complex operator.

Performance on the debugging task also showed some differences by grade level. All pairs (3 kindergarteners, 6 first-graders, and 5 second-graders) correctly solved the first debugging task. One out of two pairs of kindergartners correctly solved the more complex second debugging task correctly. Among first graders, all six pairs correctly solved the second debugging task, but one of the pairs required several tries. Among second graders, five out of six pairs solved it correctly, and one pair ran out of time.

Although not a controlled experimental task with random assignment and carefully monitored times on task, the debugging task provides some insight into student progress and their problem-solving skills within the game. Students' progress through the game levels and performance on the debugging task suggests that they learned problem-solving strategies within the game context after four in-class sessions using the game.

Teacher Support

Teacher support was assessed based on interviews with the teacher and principal (See Appendix 1F: Teacher Interview Protocol and Appendix 1C: Administrator Interview Protocol), and communications with Digital Dream Labs. Overall, teacher support provided by the company was timely and helpful. Individual accounts for students are not currently available, but Digital Dreamlabs set them up for student pairs in the three classrooms being observed, so that their data could be tracked systematically over the course of the pilot. The lead developer from the company was also present during the first classroom observation, to help with getting started and troubleshooting issues.

Given that the product is still being adapted for use in classrooms, the company does not have a fully implemented professional development plan and supporting materials and resources for teachers. While this was not a problem in the present pilot as the teacher has been the educational advisor for the product and is very familiar with its use in the classroom. Teacher support and tested training materials will need to be produced for larger-scale adoption in schools.

Teacher Satisfaction

Teacher satisfaction was examined through semi-structured teacher interviews. Only one teacher was involved in this pilot. As previously noted, this teacher acts as an advisor to the product developer, Digital Dream Labs, and has conducted her Master's thesis research based on *Puzzlets*. Despite these confounding factors, the key findings relating to teacher satisfaction were as follows:

- The teacher noted that she got a lot of positive feedback from students and parents, and that she found students to be engaged when working on *Puzzlets* in the classroom
- Students are increasingly getting more competitive when using *Puzzlets*

- Avonworth is not a 1:1 iPad school, so sharing of devices is necessary. *Puzzlets* was not originally designed for classroom use, so currently a maximum of only three logins is available on each device. So, students' work can't be saved, and often students have to play resume a level played by a student who used device before them.

- Being able to see the data on student progress would be a big plus.

Self-reported satisfaction is not necessarily indicative of teachers less involved with the product development. As more teachers get involved in using this product in the classroom, there will be an opportunity to study this dimension in greater detail.

Administrator Satisfaction

Administrator satisfaction was assessed through a semi-structured interview with the principal of the Primary Center (Appendix 1C: Administrator Interview Protocol). Overall, the principal was satisfied with the product. He noted that the developers were responsive to suggestions, and were appreciative of feedback. They talked directly to the kids using *Puzzlets*, and gathered feedback and suggestions. *Puzzlets* was an exceptional case in that, the district would not normally choose to pilot a product that is still in development and does not contain basic functionality for an ed-tech product, such as a teacher dashboard, and student log-in screen. However, the teacher's deep knowledge of the product, as well as the developers' responsiveness were key factors for the principal to decide to pilot *Puzzlets.*

In terms of suggestions for improvement, the principal noted that the curriculum/ scope and sequence needs to be more developed. There also needs to be a plan for more comprehensive professional development, which will guide the teachers on getting started, diagnosing and troubleshooting issues, and other relevant topics.

Additional Observations / Findings

Collaborative Behaviors

The evidence for collaboration was mixed. During the first round of observations, players did not seem to communicate very much with each other about strategies. Most often, one player took control of the *Puzzlets* board, while the other took control of the screen. The division did not seem to be the most beneficial for collaboration, because one player generally decided the strategy, while the other executed.

In the time between the first and second rounds of observations, the teacher introduced some strategies for collaboration. Of the strategies involved one player taking on the role of "driver" and the other the "passenger", and switching roles midway between their play. Researchers noted more evidence of turn taking and discussion about strategy was observed in the second round of classroom observations.

Conclusion

As an early-stage product, *Puzzlets* shows promise in promoting 21st century skills of communication, collaboration, creativity, and computational thinking in students. In order to improve its educational value, we made several recommendations on usability, intuitiveness of experience, increasing complexity, and promoting communication and collaboration. To improve teacher support, the company is in the process of developing a teacher dashboard, through which teachers can access data on students' progress. The company is also developing a comprehensive professional development plan, which will help teachers integrate it into their curriculum.

The teacher and administrator at Avonworth were satisfied with the student engagement aspect of *Puzzlets*. They were also satisfied with the level of support provided by the developers, and plan to continue the partnership with Digital Dreamlabs for the next school year.

Computational skill development is an expressed goal and desired outcome for this product. To better assess and identify student learning with *Puzzlets* it would be important to determine which knowledge components of computational thinking are being targeted. A pretest and a posttest could assess students' knowledge of those components gained through using *Puzzlets*. Additionally, providing teachers and students with vocabulary to tie *Puzzlets* play experiences to computational expressions and terms such as operators, sequencing, and parsimony would help increase the promise and value of this product as an educational tool. With these learning goals and constructs defined, future studies could examine more in-depth the learning potential of *Puzzlets* as an ed-tech product that supports the development of computational literacy skills in learning play.

Key Takeaways

Key takeaways from the two pilots at Avonworth can be summarized as follows:

- Communicating the goals and objectives for the pilot with teachers early in the process and making the courseware available well in advance of the start of school year would help reduce teacher challenges.
- Providing teachers with opportunities for hands-on time with the product to get to know it before integrating it into classroom curriculum would be beneficial
- Before piloting a product, possible technological issues should be anticipated, and developers should be able to articulate a plan for provide troubleshooting support for resolving those issues
- Learning analytics should be readily available and easy to parse. Dashboards that provide extraneous information are likely to be underused compared to those that provide accessible and pertinent information
- Access to external research partners makes it easier to gather objective feedback – teachers feel comfortable sharing their feedback in an uninhibited manner.
- When piloting products with younger participants, survey measures cannot be reliably used to gather student feedback. Alternative ways for capturing student voice, e.g., survey scales that use pictures or smiley faces to represent engagement should be considered.

Case Study:

Elizabeth Forward School District

The Elizabeth Forward School District (EFSD), a member of the Digital Promise League of Innovative Schools, is a small, suburban school district in Elizabeth, PA in Allegheny County, about 15 miles to the southeast of the city of Pittsburgh.

It serves close to 2400 students, with nearly 40 percent of them from economically disadvantaged households (based on students qualifying for free or reduced lunch).[3] Elizabeth Forward has implemented 1:1 computing since 2013 and all students in K-12 at EFSD have iPads (see Table 5 for district snapshot). EFSD is focused on creating a culture that supports learning using technology. EFSD has worked closely with local partners and successfully leverages the robust network of philanthropy, industry, museums, and universities in Pittsburgh to provide deeper learning opportunities for students.[4]

For the 2015-16 school year, Elizabeth Forward piloted *Amplify* games — a suite of over 30 games in the subject areas of middle school ELA, math, and science. The school wanted to offer students an engaging alternative to playing video games during extra-curricular time, to direct that time to educational activities on the iPads. Elizabeth Forward also wanted to explore how well the games aligned with curricular needs, and whether they could be integrated with classroom instruction.

Table 6 provides an overview of the different measures used to study product efficacy of *Amplify* games at Elizabeth Forward, noting when a measure was deployed more than once. Figure 15 shows a timeline of research activities conducted at Elizabeth Forward. In addition, we conducted monthly check-ins phone calls with the teachers.

Number of Students Served	School Ranking	Percent free or reduced lunch	Products Piloted	Target Subject Areas	Grade-Levels in Pilot
2400	181/ 498	40	*Amplify Games*	ELA, Math, Science	6, 7, 8

Table 5:
Elizabeth Forward School District Snapshot

[3] Pennsylvania Dept. of education website

[4] Remake Learning Playbook

Elizabeth Forward School District (*Amplify Games*)

Dimension of Product Efficacy	Measure	
Student Learning	Log Data	
	Pre-Post Survey	✓
	Post-test	
	NWEA assessments	✓
	Interview / Focus Group	✓
Student Engagement	Log Data	✓
	Survey	✓
	Interview / Focus Group	✓
	Student Activity Observations	✓
Teacher Support	Survey	✓ (x 2)
	Interviews/ Focus Groups	✓ (x 2)
	Observation of PD sessions	✓
Teacher Satisfaction	Survey	✓ (x 2)
	Interviews/ Focus Groups	✓ (x 2)
Administrator Satisfaction	Interview	✓

Table 6:
Overview of research methods and measures

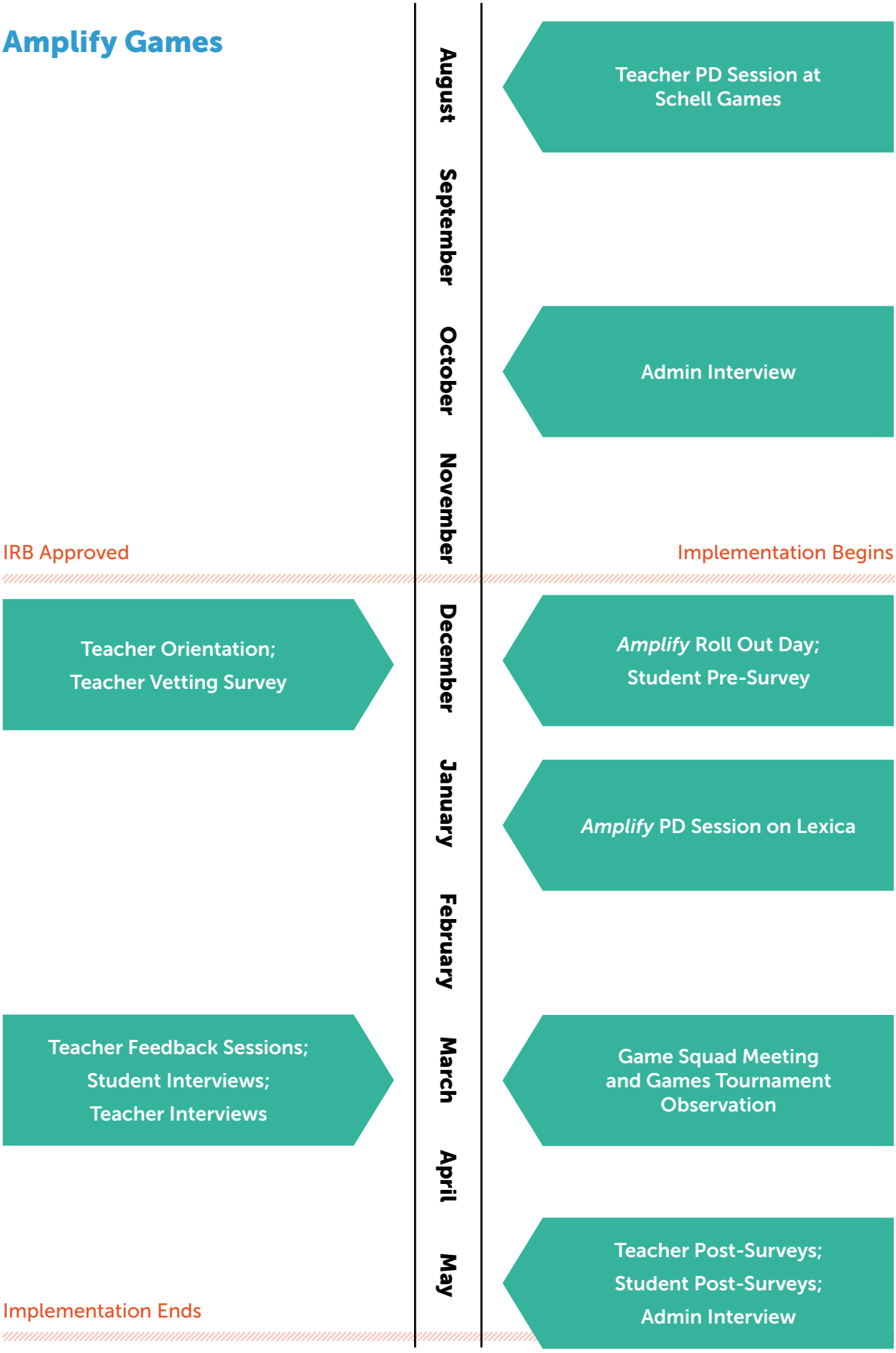

Figure 15:
Timeline for *Amplify* games pilot at Elizabeth Forward School District

Case Study: Elizabeth Forward School District

Product: Amplify Games

Product Overview & Pilot Goals

The *Amplify* suite of games comprises English Language Arts (ELA), science, and math games designed for middle school students (see Appendix 2A: Games in *Amplify* suite for complete list of games). The ELA games are organized in the World of Lexica ecosystem, which comes bundled with a digital library of 600+ books, along with games and side-quests that help with skills such as spelling, grammar, and vocabulary building. The science and math games are stand-alone game applications, with math games centered around building skills for pre-algebra, and science games being more topic-specific (e.g., cell-biology, ecosystems, properties of light).

The goals of the pilot were as follows:

- Test whether *Amplify* games provide an engaging alternative to non-educational games that students play during leisure time
- Explore integration of educational games into classroom instruction
- Encourage competition among students and create a culture of gaming at the school
- Encourage students to read more books through the *Amplify* library (specific to Lexica)

Curricular Need

Initial interviews with the administrator revealed that the goal for *Amplify* games was to not replace in-class instructional time, but rather to redirect students' leisure time iPad use towards learning materials by providing high quality educational games. However, if teachers found any of the games that fit with their curriculum, they were encouraged to integrate them into classroom instruction.

Research Questions & Study Design

For the *Amplify* games product pilot, we examined four product efficacy dimensions — student learning, engagement, teacher support, and satisfaction using a mixed methods approach. We conducted two teacher feedback sessions, individual student and teacher interviews, and admin interviews, deployed teacher and student surveys at two time points, attended professional development sessions conducted by *Amplify*, and observed a game tournament organized to incentivize students to play the games. In addition, Elizabeth Forward and *Amplify* were interested learning more about what kinds of engagement and incentive structures correlated with increased use of *Amplify* games, so we expanded our study design to examine this question as well.

In addition to rapid cycle product efficacy assessments, an important aspect of this work is to provide meaningful feedback cycle loops with developers so they can utilize the findings, data and insight to improve their products as well understand the particular local conditions and factors affecting deployment. To gather feedback data effectively, two months into the roll out of *Amplify* games, we conducted feedback elicitation sessions with teachers

from each of the three grades, in which we asked them to reflect on the benefits and the challenges of using *Amplify* games both in and out of the classroom. Teachers wrote down the benefits and challenges on colored sticky notes respectively, after which they discussed each idea as a group. During the group discussion, we grouped related ideas into idea-clusters. Members of the research team at *Amplify* games were also present during the feedback sessions, which provided an opportunity for teachers to share their feedback with the *Amplify*.

Product Implementation Process

Elizabeth Forward is a 1:1 iPad school where students take their iPads home with them after school, and keep them during breaks and over the summer. For this pilot, Elizabeth Forward decided to test the full suite of games, which included science, math, and ELA games in all classes of their middle school. The ELA Lexica games developed for *Amplify* were produced by a local game design company, Schell Games.

In the summer before launch, 15 teachers visited Schell games for a hands-on introduction to the games. The actual rollout of the games was significantly delayed from the initial projected timeline. The STEM games were rolled out in December right before winter break, at which point, STEM teachers were told to spend some time playing the games on their own time to see if any of them fit into their curriculum. Lexica was available in its full functionality and compatible with the latest iOS upgrades by late January.

474 students across 6th, 7th, and 8th grades participated in the pilot. Of these, we obtained informed consent from 18 students, 6 from each grade for conducting in-depth one-one interviews. 19 ELA, math, and science teachers from 6th, 7th, and 8th grades participated in the teacher surveys, feedback sessions and interviews.

The main goal of the pilot was to get the students to play games outside of the classroom. To get students interested in the games, incentive activities were organized by teachers at Elizabeth Forward, supported by *Amplify*. A Games Squad comprising of 26 students was formed to act as gaming ambassadors. The Games Squad helped organize multi-player game tournaments for each of the following games — MasterSwords, Tyrant, Mlob Rule in March, April, and May respectively.

Product Efficacy Findings

In the sections below, we describe our findings for the four dimensions of product efficacy — student learning, student engagement, teacher and administrator satisfaction, and teacher support.

Student Learning

We analyzed NWEA data for students from all 6th, 7th, and 8th grades, for math, reading, and science. At Elizabeth Forward, students take the NWEA assessment three times during the school year — in the fall, winter, and spring. These assessments provide one way to assess change in student achievement over the period of the school year.

Figure 16, Figure 17, and Figure 18 show the changes in NWEA scores for 6th, 7th, and 8th grade students respectively. Bars indicate mean percentile scores on each subject for each grade at fall, winter, and spring assessments. Error bars show standard errors. Differences indicated with one asterisk are marginally significant at $p = 0.1$. Differences indicated with two asterisks are statistically significant at $p = .05$. Differences shown with three asterisks are significant at $p = .01$.

Figure 16 shows that NWEA scores for 6th graders for math increased marginally from winter to spring, and significantly from fall to spring. Scores for 6th graders on the reading assessment decreased significantly from fall

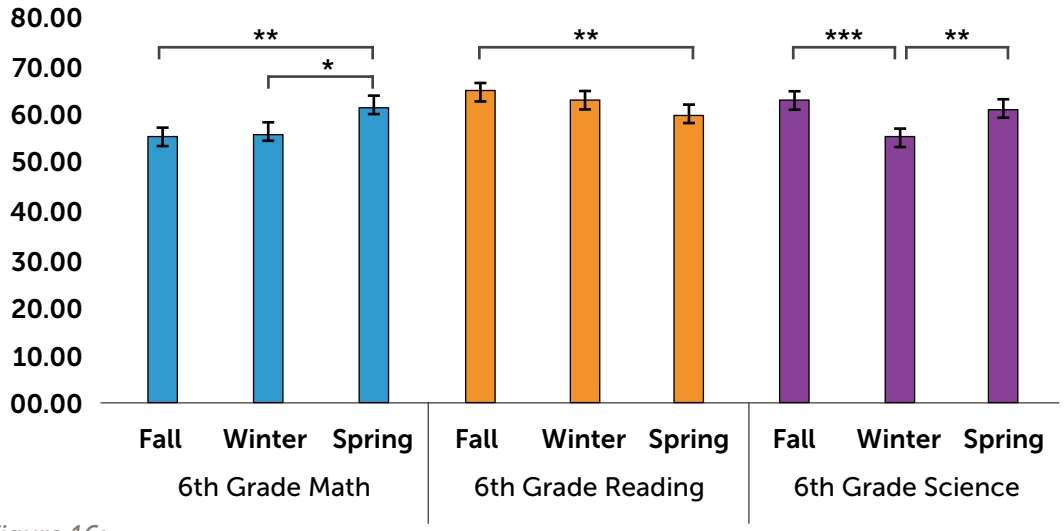

Figure 16:
NWEA scores for 6th graders at fall, spring, and winter on math, reading and science assessments

to spring. Scores for sciences fell significantly from fall to winter, but increased significantly again from winter to spring.

As seen in Figure 17, math scores for 7th graders increased significantly from winter to spring. Scores for reading and science did not show statistically significant differences.

Figure 18 shows that math score for 8th graders increased marginally from winter to spring, and significantly from fall to spring. Just as for 7th graders, scores for reading and science did not show statistically significant increases or decreases.

Before they began to use *Amplify* games, students took a pretest to gauge their current

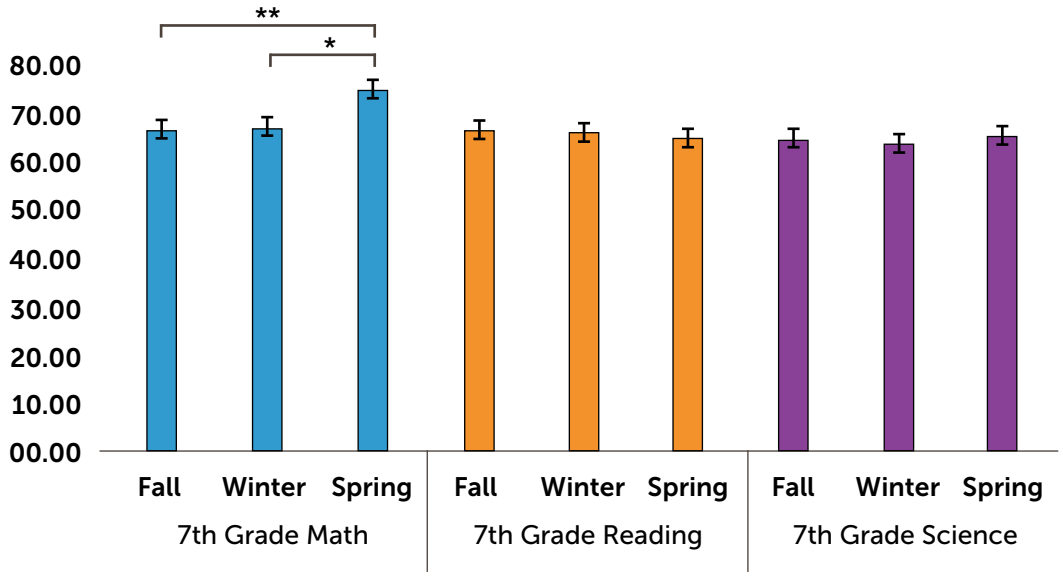

Figure 17:
NWEA scores for 7th graders at fall, spring, and winter on math, reading and science assessments

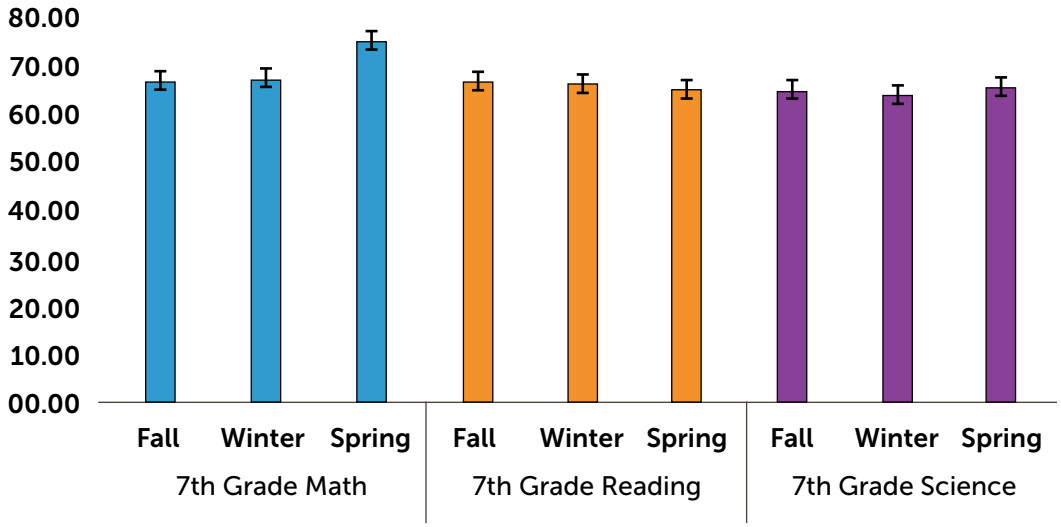

Figure 18:
NWEA scores for 8th graders at fall, spring, and winter on math, reading and science assessments

levels of interest and engagement in math, science, and ELA, and their experience and interest in gaming in general. At the end of the implementation, they took a posttest to assess any changes in their initial levels of interest and engagement (see Appendix 2B: Student pre-survey and Appendix 2C: Student post-survey for complete pretest and posttest instruments).

407 students returned the first survey, whereas only 173 returned the post-survey. However, distributions of students in both samples look similar, therefore, percentage values are presented for comparison.

Students responded on the questions relating to engagement and interest in math on the pre-survey and post-survey. For all items, "NO!" corresponds to a high level of negative endorsement, "no" to a modest negative endorsement, "yes" to a modest positive endorsement, and "YES!" to a high positive endorsement. Overall, we did not observe major shifts in patterns of responses. Interestingly, the only significant differences were observed on the item "Learning math is important to me" and were in an unexpected direction. The proportion of students giving a strong positive endorsement to that statement fell from 48.52 percent on the pre-survey to 19.65 percent on the post-survey; $t(578)=6.496$, $p<.001$. The proportion of students who gave a modest negative endorsement to that statement rose from 3.94 percent on pre-survey to 23.12 percent on post-survey; $t(578)=7.153$, $p<.001$. Finally, The proportion of students who gave a strong negative endorsement to that statement rose from 1.72 percent to 10.98 percent; $t(578)=4.931$, $p<.001$.

Students' engagement and interest in ELA topics such as reading and writing also changed from pre-survey to post-survey. As in math, some differences were noted in an unpredicted direction. For example, the proportion of students who gave a strong positive endorsement to the statement "In general, I find writing interesting" fell from 27.09 percent at pre-survey to 13.29 percent at post-survey. This difference was statistically significant, $t(578)=3.615$, $p<.001$.

However, more encouragingly, students who gave a moderate positive endorsement to the statement "reading is important to me" rose from 28.08 percent to 49.13 percent;

Figure 19:
Student playing *MasterSwords* during tournament

$t(578)=4.884$, $p<.001$, whereas those moderate negative endorsement on statement fell from 30.79 percent to 16.18 percent; $t(578)=3.65$, $p<.001$. The proportions of students who gave a strong positive or negative endorsement on the statement did not change significantly.

Like ELA and Math, most items related to science engagement did not show significant changes from pre-survey to post-survey. However, some interesting differences were observed. For example, the proportion of students who gave a strong positive endorsement to the statement *"In general when I work on a science project, I enjoy it"* fell from 36.21 percent to 26.59 percent, a statistically significant difference; $t(578)=2.248$, $p=.025$, whereas that of students who gave a moderately positive endorsement to that statement rose from 47.78 percent to 56.65 percent, again a statistically significant difference; $t(578)=1.955$, $p=.051$. These differences were in an unpredicted direction.

On the item, *"After a really interesting science activity is over, I talk about it with other people,"* interesting differences were observed. The proportion of students who gave a strong positive endorsement to that statement grew from 12.56 percent to 34.68 percent; $t(578)=6.193$, $p<.001$, whereas that of students who gave a strong negative endorsement fell from 37.68 percent to 8.09 percent; $t(578)=7.196$, $p<.001$.

Student Engagement

Student engagement was assessed through interviews with students and teachers and surveys given to students and teachers at the beginning and end of the implementation. Researchers also attended the first meeting of the Games Squad, and one of the game tournaments hosted by the Games Squad, to get additional insight into how the Games Squad affected overall engagement in the games.

Student engagement was observed to be high throughout the period of the pilot. Students noted in the interviews that they enjoyed playing the games. For example, one student said,

> "... a lot of times I just play *Amplify* for fun, but other times, there's quests and stuff through it that help me learn without me knowing."
>
> *— 7th grade student*

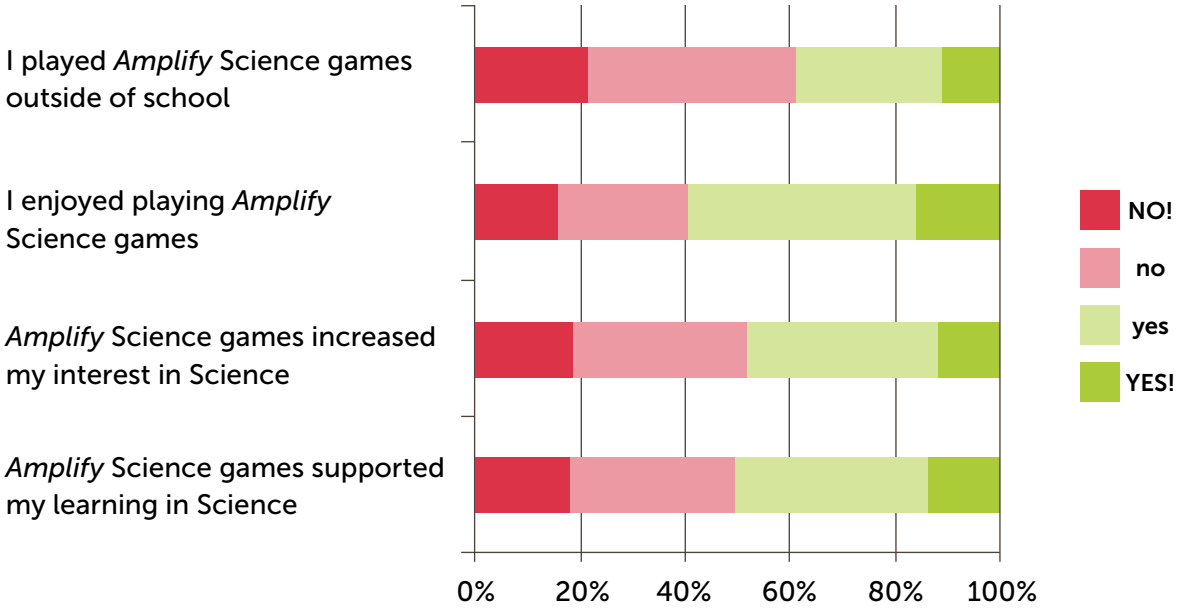

Figure 20:
Self-reported perceptions of learning and engagement on *Amplify* science games

Teachers also noted the high levels of enthusiasm for the games. Early in the implementation, one math teacher offered the following comment,

> "...my kids love Crafty Cut — one of the games by *Amplify*. I asked 2nd period who played last night and over half the class put their hand up...and I didn't assign it. For that to happen in 2nd period is really saying something!"
>
> *— 6th grade math teacher*

Figure 20 shows the proportions of students' responses to questions relating to engagement and interest in *Amplify* science games on the post-survey.

Figure 21 shows the proportions of students' responses to questions relating to engagement and interest in *Amplify* math games on the post-survey.

Figure 22 shows the proportions of students' responses to questions relating to engagement and interest in *Amplify* math games on the post-survey.

Figure 23 shows how the average amount of time students played the games in the months of December, January, and February for all games combined, broken down by grade.

On average, students across all grades spent approximately 1.5 hours playing the games every month from December through January. The usage of the games dropped off in February for all three grades. Teacher and student interviews revealed that that for some of the games (e.g., *Faktr*), students quickly aced all the levels, which could explain some of the usage drop-off. Further, the space limitations

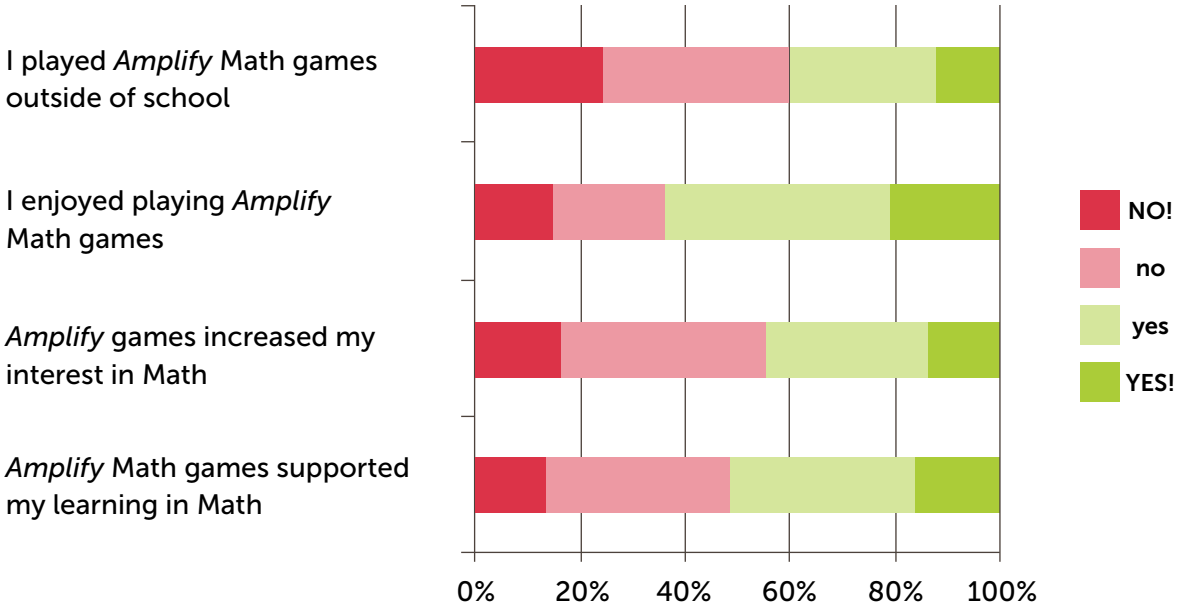

Figure 21:

Self-reported perceptions of learning and engagement on *Amplify* math games

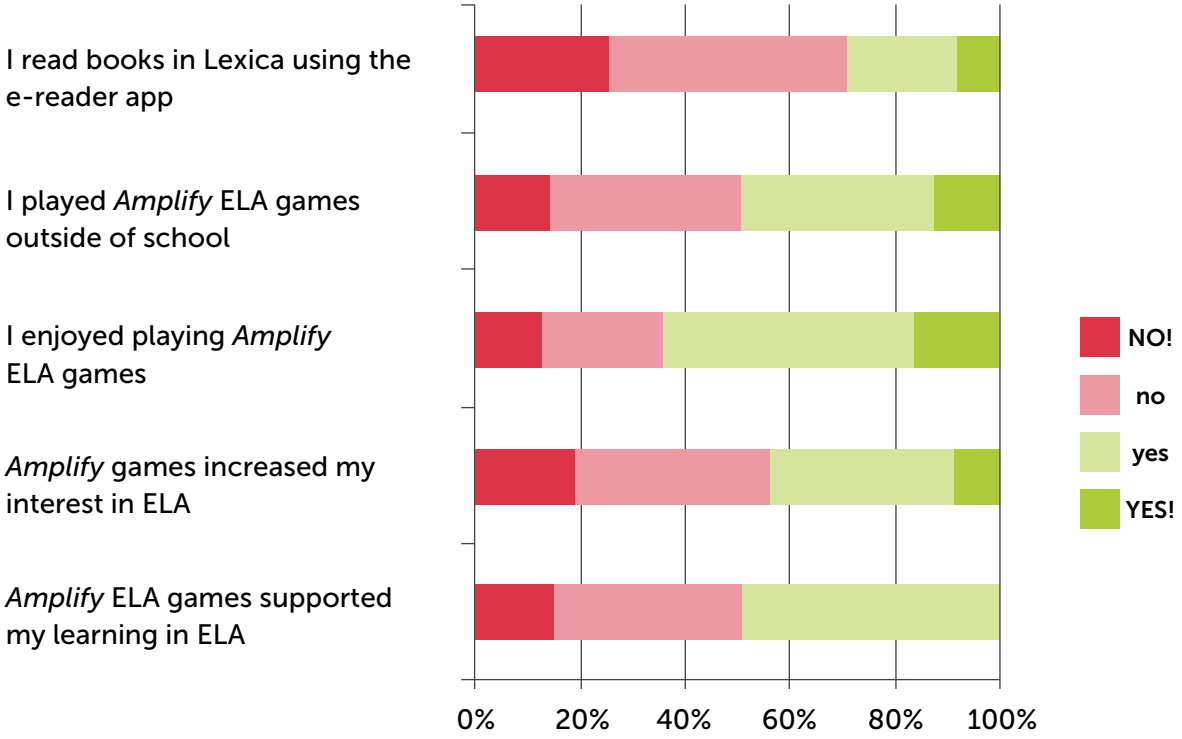

Figure 22:

Self-reported perceptions of learning and engagement on *Amplify* ELA games

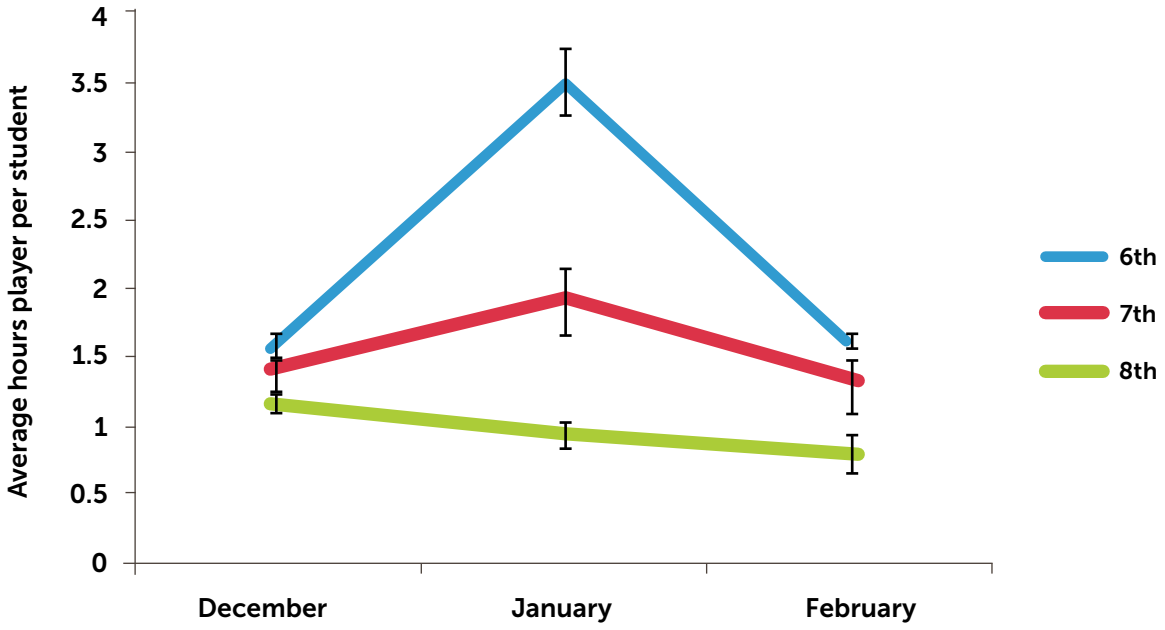

Figure 23:
Average usage of *Amplify* games by grade level

on the iPad could have prevented students from installing the games, which explain why overall usage is on the low side.

Self-reported iPad use

Students reported their self-perceived iPad usage on the pretest as well as posttest. As illustrated in the pie charts in Figure 24 and Figure 25 students' self-reported usage did not appear to change drastically from pre-survey to post.

Games Squad Incentive Activities

A "Games Squad" of about 26 students across the three grades was constituted in March to act as "gaming ambassadors" for the school. The members of the Games Squad would to shape the experience of *Amplify Games* by running and creating their own displays, activities, and challenges, to be held during after-school hours with materials provided by *Amplify*. The goal of the Games Squad was to organize activities such as game tournaments, which would encourage students to play more games.

Three teachers supported the Games Squad and helped organize these activities, in conjunction with *Amplify* staff. Since the launch of the Games Squad, tournaments have been held for three of the multi-player games in the *Amplify* suite — MasterSwords (ELA game in Lexica), Tyrant (science), and Mlob Rule (math). One student from each classroom was nominated (either self-nominated or nominated by teacher) to participate in each

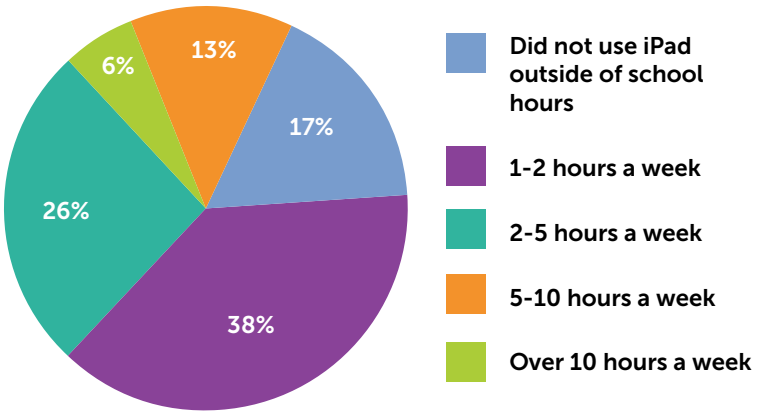

Figure 24:
Self-reported iPad usage on pre-survey

tournament. Students played off until one winner emerged. Interviews with students as well their responses to a survey deployed immediately after the first Games Squad tournament indicated that students enjoyed participating in the tournaments, and were motivated to play the game because of it.

Interviews with teachers noted that students who were interested in gaming showed interest in being on the Games Squad. It provided an avenue for some of the students who did not traditionally participate in other forms of extra-curricular school activities (e.g., debate, sports) to explore their interests more. From interviews with teachers, the Games Squad and tournaments were more popular among 6th and 7th graders, but less so with 8th graders.

Teacher Satisfaction

Teacher satisfaction was assessed via surveys given at the beginning and end of the implementation, as well as through group feedback sessions conducted at a midpoint in the implementation. The group feedback sessions were conducted separately for 6th grade, 7th grade, and 8th grade teachers. Teachers were asked to individually reflect on the benefits and challenges of using *Amplify* games, and write down their ideas on different colored sticky notes — warm colors denoting benefits, and cool colors denoting challenges.

Figure 26:
Student receiving *Amplify* promotional materials during tournament

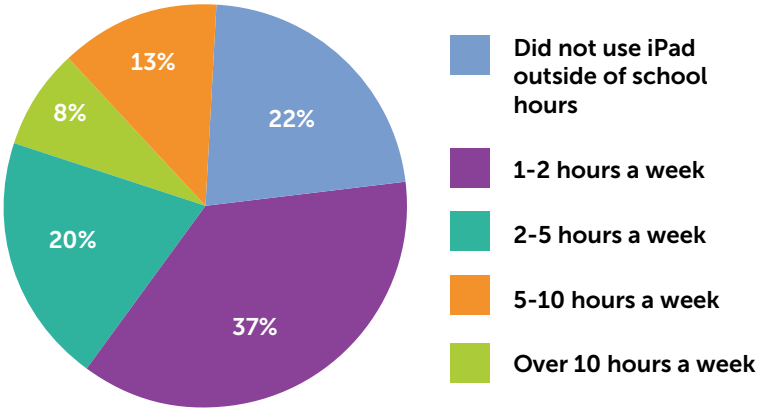

Figure 25:
Self-reported iPad usage on post-survey

After teachers noted down their ideas, the research team facilitated a group discussion in which similar ideas were clustered together. Members of the research team at *Amplify* were also present during these sessions, which gave teachers an opportunity to share their feedback with the developers (see Appendix 2D: Feedback Elicitation Protocol for a detailed description of this activity).

A vetting survey for STEM teachers was conducted (see Appendix 2E: Games vetting survey for teachers for complete instrument) when the STEM games first became available in December. This survey asked teachers to reflect on which games they thought would be most relevant to their curricula, what features of the games they thought were beneficial, and what were some potential challenges they foresaw when using the games. Twelve teachers, of which 8 were science teachers and 4 math teachers responded to the survey. 7 out of 12 teachers responded that they were not very likely or only somewhat likely to use the games during class time. 7 out of 12 also responded that they were likely or very likely to recommend usage of the games in out of school time. Most teachers commented on the rich, interactive graphics and the engaging nature of the games. Several teachers noted the concern that the games did not tie in well with their curriculum,

which could explain their hesitation to use them during classroom time. However, there were a few exceptions. For example,

> "...SIM Cell, Cell Strike, and Habitactics were definitely aligned with content standards and would fit seamlessly into our curriculum/classroom instruction."
>
> *— 8th grade science teacher*

One 6th grade math teacher also noted that the game *Faktr* was usable with their curriculum.

Towards the end of the implementation, a reflection survey for teachers (see Appendix 2F: Teacher post-survey for complete instrument) was administered, to understand their thoughts and opinions on the games, what worked well over the course of the pilot and what could be improved. The response rate on the post-survey was lower; only seven teachers took the survey. Five of the teachers taught ELA, one taught science and one special education. Only two of the teachers stated that they were somewhat likely to recommend continued usage of the games in their current form, whereas the majority was undecided or unlikely. However, all responded that they were either somewhat likely or extremely likely to recommend usage of games if the changes they recommended were implemented. The most common recommendation was to make the games work better with curriculum standards, followed by including built-in assessments, and providing better instructions to use the games.

Other key takeaways on teacher satisfaction based on from the teacher feedback sessions and responses to surveys were as follows:

Benefits of *Amplify* Games:

- The games provide a good way to keep students engaged during down time, e.g., if they finish an assignment early, or during free periods.
- Students really enjoy playing the games, especially ones who are already "gamers."
- Students ask to play games during down-time, when their assigned work is done. This is true even for students with disabilities.
- The games are well-made with highly engaging graphics.
- Games encourage problem-solving.
- Students engage in Math talk with each other during play "Quote."
- Storycards that you can collect in Lexica provide a motivation to read more books.
- The *Amplify* library is extensive, and can cater different interests.
- Math games provide a good tool for practicing basics.
- Games are user-friendly. Students can figure them out by themselves and work independently.
- Games are easy to figure out, and do not excessive preparation times.
- Some games, specifically science games such as Cell Strike and Habitactics have some connections with the 8th grade curriculum, and two of the teachers reported using them during classroom instruction.

Challenges faced when using *Amplify* games:

- Several teachers across the three grade levels and subjects shared the concern that the games did not link directly with

standards. While the math games are good for practicing basic skills, teachers are covering much more advanced topics in class (e.g., compound probability, Pythagorean theorem) and the math games do not align what is being covered in class.

- The delayed launch of games was problematic, and many teachers felt that they did not have an adequate background when starting up, especially ones that did not attend the session at Schell games held in the summer.

- Due to lack of a dashboard, it is unclear how to monitor student progress. Teachers noted that the data reports provided by *Amplify* were not timely, and did not provide a way to easily track students' progress.

- The space on iPads was a big issue, and many students could not keep Lexica on their iPads, because it takes a significant amount of memory space. Students need other apps on their iPads such as eBackpack, which are used for turning in homework assignments, so games were a lower priority.

- Students are more interested in the gaming aspect, and spend time in side quests but don't actually read books in Lexica, which was one of the primary objectives of using Lexica for ELA.

- Teachers thought that they did not have adequate time to explore the games. Some team time where they could play the games and discuss with their colleagues would have been beneficial.

- Some teachers noted that there was not sufficient time to include games in the classroom, because it takes away from crucial instructional time.

- Some games did not have adequate content; students aced all available levels in one sitting (e.g., *Faktr*, *Twelve a Dozen*). This sometimes resulted in the initial enthusiasm for the games not being sustained over time.

- A few teachers noted concerns about constantly being in front of an iPad in lieu of playing outside, being active leading to lack of face-to-face social interaction and physical exercise.

- Directions would be helpful for some of the games.

In sum, most teachers said that they liked that the games provided an engaging activity for students during down time. A few teachers found games that cover concepts that they covered in their curriculum. However, many others shared the concern that the games do not align well with their curriculum, and that they would use it more in the classroom if they did. The ELA teachers liked that the *Amplify* library provides access to a variety of books; however, they found that students were spending more time playing games and side-quests instead of reading the books. Lack of space on the iPads was also a critical issue, because of which students were not able to load all games and book library, to make sure there was space for apps necessary for schoolwork.

Administrator Satisfaction

Semi-structured interviews with the assistant superintendent provided insight on his satisfaction with the games and with the pilot process (See Appendix 2G: Administrator Interview Protocol for full instrument). The key takeaways were as follows:

- Delay in launching the games meant that the pilot could not begin on time. Due to the update to IOS 9, some of the games needed to be reworked, and approved by Apple. This process took longer than expected, and as a result, the games were launched in late December 2015/ January 2016. Thus, it was months

after the initial orientation session held at Schell games that the games were available for use, resulting in some of the information being lost or forgotten.

- In hindsight, it may have been more tractable to limit the pilot scope, perhaps focusing on just one grade-level or one content area. There were too many games, and too many students and teachers using them at a time, which increased the complexity of the pilot significantly.

- The games took too much space on iPad, and students needed to delete games from their devices to make room for academic programs such as eBackpack.

Overall the assistant superintendent was satisfied with the engagement aspect of *Amplify* games. The school made a decision to replace the students' iPads with newer iPads with a larger memory to address the issue of lack of space on iPads. Students turned in their iPads at the end of the school year and received new iPads for the summer. The students will continue to use *Amplify* games through the summer months on their new iPads.

Teacher Support

Insights on teacher support were garnered through teacher interviews, teacher group feedback sessions and administrator interviews, and attending professional development sessions conducted by *Amplify*. Observations from all the above measures indicated that teacher support provided by *Amplify* was of high quality and helpful.

The key takeaways on teacher support were as follows:

- Teachers found the emails about new games helpful.

- A roll-out day was held in January for Lexica when *Amplify* staff visited to give an overview of Lexica. Students in each grade were introduced to the game-world, and were given some time to explore the games by themselves.

- *Amplify* staff were present for the first Games Squad meeting to introduce it to the students, and provided materials for gaming tournaments.

- *Amplify* staff were prompt in answering questions via email and phone.

Conclusions

The primary goal of the pilot was to test whether *Amplify* games provided a viable alternative to non-educational iPad activities that students engage in during leisure time. Students reported enjoying the *Amplify* suite of games, however, the average usage of games was on the low side at about 1.5 hours per month. Factors related to this may be the limited space on iPads, which the school is addressing by purchasing new iPads for the next school year. Integration of games in the classroom was not always successful because of lack of alignment with curriculum, time and training learn how to incorporate the games into the classroom, however, teachers liked that the games provided engaging and educational activities during downtime. A Game Squad was constituted, and the tournaments they organized received enthusiastic response.

Key Takeaways

Key takeaways from the *Amplify* games pilots at Elizabeth Forward School District can be summarized as follows:

- The scale of the pilot should be carefully considered before launching the pilot. In this case, the pilot spanned three grades, three different subject-areas, and a suite of over 30 games. As a result, a detailed

study of each of the games was not possible within the scope of this pilot. Instead, if the school had chosen one game for each of the subjects to be piloted in a single grade, it would have narrowed the focus, and allowed for more detailed analyses leading to more specific insights.

- Clarity of communication with all stakeholders is key. In this case, the specific objectives for piloting *Amplify* games were somewhat ambiguous. For example, teachers were initially unclear on whether the games were for out of school use or whether they were expected to integrate the games into classroom instruction. Clearly communicating the curricular and instructional goals of the pilot would result in a smoother implementation process.

- Hardware and other technological limitations (e.g., internet speed) should be taken into account before committing to a product that requires significant resources. For example, the lack of space on iPads was a barrier to use of games outside of the classroom, even though students thought them to be engaging.

- NWEA scores may not always provide the best window into student learning and achievement. In this case, the games were not aligned with curricular standards, and any systematic changes in NWEA scores cannot be attributed to the use of games or lack thereof. To assess student learning, questions pertaining to specific content targeted by the games should be curated in advance, and pretest and posttest measures obtained.

- Availability and timeliness of professional development sessions is critical. When PD sessions were far removed from the beginning of the implementation, they were less effective, whereas those provided closer to the launch were more helpful.

- Providing time for teachers to discuss best practices, implementation strategies, and offer peer-to-peer support is helpful.

- Involving students in extra-curricular activities around educational games can increase engagement and enthusiasm for the games, as illustrated by the Games Squad initiative at Elizabeth Forward.

Case Study:

South Fayette School District

South Fayette School District, a member of the Digital Promise League of Innovative Schools, is a small, suburban school district located in McDonald, PA, about 20 miles to the south of Pittsburgh.

South Fayette serves approximately 3000 students, 13 percent of whom qualify for reduced or free lunch. All students have access to high-speed Internet at the school, and 66 percent of students have access to a personal school-provided device. See Table 10 for a district snapshot.

In 2015, the Pittsburgh Business Times ranked South Fayette the top-performing district in Western Pennsylvania, based on three years of standardized test scores. The district has a forward-thinking vision for its science, technology, engineering, art, and mathematics (STEAM) curriculum, and since 2010, has taken systematic efforts to incorporate engineering and design problem solving into K-12 education.

For the 2015-2016 school year, South Fayette piloted two products — *INVENTORcloud*, a curriculum and hardware package to teach creative entrepreneurship in an 8th grade Technology Education classroom, and *Microsoft OneNote*, an online environment to replace traditional modes of content delivery and content customization, in a 7th grade social studies classroom.

One of the unique qualities of South Fayette is that it has a "research champion" on staff who directs research efforts, building collaborations with research institutions and industry partners, and supporting teachers in identifying the right tools and curricula to best meet their needs. Teachers are involved in the process of choosing products to pilot since the beginning. In the words of an administrator,

> "...the earlier the better in involving the teachers in the process. Instead of showing up at their doorstep with, 'hey, here's a new technology or device you can use in your instruction as opposed to here's an invitation to consider how this device can help you serve your needs and the needs of your students."

Table 11 gives an overview of research methods and measures used to assess product efficacy. See Figure 27 for a timeline of research activities at South Fayette across both products.

Number of Students Served	School Ranking	Percent free or reduced lunch	Products Piloted	Target Subject Areas	Grade-Levels in Pilot
3000	1/498	13	*INVENTORcloud, Microsoft OneNote*	Technology education, social studies	7, 8

Table 10:
South Fayette School District Snapshot

		Products	
Dimension of Product Efficacy	Measure	*INVENTORcloud*	*Puzzlets*
Student Learning	Log Data		
	Pre-Post Survey	✓	
	Post-test		
	NWEA assessments		
	Interview / Focus Group	✓	✓
Student Engagement	Log Data		
	Pre-Post Survey	✓	
	Interview / Focus Group	✓	✓
	Classroom Observations	✓	✓
Teacher Support	Interviews	✓	✓
Teacher Satisfaction	Interviews	✓	✓
Administrator Satisfaction	Interview	✓	✓

Table 11:
Overview of research methods and measures

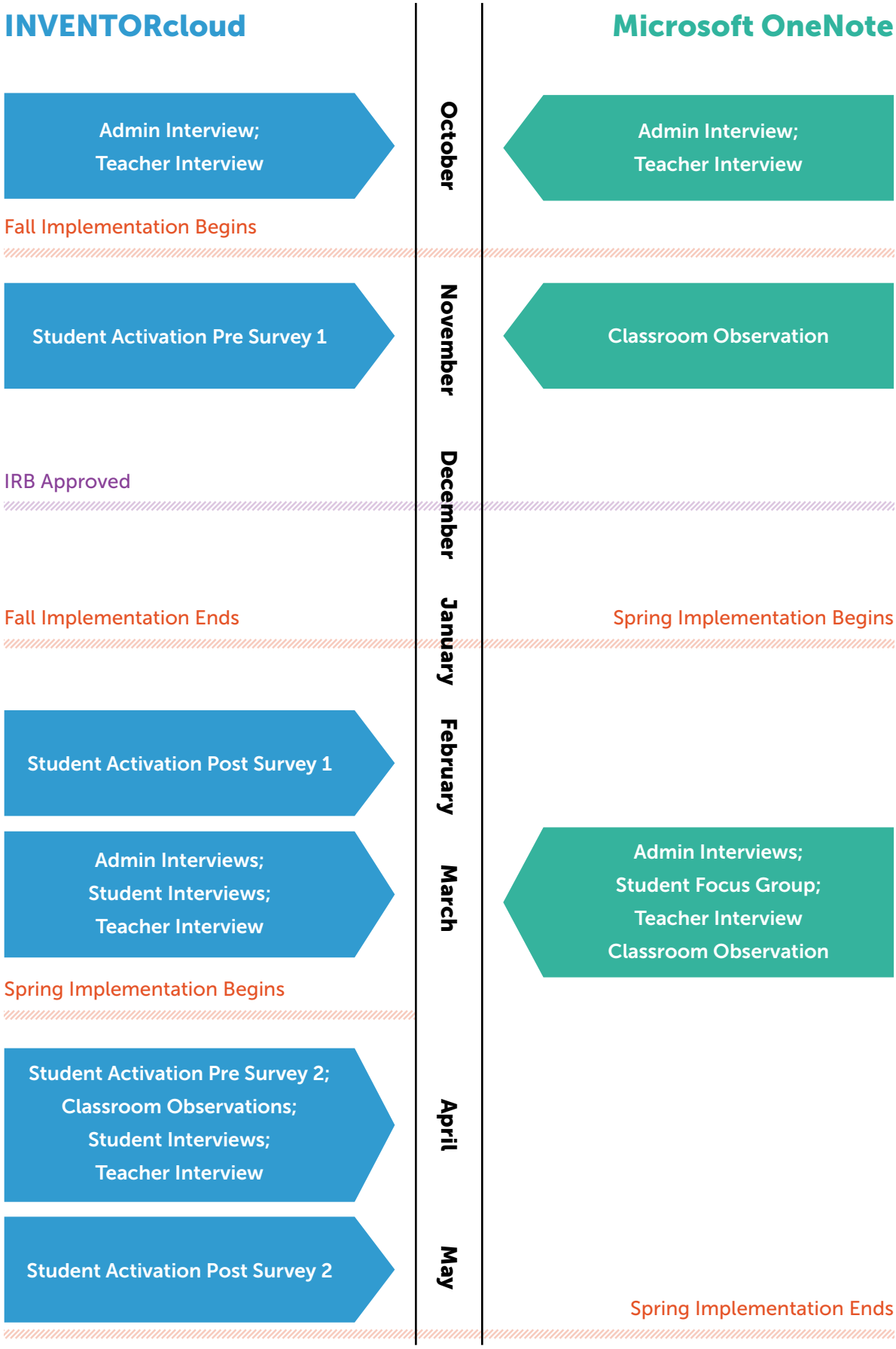

Figure 27:

Figure 27: South Fayette Pilots Timeline

Case Study: South Fayette School District

Product: INVENTORcloud

Product Overview & Pilot Goals

INVENTORcloud is a curriculum and hardware package developed by INVENT3D MakerSpace, which provides virtual, remote access to CAD instruction, design file review and rapid prototyping equipment such as 3D printers, CNC mill and routers, laser cutters, vinyl printers and digital sewing machines. In the Creative Entrepreneurship course within the *INVENTORcloud* curriculum, students invent, design, and build a product and learn how to create a business using social media and 21st century enabling technologies.

South Fayette has been developing a vertically aligned computational thinking curriculum throughout K-12. As part of this initiative, the school wanted to introduce students to the fundamentals of entrepreneurship in its 8th grade Technology Education classroom. The *INVENTORcloud* curriculum and 3D printer package was a good fit for the school's needs, therefore, South Fayette chose to pilot it as part of the Product Efficacy and Feedback Loops project.

Curricular Need

South Fayette had identified a need for curriculum and reliable 3D fabrication tools to scaffold their Technology Education class. The *INVENTORcloud* curriculum emphasizes a human-centered design process framed as a design challenge to develop innovative solutions to an existing problem using 3D printer to create a prototype of the product. Students create the prototype, write an abbreviated business plan, design product branding, and then create an infomercial and present their product during a Pitch Fest to a team of judges. The 3D printers that South Fayette had used in the past were unreliable, breaking down frequently, and often took long amounts of time to repair, so they needed reliable technology and a vendor that provided timely troubleshooting.

Product Implementation Process

INVENTORcloud was deployed in the 8th grade classroom in the Technical Education class. The Creative Entrepreneurship curriculum within *INVENTORcloud* is designed to be a 90-day course targeted towards high-school students, but was adapted to be used as a 45-day unit for 8th graders at South Fayette.

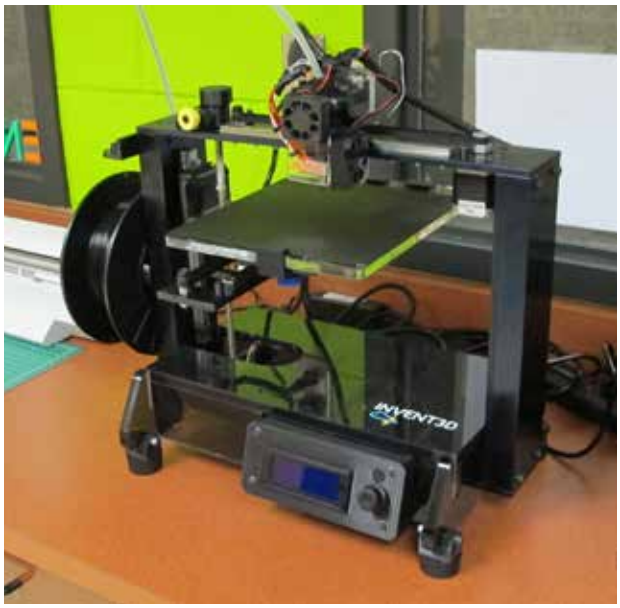

Figure 28:
3D printer built by South Fayette students with help from *INVENTORcloud*

The *INVENTORcloud* package consists of TeamUP —an open source browser-based learning management system (LMS; see *Figure 29* for screenshot), Autodesk 123D Design — a free to use CAD software for design 3D parts, INVENT3D Printer (see *Figure 28*), Slic3r — software that allows for 3D printing with INVENT3D, StormTool Learn – a program that allows conferring with the remote fabrication lab for advanced instruction and troubleshooting, and StormBox, an optional computer which comes with all software items pre-installed.

South Fayette gives teachers the flexibility to personalize their curricula, rather than implement them en-masse in the classroom. For example, *INVENTORcloud* suggests using the program AutoCAD Invent 123D Design for making 3D drawings of the product that students want to print, however, students had already learned to use it in previous classes, and were ready to use a more professional program, so the teacher decided to use Autodesk Inventor instead.

Research Questions & Study Design

For the *INVENTORcloud* product pilot, the research team examined the following dimensions of product efficacy — student learning, engagement, teacher support, satisfaction, and administrator satisfaction using a mixed methods approach. The primary measure of student learning was a survey designed to measure activation — a state composed of dispositions, practices, and knowledge that enables success in proximal learning experiences in entrepreneurship, design, and computational thinking, given at the beginning and at the end of the semester (See Appendix 3 A: Activation Survey for complete instrument). This survey was built upon prior work by Activation lab at the University of Pittsburgh and UC Berkeley. Their activation instruments, which had been designed to measure activation in STEM domains were extended and adapted to measure activation in creative entrepreneurship and innovation, which

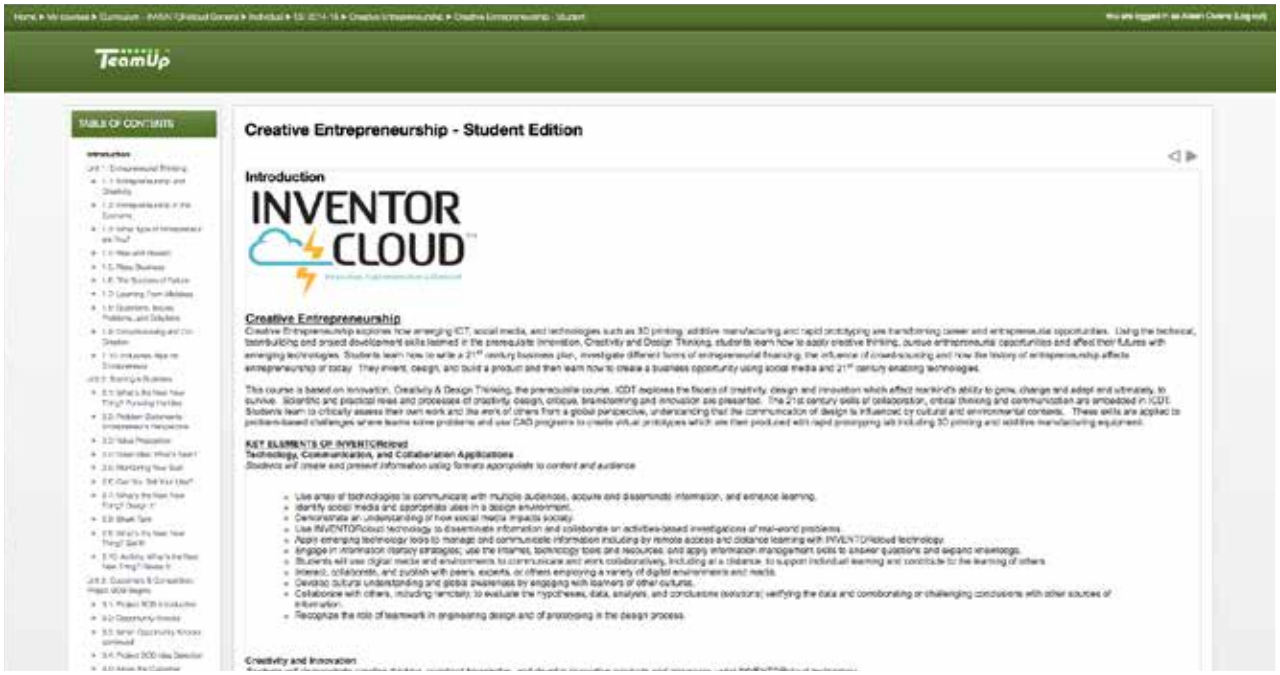

Figure 29:
Screenshot of *INVENTORcloud* Curriculum deployed on the TeamUp LMS

were measures of interest to the school. Additionally, semi-structured interviews with students, teacher, and the technology director of the school were conducted at two time-points — in the fall and the spring semester to gain insights on efficacy of *INVENTORcloud*.

Across the fall and the spring semesters, 58 students participated in the study. Informed consent was obtained from parents/ guardians of 18 students for interviews and focus group discussions.

Evaluation Study Methods & Findings

Student Learning

The primary measure of student learning was based on students' responses on the activation pre-survey and the post-survey, which they took at the beginning and end of the course, both during the fall and the spring semesters. 23 eighth-graders (2 female) took the pre-survey, and 28 eighth-grade students (7 female) took the post-survey during the fall semester. 30 eighth-graders (6 female) took the pre-survey, and 22 eighth-graders (5 female) took the post-survey in the spring semester.

Table 12 presents the reliability of the instruments used in this investigation. For all constructs, Cronbach's alpha values were sufficiently high to produce meaningful pre-post data.

Figure 30 and Figure 31 present pre-post changes in activation level for the fall and spring semesters respectively. On the scale, "6" represents the highest level of positive endorsement, whereas "1" represents the strongest negative endorsement.

With very few students participating in this pilot, it is not surprising that statistically significant differences were not evident in the survey data. However, a number of interesting patterns emerged. Some of the key findings were as follows:

- 60 percent of the students strongly agreed with the statement that they can do the design challenges they get in class, up from 13.04 percent on the pre-survey.
- 53.6 percent of the students strongly agreed with the statement that they can understand technical information on websites for kids their age, up from 26.1 percent on the pre-survey.
- The percentage of students who strongly agreed with the statement that they are good at providing evidence when they give

	Fall		Spring	
Instrument (n items)	Pre (n = 23)	Post (n = 28)	Pre (n = 30)	Post (n = 22)
Competency Beliefs (11)	0.885	0.846	0.768	0.626
Fascination (8)	0.907	0.839	0.853	0.947
Innovation Stance (12)	0.812	0.826	0.848	0.913
Values (13)	0.865	0.829	0.91	0.959

Table 12:
Scale Reliability for Activation Survey

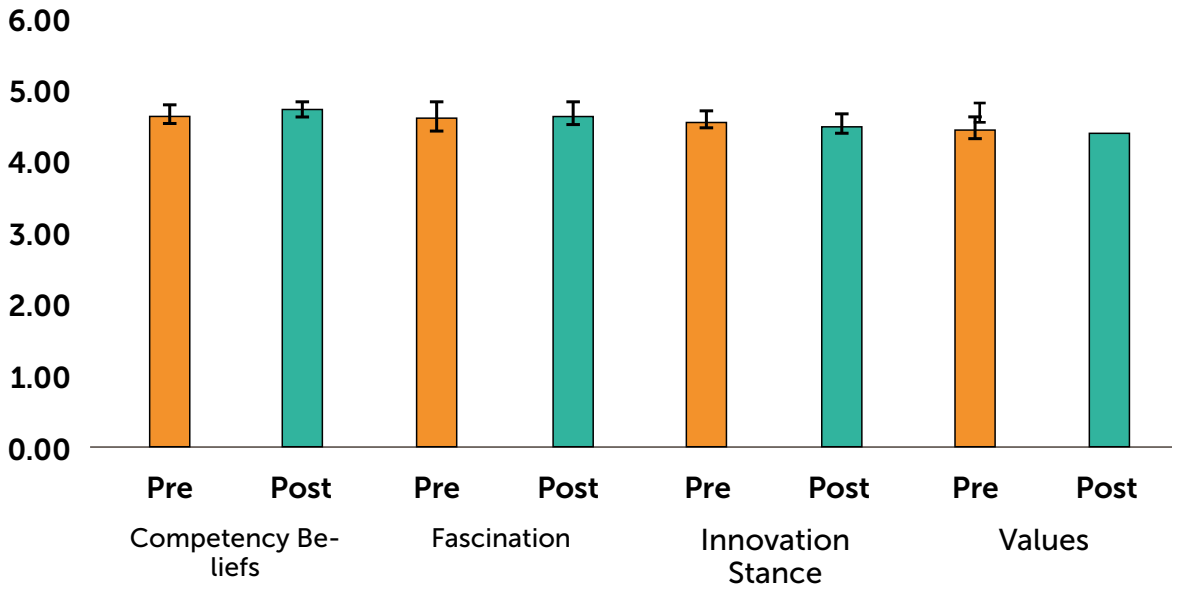

Figure 30:

Changes in Activation Levels from pretest to posttest during the fall semester

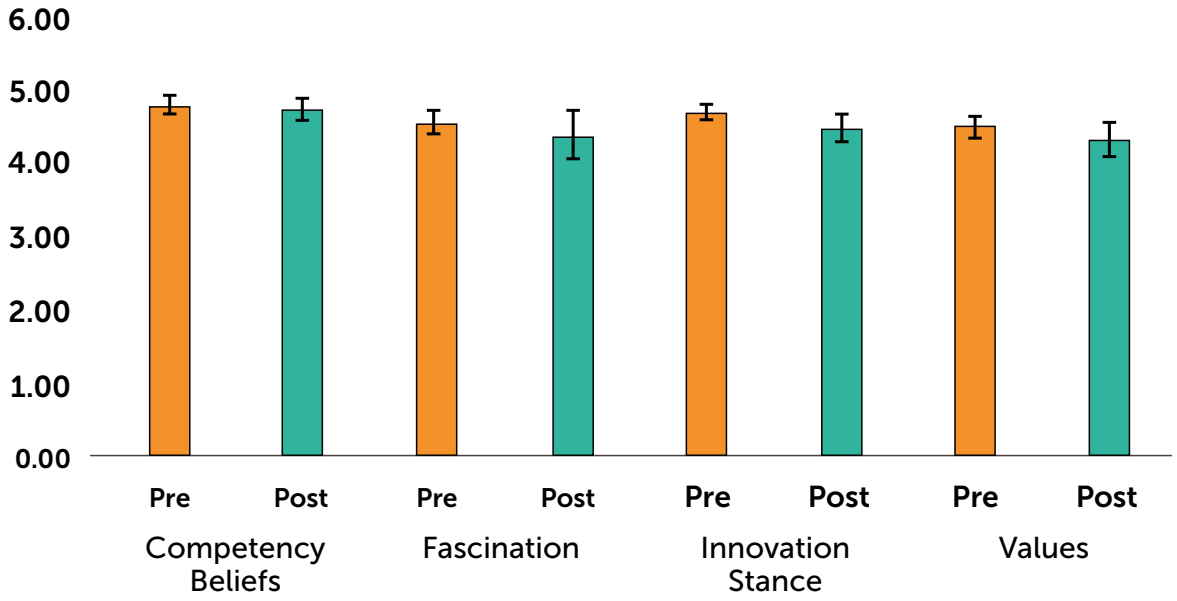

Figure 31:

Changes in Activation Levels from pretest to posttest during the spring semester

their opinion nearly doubled from 18.2 percent on the pre-survey to 35.7 percent on the post-survey.

- 71 percent agreed or strongly agreed that they were good at explaining their solutions to technical problems, up from 53 percent on the pre-survey.
- 75 percent agreed or strongly agreed that they liked figuring out how things worked, up from 65 percent on pre-survey.
- 71 percent agreed or strongly agreed that they knew they thought differently from other people, up from 56 percent on pre-survey.
- 70 percent agreed or strongly agreed that innovation makes the world a better place to live, up from 60 percent on pre-survey.
- 32 percent agreed or strongly agreed that knowing computational thinking is more important than knowing anything else, up from 17 percent on pre-survey.

These findings reveal that participation in the Creative Entrepreneurship course was associated with patterns of improved Activation Levels on several critical dimensions.

Student Engagement

Classroom observations and student interviews provided insights into student engagement. Overall, student engagement was high, and students enjoyed taking the class (See Appendix 3 B: Student Interview Protocol for complete instrument).

Key findings relating to student engagement were as follows:

- Some of the students got an opportunity to build the 3D printers as part of the summer program. They enjoyed putting it together.

> "Getting to build the 3D printer...was one of the best experiences of my life. It came in hundreds of parts, and a ton of wiring that we had to get right. It was a lot of teamwork...it was really fun."
>
> — *Female 8th grade student*

- Students who helped build the printers also helped with troubleshooting when necessary. They liked being able to use the Helpdesk to issues with the 3D printer that they couldn't fix themselves.

Teacher Support

Teacher interviews and administrator interviews both revealed that teacher support provided by *INVENTORcloud* was high quality and timely (See Appendix 3 C: Teacher Interview Protocol and Appendix 3 D: Administrator Interview Protocol).

> "Here is an example of how great they were — one of my student groups created a drawing using *Autodesk Inventor*. They created a file that was 3D but it was showing up with no volume. When we contacted *INVENTORcloud* through help desk, they not only looked at file, but went further than that, fixed the file, 3d printed the prototypes, and mailed them to us all in two days!"
>
> — *Technology Education teacher*

Key findings on teacher support were as follows:

- Overall, INVENTORcloud was very responsive providing help and troubleshooting issues. For example, one of 3D printers malfunctioned once, and INVENTORcloud fixed the issue promptly. The help desk support provided was useful, and when contacted about any issue, they responded within a day or two with a fix.

- The videoconferencing option StormTool Learn did not work when the teacher and students tried using it. This needs to be fixed.

- The administrator also noted that INVENTORcloud accommodated additional requests by South Fayette. When asked whether students could build their own 3d printer, INVENTORcloud facilitated that process and provided all the necessary support.

Teacher Satisfaction

- Overall, teacher satisfaction with *INVENTORcloud* was high. During semi-structured interviews, the teacher was asked to reflect on how satisfied he was with the curriculum. He noted some areas for improvement, which were as follows:

- Currently, there is no link to access TeamUP, the learning management system directly, and students need to type in a long url. This process could be made smoother.

- There is no link to navigate curriculum to journal, student need to click through three links to access the journal. Once in the journal, there is no way to keep track of which topic they were on.

- For one of the topics, the project resource sheet was unavailable. The teacher contacted the developer, but ended using an alternative resource sheet he created in Google classroom.

- The amount of reading is a bit overwhelming, may be preferable to use one good article, make others optional

- The team journals allowed students to answer as a teams, however, there was a bug in it, such that once the second group entered their answer, the first group's answer was erased.

Administrator Satisfaction

The research team conducted Semi-structured interviews with the Technology director at South Fayette to understand administrator satisfaction with *INVENTORcloud*. Key takeaways were as follows:

- The Technology director reported being extremely satisfied with *INVENTORcloud*, and found it to be well aligned with the school's larger vision of creating a vertically integrated computational thinking curriculum.

- *INVENTORcloud* was prompt in responding to concerns and provided technical support during the set up of 3D printers as well as help with troubleshooting when it was necessary.

- The 3D printers themselves were of high quality and encountered few breakdowns during the pilot period.

- Student satisfaction was high, and students took pride in the products they created when taking this class.

- The teacher was highly satisfied with *INVENTORcloud*, and it allowed him the flexibility to integrate it into his own curriculum.

- As a result of the positive findings described above, the school has decided to continue using *INVENTORcloud* during the next school year.

Conclusion

To summarize, South Fayette conducted a thorough needs-analysis and chose a product well-suited to their goals and objectives. There was 100 percent teacher buy-in from the day one. The teacher had the flexibility to adapt the curriculum to his students' needs and did so effectively. The teacher reached out to the company at various time-points, and resolved issues with their help. The teacher's satisfaction with the product will play a big role in the future adoption of this product. At this point, both the teacher and technology director have indicated that they would like to continue the use of *INVENTORcloud* in the next school year.

Case Study: South Fayette School District

Product: Microsoft OneNote

Product Overview & Pilot Goals

Microsoft OneNote is a digital note-taking application, used to gather student notes drawings, screen clippings, audio commentaries and creative artifacts in one online workspace. Notes can be shared and collaboratively worked on with other users over the Internet or a network. Teachers use *OneNote* to create instructional content and share custom interactive lesson plans with students. Although not originally designed as an educational product, the platform is becoming increasingly popular in educational settings. *Microsoft OneNote* was deployed in the 7th grade social studies classroom at South Fayette.

South Fayette's goals for this pilot were as follows:

- Explore the use of *Microsoft OneNote* to create customized instructional materials
- Examine the usability of *Microsoft OneNote* as a collaboration tool
- Test the affordances of *Microsoft OneNote* as an assessment tool

Curricular Need

South Fayette was exploring the use of *Microsoft OneNote* as a platform for creating and sharing custom instructional content and as a collaboration tool for students, moving away from traditional paper-and-pencil based teaching. In one 7th grade social studies classroom, the teacher had been moving away from traditional textbooks in the past few years in favor of creating his own custom designed interactive textbooks using the program iAuthor, deployed on iPads. However, iAuthor did not allow for the desired level of interactivity that he desired, because students could not write their own notes, or document their thoughts or reflections within the ibook. To address this gap, South Fayette decided to pilot *Microsoft OneNote,* which allowed for this level of interactivity. Although the present pilot was limited to one 7th grade classroom, South Fayette wanted to explore how it could be adopted more widely in the school district in the future.

Product Implementation Process

All students received HP Revolve laptops as part of South Fayette's 1:1 computing initiative. The original goal of the pilot was to implement the use *Microsoft OneNote* in the 7th grade social studies classroom. However, evidence of its usefulness as classroom curriculum design, management and sharing tool quickly spread throughout the school with teachers adopting it across various subjects, such as Spanish, English language arts, and science, in multiple grades. In the words of the technology coordinator at South Fayette,

> "...it has absolutely snowballed, I'd never expected it get this big, this fast."
>
> — *Technology Coordinator, South Fayette school district*

During the first half of the year, the social studies teacher developed a curriculum and created a custom history textbook in *OneNote* to deploy in spring. All students had access to all sections of the textbook, except for one section, which is designated as an individual notebook workspace for each student. There are virtual files in a shared content library, a collaboration space, and a space for students to post links to related videos and resources that they find. Students often work in groups of 5-6 in the classroom, using the collaboration space in *OneNote*. Over the course of the semester, the teacher added PDF handouts, readings, review questions, and maps, which help students review the material and prepare for tests. The entire curriculum for this class resided within *OneNote*, and no physical textbook was required for this class.

The teacher also integrated other platforms with *OneNote*, for example, Nearpod — an "all-in-one" presentation and polling application for classrooms, and Socrative — an app for real-time questioning, result aggregation, and visualization. The teacher posted PDFs of students' assessments in their individual notebook in *OneNote,* and has largely moved away from paper-and-pencil assessments in his classroom.

Research Questions & Study Design

For the *Microsoft OneNote* product pilot, the research team focused on the following dimensions of product efficacy—student engagement, teacher support, teacher satisfaction, and administrator satisfaction using a qualitative approach. Research activities included classroom observations, student focus groups, teacher and administrator interviews, and an interview with the technology coordinator at South Fayette.

Student learning was not directly assessed for this product, because unlike the other pilots in this study, this was not deployed as a curricular product, but a curriculum support tool. Further, we were not able to obtain any usage data from Microsoft, therefore quantitative analyses of product usage by the students and teacher were not possible.

Evaluation Findings

In the following sections, findings on student engagement, teacher support, teacher satisfaction, and administrator satisfaction are described. Various qualitative sources of data — student focus group, teacher interviews, interviews with the technology director and technology coordinator at South Fayette, phone conversations with Microsoft, and classroom observations of student using *OneNote* were used to gain insights on product efficacy of *Microsoft OneNote*. See Appendix 3 C: Teacher Interview Protocol, Appendix 3 D: Administrator Interview Protocol, and Appendix 3 F: Technology Coordinator Interview Questions for complete instruments.

Student Engagement

Student engagement was assessed through focus group discussions with students and classroom observations. See Appendix 3 E: Student Focus Group Protocol for complete instrument. The key takeaways relating to student engagement were as follows:

- Students liked having all their materials for the class in one place — textbook, review questions, videos, maps, along with their own notes and annotations.
- Students liked the collaborative aspect of working in *OneNote.*
- There were some challenges with collaboration, because it takes a few

seconds for a person's input to sync up, and as a result can get overwritten by another person's input.

- Studying in *OneNote* is easier, because students have access to all groups' work, and can capture what their group may have missed.

- The teacher gives polls in EdModo to gauge how students like using *OneNote*. While most of them view it positively, a minority of students (less than 10 percent) say that they do not like using *OneNote*, and prefer to use pen and paper.

Figure 32:
Students using *OneNote* to collaborate with peers

Teacher Satisfaction

Teacher satisfaction was assessed through semi-structured interviews with the teacher

Key takeaways in terms of teacher satisfaction were as follows:

- The 7th grade history teacher who piloted *OneNote* is extremely satisfied with all the functionality that *OneNote* offers. In his own words,

> "...it's a format that is a beast...in a positive way...and it is driving a lot of what we are doing now."
>
> *— 7th grade history teacher, South Fayette*

- This lead teacher involved in this pilot is now evangelizing the adoption of *OneNote* throughout the district along with the technology coordinator. Since the beginning of this pilot, several other teachers at South Fayette have begun to use *OneNote* in their classrooms. The teacher and technology coordinator lead a meeting with all teachers using *OneNote* every first Thursday of the month before school, and help them troubleshoot any issues that they may be facing.

- The relationship between *OneDrive*, *Office 365*, and *OneNote* was not clear initially, and the process of figuring it out created delays in getting started up with *OneNote*.

- Creation of class notebook was easy, however getting it onto students' computers was a challenge, as noted by the technology coordinator.

- The process of embedding a video in the interactive textbook was described as cumbersome. The teacher creates a shared link to the video. He uploads a screenshot of the video and hyperlinks it to the video, which he has uploaded to the *OneDrive* business account. Students can access it as long as they are logged in to *Office 365*. The teacher also noted that this is going to change in the upcoming 2016 version, which will allow for direct embedding of videos.

Teacher Support

Interviews with the teacher, technology coordinator, and the technology director

at South Fayette, were used to assess the degree of support provided by Microsoft during initial setup and continued usage of *OneNote*.

- The teacher worked closely with the technology coordinator at South Fayette to get started up with *OneNote*. During this process, they contacted Microsoft for support with issues over phone or email. They were happy with the quality and timeliness of support they received. The technology coordinator noted that she typically received a reply to her questions within 30 minutes.

> "...for example, we had a problem caching...the notebooks were not syncing and the teacher wasn't getting any information because it wasn't connecting to their *OneDrive*. I had no idea how to fix it so I asked him (technology support at *OneNote*) and he helped me fix that"
>
> — *Technology coordinator, South Fayette School District*

- The technology coordinator attended a workshop at the International Society for Technology in Education (ISTE) meeting in Philadelphia the summer before the pilot, to get trained to obtain a Microsoft Office Specialist (MOS) *OneNote* certification. She noted that this was tremendously helpful in getting to know *OneNote* and its various functionalities. However, she thought that the technology setup part was not covered in much detail in this workshop, which would have been helpful.
- The technology coordinator also provided support to other students and the teachers who wanted to use *OneNote*. She would go to the classroom and show students how to pull it out of *Office 365*. Initially, she provided some training to students on using *OneNote*, but students have begun to use it extensively a lot of classes, and now most students are proficient in using *OneNote*.
- During initial setup there were some networking issues, and bandwidth limitation was a problem. These were addressed mid September, and after bandwidth was increased, there have been no further issues.
- Teacher had to figure out how to's for *OneNote* on his own. Good tutorials for getting started were not available, which delayed the process of getting started with *OneNote* in the classroom. He noted,

> "...it's not as if they don't have video tutorials, they do. But they feel more like marketing — here's what you can do with it, instead of here's what you need to know to do it."
>
> — *7th grade history teacher, South Fayette*

- The teacher also thought it would be helpful to have some form of teacher training, or a regional academy that teachers can attend, get to use it and learn how to customize it to meet their own needs and objectives, and offer these seminars to equip other teachers to use *OneNote*.

Administrator Satisfaction

Semi-structured interviews with the Technology director at South Fayette shed light on administrator satisfaction with *Microsoft OneNote* as a curricular support tool. Key takeaways were as follows:

- The Technology director characterizes *OneNote* as an extremely successful pilot, which has rapidly expanded beyond the one classroom in which it was piloted. Several teachers at South Fayette are adopting it, with the lead teacher involved in the pilot leading product evangelization efforts by conducting workshops for teachers interested in adopting it for use in their classrooms.

- The Technology director also reported being satisfied with the level of support offered by Microsoft in terms of help with setup and troubleshooting issues.

- As a result of the successful pilot, the school plans to continue to use *OneNote* during the next school year.

The *Microsoft OneNote* pilot has been extremely successful at South Fayette, and has already begun to expand throughout the district. *OneNote* supports the creation of custom instructional content by instructors. The teacher was able to effectively deploy his materials which including text, videos, maps. He also was able to creatively integrate *OneNote* with tools such as *Socrative* and *Nearpod*, which allow for instant assessments in the classroom. As a collaborative tool, *OneNote* allows students to engage in collaborative exchanges in real-time, when working in small groups in the classroom. While there are a few issues with collaboration, such as time lags during syncing, overall, the product supports this intended goal effectively.

Key Findings

Key takeaways from two pilots at South Fayette district can be summarized as follows:

- Conducting a needs-analysis before choosing a product, and understanding the gaps in the curriculum that need to be addressed, helps identify products that are well-suited to a school's specific needs.

- Getting teacher feedback early and often is critical. Involving teachers in the decision-making process greatly increases buy-in and makes implementation smoother.

- Teachers' lack of time to resolve technology issues with setup and troubleshooting could be a barrier in adoption. Having a dedicated technology support person in the school makes school-wide adoption of a platform like *OneNote* much more streamlined.

- Choosing companies that are responsive to the school district's concerns lead to a more successful pilot.

- The size of the pilots at South Fayette was tractable. Each product was tried in one classroom for one subject, although *OneNote* came to be adopted much more widely during the second half of the year.

- Establishing a data sharing agreement with the product developers would lead to smoother sharing of key analytics that can lead to further insights on student learning and engagement.

- There is a great beneit for companies to develop a product efficacy feedback loop to learn how to design products to best meet the needs of customers. *INVENTORcloud* made changes to its assembly and roll out because of feedback received from South Fayette.

Overall Conclusions

Across all three school districts, the teachers were deeply committed to improving student learning, and gave honest opinions on what worked well and what did not. Overall findings are organized below in four categories: 1) ways to improve the pilot process in the future, 2) the effect of each product on students, 3) the changes product developers have made as a result of the pilot, and 4) the ways in which districts plan to use the pilot evidence.

Pilot Process

- Conducting a thorough needs-analysis and choosing a product well suited to a district's goals and objectives leads to a more meaningful pilot and improved results.
- Goal alignment between a district's instructional or curricular needs and the product's intended use is essential to conduct meaningful evidence.
- Clear communication of the goals and objectives of the pilot with all stakeholders is necessary. Emphasizing research and evaluation as a team process, and not an assessment of processes or outcomes, leads to better participation in research activities.
- Establishing and agreeing to an implementation timeline helps ensure buy-in from all stakeholders.
- Involving the research team earlier in the process can facilitate timely completion of institutional requirements such as IRB approval, and can ensure that research and evaluation activities begin immediately upon roll out of the products instead of several weeks later.
- Access to an external research partner allows all stakeholders to express their opinions in an uninhibited manner, leading to higher quality insights
- Schools that have dedicated in-house personnel (e.g., South Fayette) who drive research and evaluation efforts had more streamlined processes and consequently better outcomes
- The size of the pilot needs to be carefully determined before the beginning of the implementation. Pilots that span numerous classes across multiple grade-levels are not recommended early in the process. Once a product has been vetted in a small trial, for example in one grade level, a second iteration with more grade-levels (or more subject areas) may be considered to explore its generalizability.
- Understanding local device storage requirements for each tool to ensure students can use all the product's features as intended is critical.

Student Outcomes

- Possibly because it did not align well with the literacy curriculum in Avonworth, *eSpark* did not meet its goal of increasing NWEA scores for students needing enrichment opportunities.

- *Puzzlets* showed promise in promoting 21st century skills of communication, collaboration, creativity, and computational thinking in students. Teachers and administrators were satisfied with student engagement with *Puzzlets*.

- Student engagement with educational games outside of school did not significantly increase when *Amplify Games* were introduced. Implementation factors including limited space on student iPads, limited alignment with curriculum, and too few professional learning opportunities may have impacted student usage.

- While there were no statistically significant differences in student activation levels before and after using INVENTORCloud, student engagement was high and students enjoyed working with 3D printers.

- Students were highly engaged with *Microsoft OneNote*, which provided a platform for them to access and collaborate on content, and students reported that using it facilitated content organization and review better than other methods.

Feedback Loop Outcomes

- Companies like *Puzzlets* that are responsive—in providing real-time support and in modifying their features to meet district needs—are more likely to be adopted by a district.

- *eSpark* found design insights form the research team valuable and delivered a concrete plan to make changes to the product in terms of addition of new features to the address feedback from the study.

- INVENTORcloud has made modifications to the roll out of its program, including allowing students to complete the initial assembly of the 3D printers, as a result of enthusiastic student feedback from South Fayette.

- *Amplify* found the research protocol developed by the research team for gathering useful feedback during group sessions by using the feedback elicitation and affinity grouping activities. Their in-house research team conducted a similar activity with the teachers after the end of the school year, in which they used the protocol to capture teacher reflections and suggestions for improving the product and pilot process.

Evidence Use Outcomes

- In cases where the district set a goal of increasing student achievement through the use of a tool and those gains were not realized, the districts have chosen to either extend the timeline of the pilot period or choose not to adopt the program.

- When student engagement, teacher satisfaction, and administrator satisfaction is high, a district is more likely to continue use of the product to see if student learning measures increase in the future.

- Districts feel able to make decisions about curricular support tools like *OneNote* with qualitative student, teacher, and administrator satisfaction data as opposed to quantitative survey or student learning data. *OneNote* has emerged as valuable tool allowing for custom content creation and student-teacher collaboration, and is rapidly being adopted throughout the district.

Study Limitations

Product implementation, and thus pilot success, was inhibited by technological issues, timely roll out of products, and device limitations in some cases. In addition, not all product companies were willing or able to share anonymized data on student progress and it was sometimes challenging to obtain usable data in a machine-readable format. In two of the pilots, no learning analytics data was available, so the research team relied on mostly qualitative measures such as interviews and classroom observations to garner insights into student learning and engagement.

As previously noted, the five products studied in these three case-studies were extremely diverse, spanning a wide range of age-groups, and serving highly varied implementation goals of the schools involved. In order to compare across pilot sites, and develop common measures or metrics that other schools can adopt, common goals need to be identified prior to choosing of the products. Different products aligned with these goals could be chosen to be piloted at different sites, but in the same grade-level. This could provide more generalizable data on product efficacy, which would help provide guidance to schools trying to make a decision on which product to adopt.

Appendix 1A: Teacher Pre-Survey

eSpark Midpoint Teacher Survey

Your school district is involved with piloting the eSpark learning platform in classrooms for the Digital Promise Product Efficacy & Feedback Project. This survey asks you questions about your experiences so far in this pilot program and will help us improve educational technology piloting, feedback, and decision-making.

This survey is for participants who have signed the informed consent form provided to you by CMU researchers in a prior visit. The first question of the survey will ask you if you have signed the consent form. If you select YES, you will proceed to the rest of the survey, if you select NO, you will exit the survey.

The survey should take no more than 20 minutes to complete and your participation is voluntary. Your answers will be kept confidential and will be combined with answers from other teachers. No one teacher will be identified in any of the reports or communications. We appreciate your time and effort for filling out this survey.

If you have any questions about the survey or the study, please contact:
Dr. Soniya Gadgil <soniyag@andrew.cmu.edu>
Learning Media Design Center
Carnegie Mellon University
Tel: 412-268-2665

* Required

1. **Have you signed the informed consent form provided by CMU researchers in a prior visit? If you select YES, you will proceed to the rest of the survey, if you select NO, you will exit the survey.** *
   Mark only one oval.
   - ◯ Yes
   - ◯ No *Stop filling out this form.*

2. **Which implementation model are you using in your classroom for eSpark?** *
   Mark only one oval.
   - ◯ Station Rotation Model
   - ◯ 1:1 Whole Class Model
   - ◯ Other: .....

3. **To what extent would you agree with the following statements?** *

Mark only one oval per row.

	Strongly Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Strongly Disagree
I was involved in the decision-making process when selecting the eSpark platform to pilot.					
I received sufficient professional development to prepare me for piloting the eSpark platform.					
I receive sufficient ongoing professional development and tech support throughout the year when using eSpark.					
eSpark significantly reduces my lesson planning time.					
eSpark significantly increases individual instruction time with students.					

4. **Please summarize your classroom teaching and learning goals for the eSpark pilot this year.** *

5. **To what extent would you agree with the following statements with respect to your students' use of eSpark?** *

Mark only one oval per row.

	Strongly Disagree	Disagree	Not sure	Agree	Strongly Agree
My students demonstrated improved confidence in class.					
My students participated in class more often.					
My students demonstrated improved teamwork.					
My students are excited about learning when we use eSpark.					
My students are more engaged when we use eSpark.					

6. **In terms of student learning, what do you think are the advantages of using the eSpark platform?** *

.....

.....

.....

.....

.....

7. **Please select the extent to which each of the following statements describe your attitude towards teaching with eSpark.** *

Mark only one oval per row.

	Strongly Disagree	Disagree	Not sure	Agree	Strongly Agree
eSpark aligns with our state curriculum standards.	◯	◯	◯	◯	◯
eSpark aligns with our district curriculum.	◯	◯	◯	◯	◯
eSpark aligns with my classroom curriculum.	◯	◯	◯	◯	◯
I feel very competent using eSpark.	◯	◯	◯	◯	◯
eSpark is easy for me to use.	◯	◯	◯	◯	◯
eSpark is easy for my students to use.	◯	◯	◯	◯	◯
eSpark provides personalized learning opportunities for my students.	◯	◯	◯	◯	◯

8. **In terms of classroom instruction and teaching, what do you think are the advantages of using the eSpark platform?** *

.....

.....

.....

.....

.....

9. **How often do you have technical difficulties while using eSpark in your class?** *

Mark only one oval.

- ◯ Every time I use eSpark
- ◯ 1-2 times a week
- ◯ Once every couple of weeks
- ◯ Once a month
- ◯ Fewer than once a month
- ◯ Other: .....

10. **Which of the following technical difficulties do you have while using eSpark?** *

Check all that apply.

- [ ] Internet connection is slow
- [ ] Internet connection fails
- [ ] Program is not compatible with the current hardware in my classroom/school
- [ ] Program crashes or freezes during use
- [ ] Headphones not working
- [ ] I have not had technical challenges when using eSpark
- [ ] Other: .....

11. **To what extent do you agree with the following statements in terms of challenges with using eSpark?** *

Mark only one oval per row.

	Strongly agree	Agree	Unsure	Disagree	Strongly disagree
Not enough preparation time before students started using the product	◯	◯	◯	◯	◯
Not aligned with our curriculum	◯	◯	◯	◯	◯
Insufficient training or support during the pilot	◯	◯	◯	◯	◯
Students experienced problems with devices or internet access in school	◯	◯	◯	◯	◯
Not appropriate for age/ grade level	◯	◯	◯	◯	◯
Takes away time from teaching	◯	◯	◯	◯	◯

12. **What changes to the eSpark platform would make it a better product for you and your students?** *

.....

.....

.....

.....

.....

13. **At this midpoint in the pilot, how likely are you to recommend the use of this program next school year?** *

Mark only one oval.

- ◯ Extremely likely
- ◯ Somewhat likely
- ◯ Not likely

14. **How long have you been a teacher?** *

Mark only one oval.

- ◯ Less than a year
- ◯ 1-2 years
- ◯ 3-5 years
- ◯ 6-10 years
- ◯ More than 10 years

15. **How many years have you taught in this district?** *

Mark only one oval.

- ◯ Less than a year
- ◯ 1-2 years
- ◯ 3-5 years
- ◯ 6-10 years
- ◯ More than 10 years

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Appendix 1B: Teacher Feedback Session Protocol

Digital Promise League of Innovative Schools
Product Efficacy and Feedback Loops Project

Avonworth School District:
Teacher Feedback Session Protocol

Purpose:
The goal of this study is to conduct a focus group of 1st grade ELA teachers at Avonworth Primary Center, who are using *eSpark* to promote student learning in ELA. The focus group is centered on the following two dimensions of product efficacy – teacher support, and teacher satisfaction. We will understand what their original goals and objectives were, and how the product is helping them meet those goals and objectives.

Participants:
1st ELA teachers at Avonworth Primary Center who are piloting *eSpark* in their classrooms.

1. Sticky note activity (30 minutes)
Conducted in two breakout groups of 4. Consider group station rotation teachers together.

A. *What are the greatest benefits (or opportunities) coming from using* eSpark *in classroom?*
(Allow, 3-4 minute or until writing activity slows. One by one each teacher selects one item and briefly describes, ask other teachers to add any similar notes they had to create a cluster, Label it, then move to next teacher and repeat. Until run out of time.)

1. Write down on the warm colored sticky notes the positives that comes to mind from both a teaching and learning perspective.
2. One by one, ask each teacher to choose a sticky note that is the most important and put on a sheet
3. Ask for similar (make connections, create cluster, label).
4. Draw circles around clusters and name high-level category.

B. Now, *what were the greatest challenges (or weaknesses) with* eSpark *in your classrooms?*

1. Write down on the cool colored sticky notes the negatives or drawbacks that come to mind from both a teaching and learning perspective.
2. Choose a sticky note that is the most important.
3. Ask for similar (make connections, create cluster).
4. Draw circles around clusters and name high level category
5. Ask someone from the group to report out on the discussion

2. Group Share-out (10 minutes)

1. Share-out big conversation points.
2. Groups review each other's sticky notes

3. Voting (5 minutes)

1. Everybody gets red stickers (5-6) and green sticker (5-6) to vote. Identify the *most important* issues that need to be addressed. Prioritize feedback. Think of what matters the most. You can put all your votes on one topic/feedback area if you wish or you may distribute them.

Discussion Prompts:

- What are your final summarizing thoughts on what you're looking at?
- Based on your experiences with *eSpark* so far and this discussion, what kinds of feedback will be important to give *eSpark* and your Administration to improve student learning and teaching? What changes could/should be made.

**Take pictures of teachers working, gesturing to sheets during these activities, close ups and wide shots

**Before wrapping. Take legible shots of data collected. Upload audio and images to Google drive as soon as possible when you get back to the lab.

Materials:

- Teacher consent forms
- Post-its
- Butcher block paper
- Sharpies, big and small
- Colored stickers
- Tape
- Recorders
- Stands for recorders
- Extra batteries

Appendix 1C: Administrator Interview Protocol

Digital Promise League of Innovative Schools
Product Efficacy and Feedback Loops Project

Avonworth School District:
Administrator Interview Questions

The goal of this interview is to understand the product efficacy pilots at Avonworth from an administrator perspective. I will begin by first asking questions about your pilot process in general, and then focus on each of the products that were piloted this year.

Do you have any questions before we begin?
Do I have your permission to record this interview?

School EdTech Decision-making

1. How does Avonworth go about choosing an edtech product?
2. Please describe is your pilot process.
3. What challenges do you typically face when piloting products?
4. How does your school make a decision to adopt a new edtech product? What stakeholders are involved, and in what ways?
5. How would you characterize the criteria, evidence or insights you are using to make your decisions? What factors do you weigh?
6. What is the process for teachers and students to provide feedback to decision-makers, and how influential is that feedback?

eSpark

1. How did your school decide to use *eSpark*?

1. How did you find out about *eSpark*? Who else was involved? What are their roles?
2. How does it differ from other pilots?
3. What were the specific goals for piloting *eSpark*? In other words, what challenge were you hoping it would address and what would success look like
4. What learning objectives does this product address?
5. To what degree has *eSpark* been successful in meeting those goals?
6. Please tell us how your teachers integrated *eSpark* into their curriculum? What adaptations or modifications have be made over the course of the pilot?
7. What challenges did you face during the implementation of *eSpark*? Would you be doing anything differently if you had to do it again?
8. How satisfied are you with *eSpark* at this point?
9. What changes to *eSpark* would make it a better product for schools hoping to use it in the future? Any other feedback you'd like to give *eSpark*?
10. How likely are you to use this product again, if the changes you suggested were made?

Puzzlets

11. How did your school decide to use *Puzzlets*?
12. How did you find out about *Puzzlets*? Who else was involved? What are their roles?
13. How does it differ from other pilots?
14. What were the specific goals for piloting *Puzzlets*? In other words, what challenge were you hoping it would address and what would success look like

15. What learning objectives does this product address?
16. To what degree has *Puzzlets* been successful in meeting those goals?
17. Please tell us how your teacher(s) has integrated *Puzzlets* into your curriculum? What adaptations or modifications have be made over the course of the pilot?
18. What challenges did you face during the implementation of *Puzzlets*? Would you be doing anything differently if you had to do it again?
19. How satisfied are you with *Puzzlets* at this point?
20. What changes to *Puzzlets* would make it a better product for schools hoping to use it in the future? Any other feedback you'd like to give *Puzzlets*?
21. How likely are you to use this product again, if the changes you suggested were made?

Appendix 1D: Classroom Observation Protocol

Digital Promise League of Innovative Schools
Product Efficacy and Feedback Loops Project

Avonworth School District: *Puzzlets* Student Observation Study

Purpose:
The goal of this study is to observe students using the *Puzzlets* (DDL) platform to look for markers of interest and engagement, problem solving strategies, debugging skills, collaborative behavior.

Participants:
Students in K-2 Digital Literacy classes at Avonworth Primary Center whose parents/ caregivers have consented to participation in study.

Protocol Description:
The lead teacher, uses station rotation model in her digital literacy classes to ensure all students have access to the ed-tech learning experiences. The three stations available in the computer lab are *Puzzlets*, *Scratch Jr.*, and *Type Rocket*. Each station has four game setups available, and student work in teams of two. Each rotation runs 10-12 minutes long. The maximum number of students in the lab is 3 X 4 X 2 =24. We will observe students using *Puzzlets* only. There will be 6-8 students (3-4 pairs) using the *Puzzlets* during every rotation who will be divided teams. There will be two CMU researchers, and each researcher will focus two groups of student pairs.

The researchers will observe *Puzzlets* game play for first 5 minutes. If the children fall silent, the researchers may prompt them to talk by asking "can you tell me what you are doing?" Mid-task, the researcher will ask the first team questions 1-5 (below) which should not take longer than 3-4 minutes. The researchers will then move to the second team and ask the same set of questions. The first group can resume play after responding to the researcher questions. At the end of the rotation (12 minutes), the researchers will hand out participation stickers. Non-participating children will receive a different kind of stickers. We plan to take over the shoulder and non-identified photographs of the students, and audio record their answers to questions.

Observation Categories (see Observation sheet):

- Play Strategy: Planned vs. trial and error
- Problem solving (debugging strategies used)
- Collaborative Talk & Behaviors (turn-taking, disagreement resolution)
- Off task behaviors
- Tech challenges (e.g. the Bluetooth connection, log-ins)

Tally Sections (Footer; see Observation sheet):

- Questions & requests to teacher
- Turn taking (Are the children taking turns, i.e., does one child handle the iPad and the other the *Puzzlets* board and switch during the rotation?)
- Session Close: End/Continue Play

Questions for Students:

1. Can you explain to me how this game works?
2. Can you tell me what these tiles do?
3. What do you think of this game?
4. How do you like playing this game?
5. Which one of these games do you most like to play (show three start pages)?

Materials:

- Cameras + batteries
- Observations sheets
- 2 DVR recorders + batteries
- Consent forms
- Clipboards
- Participant and nonparticipant stickers
- Pens
- Watch/Timer
- Screenshots for each of the three stations

Appendix 1E: Classroom Observation Recording Sheet

Digital Promise League of Innovative Schools
Product Efficacy and Feedback Loops Project

Avonworth School District: *Puzzlets* Student Observation Recording Sheet

Student ID:	Observer:	Instructor:	Date:
Start Time:	End Time:	DVR #:	Photo Consent?
Type of Play Strategy (ex. trial and error)			
Problem-Solving (debugging strategy)			
Collaboration			
Off-Task Behavior			
Tech Challenges			
Ask for Assistance		Turn-Taking	

Session End: Ended Play Continued Play

Post-Task Questions:

1. Can you explain to me how this game works?

2. Can you tell me what these tiles do? (Note: Point to a few of the directional tiles, as well as the X 2 and X 3 tiles)

3. What do you think of this game?

4. What do you like (or not like, depending on answer to question 3) about this game?

Notes:

Appendix 1F: Teacher Interview Protocol

Digital Promise League of Innovative Schools
Product Efficacy and Feedback Loops Project

Avonworth School District:
Teacher Interview Questions

The goal of this interview is to talk about the *Puzzlets* pilot from a teacher's standpoint. I'll begin by asking you some questions about your pilot process in general, then some questions that are specific to *Puzzlets*, and then finally some reflection questions about what went well, and what can be improved. We have covered some of this information in our previous conversations, but I'd like to be comprehensive, so don't worry if you feel like you are repeating some things I may already know.

Do you have any questions before we begin?
Do I have your permission to record this interview?

School EdTech Decision-making

1. How does your school make a decision to adopt a new ed-tech product? What stakeholders are involved, and in what ways?
2. What is the process for teachers and students to provide feedback to decision-makers, and how influential is that feedback?

Product Implementation

3. How did your school decide to use *Puzzlets*?
   a. How did you get involved? Who else is involved? What are their roles?
   b. How did it differ from other pilots?
4. What were the specific goals for piloting *Puzzlets*? In other words, what challenges were you hoping it would address and what would success look like?
5. What learning objectives does this product address?
6. How did you teacher(s) integrate *Puzzlets* into your curriculum? What adaptations or modifications have be made over the course of the pilot? (e.g., Can you talk a bit about how you decided upon the number of stations; weekly rotations vs rotations within a single class)
7. Can you comment on how students interacted with *Puzzlets* and how that changed over the course of the pilot?
8. To what degree has *Puzzlets* been successful in meeting your original goals and objectives?
9. What challenges did you face during the implementation of *Puzzlets*? Would you be doing anything differently for the next round?
10. What changes to *Puzzlets* would make it a better product for schools hoping to use it in the future?
11. Your experience may have been a little different given that you were so intimately familiar with the product. But do you see teachers who have not have experience with it?
12. Is there any other feedback you'd like to give Digital Dreamlabs?
13. How likely are you going to want to use this product again, if the changes you suggested were made?
14. What advice would you share with teachers, administrators, or edtech companies about conducting educational technology pilots?

Appendix 2A: Games in Amplify suite

Science Games:

- Cell Strike
- Habitactics
- Lightsmith
- MetaboSIM
- Planet Planners
- Sim Cell
- Tyrant*

Math Games:

- Crafty Cut
- Creature Cubes
- FAKTR
- Hundreds Edu
- Mlob Rule*
- Phoenix Protocol
- Twelve a Dozen Edu
- C0D3BR34K3RS
- DragonBox Elements

ELA Games:

- The World of Lexica (includes Scriptus)
- Lexica Vol. 1; includes
  - Ink Blott: Underground
  - Mukashi Mukashi
  - Sentence Sensibility
  - Spelling Stone
  - Venture
- Lexica Vol. 2; inlcudes
  - Terribone
  - The Tomes
  - Twisted Manor
- Lexica Vol. 3; includes
  - MasterSwords*
  - Page Invaders
  - Shelf Life
  - W.E.L.D.E.R.Edu
- Lexica Vol. 4; includes
  - Story Cards
- *Amplify* Library (includes over 600 titles of literature and literary non-fiction)

* Games marked with asterisk are multi-player games

Appendix 2B: Student pre-survey

Amplify Games: Student Pre-Survey

Your school is involved in conducting a pilot (try-out) of Amplify games this school year, as part of the Digital Promise Product Efficacy & Feedback Project. This online survey asks you about your thoughts and feelings about academic subjects, and about your game-playing behaviors on electronic devices.

This survey should take no more than 15 minutes to complete and your participation is voluntary. Your answers will be kept anonymous and responses from all participants will be summarized such that no one student will be identified in any of the reports or communications. We appreciate your time and effort in filling out this survey.

If you have any questions about the survey or the study, please contact:

Dr. Soniya Gadgil <soniyag@andrew.cmu.edu>
Learning Media Design Center
Carnegie Mellon University
Tel: 412-268-2665

* Required

1. **What is today's date** *

   Example: December 15, 2012

2. **Prior to starting to use Amplify games, approximately, how much time per week did you spend using your iPad outside of school hours?** *

   Mark only one oval.

   - ◯ I did not use my iPad outside of school hours before starting to use Amplify games
   - ◯ 1-2 hours a week
   - ◯ 2-5 hours a week
   - ◯ 5-10 hours a week
   - ◯ Over 10 hours a week

3. **What kind of activities do you most frequently do on your iPAD outside of school hours? Check all that apply.** *

   Check all that apply.

   - ☐ Email/ texting
   - ☐ Social networking (e.g., Facebook, Snapchat, Twitter etc.)
   - ☐ Games
   - ☐ Homework
   - ☐ Reading
   - ☐ Other: _____

4. **If you selected Games as an option for the above question, please name up to three games that you played prior to Amplify games.**

5. **Prior to starting to use Amplify games, approximately how much time did you spend playing games on your laptop, desktop, tablet, or phone? Check all that apply.** *

Mark only one oval.

- ◯ I did not play games on any devices before starting to use Amplify games
- ◯ 1-2 hours a week
- ◯ 2-5 hours a week
- ◯ 5-10 hours a week
- ◯ Over 10 hours a week
- ◯ Other:

Please fill in the circle that represents how YOU used your iPAD in your free time prior to starting to use Amplify games.

6. *

Mark only one oval per row.

	YES!	yes	no	NO!
Prior to using Amplify games, I chose to play Math games on my iPad.	◯	◯	◯	◯
Prior to using Amplify games, I chose to play English Language Arts (ELA) games on my iPad.	◯	◯	◯	◯
Prior to using Amplify games, I chose to play Science games on my iPad.	◯	◯	◯	◯

Math Survey

We are interested in your thoughts, feelings, and experience with Math activities.
Please answer these questions as honestly as you can. There are no right or wrong answers — we only want to know what you think and feel about Math.

7. **Please fill in the circle that represents how YOU think and feel about Math.** *

Mark only one oval per row.

	YES!	yes	no	NO!
Learning math is important to me.	◯	◯	◯	◯
I find math interesting.	◯	◯	◯	◯
Math is easy for me.	◯	◯	◯	◯
In general, when I work on a math problem, I enjoy it.	◯	◯	◯	◯

8. **When I'm done solving an interesting Math problem,** *

Mark only one oval per row.

	YES!	yes	no	NO!
I look for other similar problems to solve.				
I try to apply it to situations in daily life.				
I look for more information about it.				
I keep practicing what I've learned.				

9. **Can you do these things? Use the scale below to rate how sure you are.** *

Mark only one oval per row.

	YES!	yes	no	NO!
I can do the math problems I get in class.				
I can answer all the questions on a math test in class.				

English Language Arts (ELA) Survey

We are interested in your thoughts, feelings, and experience with English Language Arts (ELA). Please answer these questions as honestly as you can. There are no right or wrong answers — we only want to know what you think and feel about ELA.

10. **Please fill in the circle that represents how YOU think and feel about ELA.** *

Mark only one oval per row.

	YES!	yes	no	NO!
In general, I find reading interesting.				
In general, I find writing interesting.				
Reading is important to me.				
Writing is important to me.				
I enjoy reading for fun.				
I enjoy writing for fun.				
I am a good reader.				
I am a good writer.				
I can easily find interesting things to read.				

11. **After I finish reading a really interesting book,** *

Mark only one oval per row.

	YES!	yes	no	NO!
I can't stop thinking about it.				
I see how it relates to things around me.				
I look for more online information about it.				
I talk about it with other people.				
I look for more books like it.				

12. **What kind of books do you like to read? (e.g., mysteries, fantasies, thrillers, sci-fi, non-fiction)** *

.....

Science Survey

We are interested in your thoughts, feelings, and experience with Science.
Please answer these questions as honestly as you can. There are no right or wrong answers — we only want to know what you think and feel about science.

13. **Please fill in the circle that represents how YOU think and feel about science.** *

Mark only one oval per row.

	YES!	yes	no	NO!
Learning science is important to me.				
I find science interesting.				
Science is easy for me.				
In general, when I work on a science project, I enjoy it.				

14. **After a really interesting science activity is over:** *

Mark only one oval per row.

	YES!	yes	no	NO!
I can't stop thinking about it.				
I see how it relates to things around me.				
I look for more information about it.				
I talk about it with other people.				
I keep practicing what I've learned.				

15. **Can you do these things? Use the scale below to rate how sure you are.** *

Mark only one oval per row.

	YES!	yes	no	NO!
I can do the science activities I get in class.	◯	◯	◯	◯
I can answer all the questions on a science test in class.	◯	◯	◯	◯

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Appendix 2C: Student post-survey

Amplify Games: Student Post-Survey

Your school has been involved in conducting a pilot (try-out) of Amplify games this school year, as part of the Digital Promise Product Efficacy & Feedback Project. This final survey asks you to reflect on your experiences using Amplify games in and out of the classroom.

This online survey should take no more than 15 minutes to complete and your participation is voluntary. Your answers will be kept anonymous and responses from all participants will be summarized such that no one student will be identified in any of the reports or communications. We appreciate your time and effort in filling out this survey.

If you have any questions about the survey or the study, please contact:

Dr. Soniya Gadgil <soniyag@andrew.cmu.edu>
Learning Media Design Center
Carnegie Mellon University
Tel: 412-268-2665

* Required

1. *

Example: December 15, 2012

2. **After starting to use Amplify games, approximately how much time per week did you spend using your iPad outside of school hours?** *

Mark only one oval.

- ◯ I did not use my iPad outside of school hours
- ◯ 1-2 hours a week
- ◯ 2-5 hours a week
- ◯ 5-10 hours a week
- ◯ Over 10 hours a week

3. **What kind of activities do you most frequently do on your iPAD outside of school hours? Check all that apply.** *

Check all that apply.

- ☐ Email/ texting
- ☐ Social networking (e.g., Facebook, Snapchat, Twitter etc.)
- ☐ Games
- ☐ Homework
- ☐ Reading
- ☐ Other:

4. **If you selected Games as an option for the above question, please name up to three games that you played the most since December.**

.....

5. **Since December, approximately how much time did you spend playing games on your laptop, desktop, tablet, or phone? Check all that apply.** *

Mark only one oval.

- ◯ I did not play games on any device
- ◯ 1-2 hours a week
- ◯ 2-5 hours a week
- ◯ 5-10 hours a week
- ◯ Over 10 hours a week
- ◯ Other: .....

Please fill in the circle that represents how YOU used your iPAD in your free time AFTER the launch of Amplify games.

6. *

Mark only one oval per row.

	YES!	yes	no	NO!
I chose to play Math games on my iPad.	◯	◯	◯	◯
I chose to play English Language Arts (ELA) games on my iPad.	◯	◯	◯	◯
I chose to play Science games on my iPad.	◯	◯	◯	◯

7. **Were you a member of the Games Squad?**

Mark only one oval.

- ◯ Yes
- ◯ No

8. **Did you participate in any of the Amplify games after-school tournaments?**

Mark only one oval.

- ◯ Yes
- ◯ No *Skip to question 10.*

After-school game tournaments

9. **Which of the after-school game tournaments did you participate in?**
   Check all that apply.

   - [ ] MasterSwords
   - [ ] TyRant
   - [ ] MLob Rule

Math Survey

We are interested in your thoughts, feelings, and experience with Math activities.
Please answer these questions as honestly as you can. There are no right or wrong answers — we only want to know what you think and feel about Math.

10. **Please fill in the circle that represents how YOU think and feel about Math.** *
    Mark only one oval per row.

	YES!	yes	no	NO!
Learning math is important to me.	◯	◯	◯	◯
I find math interesting.	◯	◯	◯	◯
Math is easy for me.	◯	◯	◯	◯
In general, when I work on a math problem, I enjoy it.	◯	◯	◯	◯

11. **When I'm done solving an interesting Math problem,** *
    Mark only one oval per row.

	YES!	yes	no	NO!
I look for other similar problems to solve.	◯	◯	◯	◯
I try to apply it to situations in daily life.	◯	◯	◯	◯
I look for more information about it.	◯	◯	◯	◯
I keep practicing what I've learned.	◯	◯	◯	◯

12. **Can you do these things? Use the scale below to rate how sure you are.** *
    Mark only one oval per row.

	YES!	yes	no	NO!
I can do the math problems I get in class.	◯	◯	◯	◯
I can answer all the questions on a math test in class.	◯	◯	◯	◯

13. **The following questions ask you for your opinions on Amplify MATH games. Use the scale below to rate how sure you are.** *

Mark only one oval per row.

	YES!	yes	no	NO!
Amplify MATH games supported my learning in Math				
Amplify games increased my interest in Math				
I enjoyed playing Amplify Math games				
I played Amplify Math games outside of school				

English Language Arts (ELA) Survey

We are interested in your thoughts, feelings, and experience with English Language Arts (ELA). Please answer these questions as honestly as you can. There are no right or wrong answers — we only want to know what you think and feel about ELA.

14. **Please fill in the circle that represents how YOU think and feel about ELA.** *

Mark only one oval per row.

	YES!	yes	no	NO!
In general, I find reading interesting.				
In general, I find writing interesting.				
Reading is important to me.				
Writing is important to me.				
I enjoy reading for fun.				
I enjoy writing for fun.				
I am a good reader.				
I am a good writer.				
I can easily find interesting things to read.				

15. **After I finish reading a really interesting book,** *

Mark only one oval per row.

	YES!	yes	no	NO!
I can't stop thinking about it.				
I see how it relates to things around me.				
I look for more online information about it.				
I talk about it with other people.				
I look for more books like it.				

16. **What kind of books do you like to read? (e.g., mysteries, fantasies, thrillers, sci-fi, non-fiction)** *

17. **The following questions ask you for your opinions on Amplify ELA games. Use the scale below to rate how sure you are.** *

Mark only one oval per row.

	YES!	yes	no	NO!
Amplify ELA games supported my learning in ELA	◯	◯	◯	◯
Amplify games increased my interest in ELA	◯	◯	◯	◯
I enjoyed playing Amplify ELA games	◯	◯	◯	◯
I played Amplify ELA games outside of school	◯	◯	◯	◯
I read books in Lexica using the e-reader app	◯	◯	◯	◯

18. **How many books did you read in Lexica?** *

Mark only one oval.

- ◯ 0
- ◯ 1-2
- ◯ 3-5
- ◯ 6-8
- ◯ 9-10
- ◯ Other: .....

Science Survey

We are interested in your thoughts, feelings, and experience with Science.
Please answer these questions as honestly as you can. There are no right or wrong answers — we only want to know what you think and feel about science.

19. **Please fill in the circle that represents how YOU think and feel about science.** *

Mark only one oval per row.

	YES!	yes	no	NO!
Learning science is important to me.	◯	◯	◯	◯
I find science interesting.	◯	◯	◯	◯
Science is easy for me.	◯	◯	◯	◯
In general, when I work on a science project, I enjoy it.	◯	◯	◯	◯

20. **After a really interesting science activity is over:** *

Mark only one oval per row.

	YES!	yes	no	NO!
I can't stop thinking about it.				
I see how it relates to things around me.				
I look for more information about it.				
I talk about it with other people.				
I keep practicing what I've learned.				

21. **Can you do these things? Use the scale below to rate how sure you are.** *

Mark only one oval per row.

	YES!	yes	no	NO!
I can do the science activities I get in class.				
I can answer all the questions on a science test in class.				

22. **The following questions ask you for your opinions on Amplify Science games. Use the scale below to rate how sure you are.** *

Mark only one oval per row.

	YES!	yes	no	NO!
Amplify Science games supported my learning in Science				
Amplify Science games increased my interest in Science				
I enjoyed playing Amplify Science games				
I played Amplify Science games outside of school				

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Appendix 2D: Feedback Elicitation Protocol

Digital Promise League of Innovative Schools

Product Efficacy and Feedback Loop Project

Elizabeth Forward School District:
Teacher Focus Group Protocol
15 March 2016

Purpose:
The goal of this study is to conduct focus groups of 6th grade, 7th grade, and 8th grade ELA and STEM teachers at Elizabeth Forward Middle School, who are using *Amplify* games to promote the use of iPADs for educational activities in outside of classroom time. The focus group is centered on the following dimensions of product efficacy – teacher support, teacher satisfaction, and teacher perceptions of student learning and engagement. We will document their original learning goals and objectives, and use elicitation techniques to discover whether and how the product is helping them meet those goals and objectives.

Participants:
6th grade, 7th grade, and 8th grade ELA and STEM teachers at Elizabeth Forward Middle School. Each group with have 2 ELA teachers, 2 science teachers, and 2 math teachers (and maybe 2 special ed teachers). There will be 6-8 teachers in each 45 minute-long session.

SESSION ACTIVITIES OUTLINE
Were going use a feed back analysis technique to gather some information from you about your pilot experience so far with the *Amplify* products. We are going to ask you to use the sticky notes in front of you to write down what comes to mind when you think about the prompts in front of you.

Next, we will ask you to put up your notes on this sheet of paper, and organize them into idea clusters. Finally, we will have you vote on issues that are most important to you.

Activity 1: Feedback Elicitation (10-12 minutes)
We are going to ask you to reflect upon your experiences with using *Amplify* games in and out of the classroom, using the the prompts in front of you. Describe each prompt as follows:

Prompt 1: *Teacher Support:* Time required to set up accounts and assign content, impact on planning time, effectiveness of training and support
Prompt 2: *Teacher Satisfaction:* Ease of use, confidence with product and subject matter
Prompt 3: *Student Learning*: How did students' knowledge and skills grow over time
Prompt 4: *Student Engagement:* Frequency and duration of usage, time on task

Probe Reminders: Remember to write down as many problems, insights, potential data needs/ uses, or opinions that come to mind in silence."

Give first probe reminder after approximately 5 minutes. When they have 3 more minutes left, give a reminder, and ask if they need more time.

Activity 2: Feedback Synthesis Activity (15 minutes)
One by one each teacher selects one item, and puts it up on the white sheet of paper taped to the table. S/he briefly describes her notes, and facilitator asks other teachers to add any similar notes they had to create a cluster, Label it, then move to next teacher and repeat. Until run out of time.

Activity 3. Prioritizing Feedback and Discussion (10 minutes)
Everybody gets red stickers (5-6) and green sticker (5-6) to vote. Identify the *most important* issues that need to be addressed. Prioritize feedback. Think of what matters the most. You can put all your votes on one topic/feedback area if you wish or you may distribute them.

Discussion: What are your final summarizing thoughts based on what you're looking at? Based on your experiences with *Amplify* so far and this discussion, what kinds of feedback would be important to give *Amplify* and your Administration to improve student learning and teaching? What changes could/should be made?

**Take pictures of teachers working, gesturing to sheets during these activities, close ups and wide shots

**Before wrapping. Take legible shots of data collected. Upload audio and images to Google drive as soon as possible when you get back to the lab.

Materials:

- Teacher consent forms
- Post-its: warm and cool colored
- Butcher block paper for tables
- Sharpies, big and small
- Colored stickers
- Tape
- Recorders
- Stands for recorders
- Extra batteries
- Camera (Make sure camera battery is charged)
- Prompts printed on letter size paper
- Data collection sheets
- Prompts: Student Learning, Student Engagement, Teacher Support, and Student & Teacher Satisfaction printed in large font.

Notes:

Appendix 2E: Games vetting survey for teachers

Amplify STEM Games Vetting Questionnaire

We'd like to know your thoughts about the Amplify iPad games that you are checking out to potentially use in your class. Please use the form below to share your initial thoughts and reviews. Your comments will be kept confidential.

Thank you,
Soniya & Marti
Learning Media Design Center
Carnegie Mellon University

* Required

1. **Which Amplify games did you review for possible use with your class? Please check all the apply.** *
   Check all that apply.

   - [ ] Cell Strike
   - [ ] Habitactics
   - [ ] Light Smith
   - [ ] MetaboSIM
   - [ ] Planet Planners
   - [ ] SIM Cell
   - [ ] Crafty Cut
   - [ ] Creature Cubes
   - [ ] FAKTR
   - [ ] Mlob Rule
   - [ ] Phoenix Protocol
   - [ ] Twelve a Dozen
   - [ ] Other: _____

2. **What do you like about the games that you reviewed?**
   Things to consider in your comments: instructional support (e.g., beginning, remedial, advanced), instructional value, alignment with standards, usage opportunities, needs addressed?

3. **What challenges or limitations do you foresee in using these games?**

4. **On a scale of 1-5, how likely are you to want to have your students use one or more of these games DURING class time?**
Mark only one oval.

	1	2	3	4	5	
Not very likely	◯	◯	◯	◯	◯	Very likely

5. **On a scale of 1-5, how likely are you recommend one or more of these games to your students to play OUTSIDE of class time?**
Mark only one oval.

	1	2	3	4	5	
Not very likely	◯	◯	◯	◯	◯	Very likely

6. **What grade levels do you teach?**
Check all that apply.

- ☐ 6th
- ☐ 7th
- ☐ 8th
- ☐ Learning support /special needs
- ☐ Other:

7. **What subject area are you currently teaching?**
Mark only one oval.

- ◯ Math
- ◯ Science
- ◯ English Language Arts

8. **What is your gender?**
Mark only one oval.

- ◯ Male
- ◯ Female

9. **In general, how easy do you find it to learn and teach with new Ed Tech products?**
Mark only one oval.

	1	2	3	4	5	
Not Easy	◯	◯	◯	◯	◯	Easy

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Appendix 2F: Teacher post-survey

Amplify Games Teacher Reflection Survey

This final year-end survey asks you to reflect on your experiences using Amplify games as part of the Digital Promise Product Efficacy & Feedback Project.

This online survey should take no more than 15 minutes to complete and your participation is voluntary. Your answers will be kept anonymous and responses will be summarized such that no one will be identified in person in any of the reports or communications. We appreciate your time and effort in filling out this survey.

If you have any questions about the survey or the study, please contact:

Dr. Soniya Gadgil <soniyag@andrew.cmu.edu>
Learning Media Design Center
Carnegie Mellon University
Tel: 412-268-2665

* Required

1. **To what extent would you agree with the following statements?** *

Mark only one oval per row.

	Strongly Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Strongly Disagree
I was involved in the decision-making process when selecting Amplify games to pilot.					
I received sufficient ongoing professional development and tech support when using Amplify games					
Over the course of the pilot, I had opportunities to provide feedback to my administration about Amplify games					
Over the course of the pilot, I had opportunities to provide feedback to the product developers.					
My opinion will be considered by the administration when making a decision about continuing to use Amplify games.					
I believe that technology will positively transform education.					
I believe that the benefits of 1:1 computing outweigh the costs.					

2. **How relevant were Amplify games to topics you needed to cover in your curriculum?** *

Mark only one oval.

	1	2	3	4	5	
Not relevant at all						Extremely relevant

3. **If you chose to use Amplify games during classroom instruction, please describe which games you used, and how.**

.....

.....

.....

.....

.....

4. **How often did you and/or your students have technical difficulties when using Amplify games?** *
Mark only one oval.

	1	2	3	4	5	
Never	◯	◯	◯	◯	◯	Frequently

5. **To what degree were Amplify games effective in supporting the goal of getting students to play educational games during out of school time?** *
Mark only one oval.

	1	2	3	4	5	
Not effective	◯	◯	◯	◯	◯	Highly effective

6. **What grade/s do you teach?**
Mark only one oval.

- ◯ 6th
- ◯ 7th
- ◯ 8th
- ◯ Other: .....

7. **What subject/s do you teach?**
Mark only one oval.

- ◯ ELA
- ◯ Math
- ◯ Science
- ◯ Other: .....

8. **For ELA teachers only: To what extent was Lexica effective in supporting the goal of encouraging students to read more books?**
Mark only one oval.

	1	2	3	4	5	
No effective at all	◯	◯	◯	◯	◯	Highly effective

9. **How likely are you to recommend the use of Amplify games in their current form for the next school year?** *
Mark only one oval.

	1	2	3	4	5	
Unikely	◯	◯	◯	◯	◯	Extremely likely

10. **What changes to Amplify games would make them better for you and your students?** *

11. **If the changes you stated above were made, how likely are you to recommend the use of Amplify games during the next school year?** *
Mark only one oval.

	1	2	3	4	5	
Unlikely	◯	◯	◯	◯	◯	Extremely likely

12. **Other than Amplify games, how many Ed Tech product pilots have you participated in so far?** *
Mark only one oval.

- ◯ None
- ◯ 1-2
- ◯ 3-5
- ◯ More than 5

13. **For how many years have you been teaching?** *
Mark only one oval.

- ◯ Less than a year
- ◯ 1-2 years
- ◯ 3-5 years
- ◯ 6-10 years
- ◯ More than 10 years

14. **For how many years have you taught in this district?** *
Mark only one oval.

- ◯ Less than a year
- ◯ 1-2 years
- ◯ 3-5 years
- ◯ 6-10 years
- ◯ More than 10 years

15. **In general, how easy do you find it to learn and teach with new Ed Tech products?** *
Mark only one oval.

	1	2	3	4	5	
Not easy	◯	◯	◯	◯	◯	Extremely easy

16. **What advice would you give to colleagues in other schools about piloting new Ed Tech products in order to make informed decisions about adoption?** *

.....

.....

.....

.....

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Appendix 2G: Administrator Interview Protocol

Digital Promise League of Innovative Schools

Product Efficacy & Feedback Loops Project

Elizabeth Forward School District:
Administrator Interview Questions

The goal of this interview is to talk about the *Amplify* games pilot from an admin perspective. I'll ask you some questions about your pilot process in general, then some questions that are specific to this pilot, and then finally some reflection questions about what went well, and what can be improved.

Do you have any questions before we begin?
Do I have your permission to record this interview?

School EdTech Decision-making

1. How does Elizabeth Forward go about choosing an edtech product to pilot?
2. In a typical school year, how many pilots do you conduct on average? How many pilots are currently being run?
3. Can you briefly describe your pilot process?
4. What challenges do you typically face when piloting products?
5. Upon completing a pilot, how does your school make a decision to adopt a new edtech product? What stakeholders are involved, and in what ways?
6. How would you characterize the criteria, evidence or insights that you use to make your decisions? What factors do you weigh?
7. What is the process for teachers and students to provide feedback to decision-makers, and how influential is that feedback?

Product Implementation

8. Decision-making process
   a. How did you find out about *Amplify* games?
   b. What made you decide to pilot it?
   c. Who else was involved in the decision-making process? What were their roles?
   d. How does it differ from other pilots?
9. What were the specific goals for piloting *Amplify* Games? In other words, what challenges were you hoping it would address and what would success look like?
10. What learning objectives do *Amplify* games address? To what degree has *Amplify* been successful in meeting those goals?
11. In the beginning, the idea was to pilot only Lexica and one Math game: twelve a dozen edu. However, the scope was expanded to cover other STEM games as well. Can you comment a bit on this decision?
12. How were teachers introduced to *Amplify* games?
13. How satisfied are you with the PD that teachers received? What improvements would you suggest?

14. Questions specific to STEM games –
    a. How did teachers decide which games were best suited content-wise?
    b. How did your teacher(s) integrate *Amplify* games into their curriculum? What adaptations or modifications have be made over the course of the pilot?
15. How did students use *Amplify* games? Are there any student opinions that you heard over the course of the pilot that you'd like to share?
16. What challenges did you face during the implementation of *Amplify* games? Would you be doing anything differently if you were to do this again?
17. Overall, how satisfied are you with *Amplify* games at this point?
18. What changes to *Amplify* games would make it a better product for schools hoping to use it in the future?
19. Is there any other feedback you'd like to give *Amplify* games?
20. How likely are you to use this product again, if the changes you suggested were made?

Reflection Questions

21. What advice would you share with teachers, administrators, or edtech companies about conducting educational technology pilots?

Appendix 3 A: Activation Survey

For each of the following questions, please choose among the following options:

Strongly Agree; Agree; Somewhat Agree; Somewhat Disagree; Disagree; Strongly Disagree

Competency Beliefs

Item	Text
CBS01	I can do the design challenges I get in class.
CBS02	I can understand technical information on websites for kids my age.
CBS03	I am the technology expert in my house.
CBS04	I can understand the technical information in books for adults.
CBS05	I think I am very good at: Figuring out how to fix things that don't work.
CBS06	I think I am very good at: Providing evidence when I give my opinion.
CBS07	I think I am very good at: Explaining my solutions to technical problems.
CBS08	I think I am very good at: Solving problems.
CBS09	I think I am very good at: Coming up with my own innovative ideas.
CBS10	I think I am very good at: Coming up with new ways to solve technical problems.
CBS11	I think I am very good at: Coming up with new ideas when working on projects.

Fascination

Item	Text
FS01	I love designing things!

FS02	I like to figure out how things work.
FS03	I love building things!
FS04	I want to learn as much as possible about innovation.
FS05	After a really interesting design activity is over, I can't stop thinking about it.
FS06	I wish I could build things more often.
FS07	Designing new things makes me feel excited.
FS08	I talk about how things work with friends or family.

Innovation Stance

Item	Text
IS01	I like making new things even if I am not very good at it.
IS02	I share my design ideas even if I am not sure they will work.
IS03	I try to find new ways of doing things even if they might not work out.
IS04	I try to learn new things even if I might make mistakes.
IS05	I have a lot of creative ideas about how to make new things.
IS06	I know I think differently than other people.
IS07	I often come up with ideas no one else has.
IS08	I like to use materials in ways they have never been used before.
IS09	I like to figure out new ways of doing things.
IS10	I find new ways to solve problems.

IS11	I like to make things no one has ever seen before.
IS12	I have a good imagination when working on projects.

Values

Item	Text
VS01	It is very important for me to learn about creative entrepreneurship.
VS02	Inventors (people who come up with ideas for something new) make the world a better place to live.
VS03	Innovation makes the world a better place to live.
VS04	Knowing design is important for all jobs.
VS05	It is important for me to think like an innovator - about how to make things work better.
VS06	I think designers have the most important job in the world.
VS07	Innovation is the most important thing in the world for me to learn.
VS08	I think knowing computational thinking is more important than knowing anything else.
VS09	Knowing design is important for being a good citizen.
VS10	Computational thinking - formulating a problem and expressing its solution(s) in such a way that a computer can effectively carry out, helps me understand how the world works.
VS11	I think innovative ideas are valuable.
VS12	I think innovation will help me solve problems.
VS13	Thinking like a designer will help me do well in all my classes.

Appendix 3 B: Student Interview Protocol

Digital Promise League of Innovative Schools
Product Efficacy and Feedback Loop Project
INVENTORcloud

South Fayette School District
Student Focus Group Protocol

Photo documentation!

1. Please tell us about the project your team made with *INVENTORcloud*.
2. How did you and your teachers use *INVENTORcloud*, what role did it play?
3. What did you think of *INVENTORcloud*?
4. According to you, what were the reasons for using *INVENTORcloud* in your Creative Entrepreneurship class?
5. Did *INVENTORcloud* support your learning process? Please describe how. How, or why not? [ask both if there are both yes and no responses]
6. Do you believe *INVENTORcloud* helped your teacher with this class?
7. How, or why not? [ask both if there are both yes and no responses]
8. Were there any challenges you faced while using *INVENTORcloud*? If, so how did you work through those challenges?
9. What kinds of things have you shared with your teacher regarding what you like and do not like about *INVENTORcloud*?
10. How much do you think your opinion matters in whether or not your school continues using *INVENTORcloud*?
11. If you could tell the developers one thing that would make a difference in *INVENTORcloud*, what would it be?
12. Would you recommend this course to your classmates? Why or why not?
13. What advice would you share with teachers or with companies, such as the one that made *INVENTORcloud*, about trying new programs in your school?
14. Were you told that you were participating in a tryout, or pilot, of *INVENTORcloud*?
    a. [If any say yes]: What does it mean that your school is conducting a tryout, or pilot, of *INVENTORcloud*? Why are they doing it?
15. Do you like participating in pilots? What role does student voice play in these pilots?

Appendix 3 C: Teacher Interview Protocol

Digital Promise League of Innovative Schools
Product Efficacy Project
INVENTORcloud / Microsoft OneNote

South Fayette School District
Teacher Interview Protocol

School Edtech Decision-making

1. How does your school make a decision to adopt a new edtech product? What stakeholders are involved, and in what ways?
2. What is the process for teachers and students to provide feedback to decision-makers, and how influential is that feedback?
3. How did your school decide to use *INVENTORcloud / Microsoft OneNote*?
   a. How did you get involved? Who else is involved? What are their roles?
   b. How does it differ from other pilots?
   c. What questions or concerns do you have about conducting educational technology pilots?

Product Implementation

4. What were the specific goals for piloting *INVENTORcloud/ Microsoft OneNote*? In other words, what challenges were you hoping it would address and what would success look like?
5. What learning objectives does this product address?
6. Reflecting at a midpoint, to what degree has *INVENTORcloud/ Microsoft OneNote* been successful in meeting those goals?
7. Please tell us how your teacher(s) has integrated *INVENTORcloud/ Microsoft OneNote* into your curriculum. What adaptations or modifications have be made over the course of the pilot?
8. What challenges did you face during the implementation of *INVENTORcloud/ Microsoft OneNote* in the fall semester? Would you be doing anything differently for the next round?
9. What changes to *INVENTORcloud/ Microsoft OneNote* would make it a better product for schools hoping to use it in the future? Any other feedback you'd like to give Inventor Cloud/ *Microsoft OneNote*?
10. How did students use *INVENTORcloud/ Microsoft OneNote* during their Creative Entrepreneurship/ social studies course?
11. How satisfied are you with *INVENTORcloud/ Microsoft OneNote* at this point?
12. How likely are you going to want to use this product again, if changes you suggested were made?

Mid Point Reflection Questions

13. What advice would you share with teachers, administrators, or edtech companies about conducting educational technology pilots?

Appendix 3 D: Administrator Interview Protocol

Digital Promise League of Innovative Schools
Product Efficacy Project
INVENTORcloud

South Fayette School District:
Administrator Interview Questions

School EdTech Decision-making

1. How does South Fayette go about choosing an edtech product?
2. Please describe is your pilot process?
3. What challenges do you typically face when piloting products?
4. How does your school make a decision to adopt a new edtech product? What stakeholders are involved, and in what ways?
5. How would you characterize the criteria, evidence or insights you are using to make your decisions? What factors do you weigh?
6. What is the process for teachers and students to provide feedback to decision-makers, and how influential is that feedback?
7. How did your school decide to use *INVENTORcloud*/ *Microsoft OneNote*?
   a. How did you get involved? Who else is involved? What are their roles?
   b. How does it differ from other pilots?
   c. What questions or concerns do you have about conducting educational technology pilots?

Product Implementation

8. What were the specific goals for piloting *INVENTORcloud*/ *Microsoft OneNote*? In other words, what challenges were you hoping it would address and what would success look like?
9. What learning objectives does this product address?
10. Reflecting at a midpoint, to what degree has *INVENTORcloud*/ *Microsoft OneNote* been successful in meeting those goals?
11. Please tell us how your teacher(s) has integrated *INVENTORcloud*/ *Microsoft OneNote* into your curriculum? What adaptations or modifications have be made over the course of the pilot?
12. What challenges did you face during the implementation of *INVENTORcloud*/ *Microsoft OneNote* in the fall semester? Would you be doing anything differently for the next round?
13. What changes to *INVENTORcloud*/ *Microsoft OneNote* would make it a better product for schools hoping to use it in the future? Any other feedback you'd like to give *INVENTORcloud*/ Microsoft?
14. How did students use *INVENTORcloud*/ *Microsoft OneNote* during their social studies course?
15. How satisfied are you with *INVENTORcloud*/ *Microsoft OneNote* at this point?
16. How likely are you going to want to use this product again, if changes you suggested were made?

Appendix 3 E: Student Focus Group Protocol

Digital Promise League of Innovative Schools
Product Efficacy Project
Microsoft OneNote

South Fayette School District:
Student Focus Group Questions

1. Have you used *OneNote* prior to this class? How long have you been using it?
2. How do you and your teachers use *OneNote*?
3. What did you think of *OneNote*?
4. According to you, what were the reasons for using *OneNote* in your history class?
5. Does *OneNote Cloud* support your learning process? Please describe how.
   a. How, or why not? [ask both, if there are both yes and no responses]
6. Do you believe *OneNote* helps your teacher with this class?
7. How, or why not? [ask both, if there are both yes and no responses]
8. Are there any challenges you faced while using *OneNote*?
   a. If so, how did you work through those challenges?
9. What kinds of things have you shared with your teacher regarding what you like and do not like about *OneNote*?
10. How much do you think your opinion matters in whether or not your school continues using *OneNote*?
11. If you could tell the developers one thing that would make a difference in *OneNote*, what would it be?
12. Would you recommend *OneNote* to other students? Why or why not?
13. What advice would you share with teachers or with companies, such as the one that makes *OneNote*, about trying new programs in your school?
14. Were you told that you were participating in a tryout, or pilot, of *OneNote*?
    a. [If any say yes]: What does it mean that your school is conducting a tryout, or pilot, of *OneNote*? Why are they doing it?
15. Do you like participating in pilots? What role does student voice play in these pilots?

Appendix 3 F: Technology Coordinator Interview Questions

Digital Promise League of Innovative Schools
Product Efficacy Project
South Fayette School District:

Technology Coordinator Interview

Edtech Decision-making

1. Can you describe the process of piloting edtech products at SF, and tell us what is your role in the pilot process?
2. Who else is involved? What are their roles?
3. What is the process for providing feedback to decision-makers, and how influential is that feedback?

Microsoft OneNote

4. What was your role in the *OneNote* pilot? How did you support students and teachers during this implementation?
5. How is *OneNote* being used in South Fayette?
6. What challenges did you face during the implementation of *OneNote*? Would you be doing anything differently for the next round?
7. Can you comment on the support from Microsoft during setting up and continued use of *OneNote*? Can you give some examples?
8. What changes to *OneNote* would make it a better product for schools hoping to use it in the future? Any other feedback you'd like to give *OneNote*?

Mid Point Reflection Questions

9. What questions or concerns do you have about conducting educational technology pilots?
10. What advice would you share with teachers, administrators, or ed-tech companies about conducting educational technology pilots?