

## Developing a Digital Toolkit for Math

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Note: *We are very grateful to ASSISTments, LearnZillion and eSpark Learning for providing us with the detailed and accurate information needed for this analysis. Their willingness to collaborate in our systematic data-gathering processes is critical for well-informed education decision-making.*

### STEP 1: DECISION PROBLEM

**Short title for this decision:** Developing a digital toolkit to support instruction and improve math outcomes.

#### Describe the problem that needs to be addressed:

- Millbank School is a medium-sized, public school serving grades K-8.
- The principal of Millbank School, Roza Oliva, recently reviewed the school's state standardized test scores for math and scores on school-based math assessments, and found that students are performing below grade level. These low test scores are apparent beginning in 3<sup>rd</sup> grade and continuing through the middle school grades.
- Millbank's math teachers generally felt students were not engaging adequately with the curriculum. The teachers were spending a significant amount of time each day looking for technology enhancements to support instruction and make it more personalized and engaging.
- Many of the middle school math teachers were particularly unhappy about the quality and standardized approach of the current math curriculum. Some even advocated for switching the middle school math curriculum or using Open Educational Resources.
- Stakeholders all seem to agree that digital math tools could provide curriculum enhancements and improve engagement and learning during regular math instruction time.
- The school has recently made a budget allocation for acquiring digital tools for the 2019-2020 school year, and Ms. Oliva needs to decide how to use these funds. Students each already have Chromebooks from a previous technology initiative, and teachers are currently using Google Classroom as a Learning Management System to manage assignments.

#### In one sentence, what is the decision you need to make?

- Which educational technology tools should Millbank School include in a digital toolkit to support math instruction for 3<sup>rd</sup> – 8<sup>th</sup> graders at the school?

#### What is the name of the institution/department/person who needs to make this decision?

- Millbank School

#### Is this a real decision problem you are working on or for training/demonstration purposes?

- Just for training/demo purposes

#### What evidence do you have that this issue needs to be addressed?

- The latest test scores for Millbank show that 60% of students in 5<sup>th</sup> grade are only demonstrating 3<sup>rd</sup> grade math skills.
- Ms. Oliva consulted with Millbank's current math teachers, and discovered that many teachers feel that students are not engaging with the math content during class time, particularly at the middle school level, and therefore believe that finding tools to help better engage students with the curriculum could be helpful.
- Teachers also spoke about the amount of time they are currently spending on class preparation for math, and advocated for tools that would help reduce teacher preparation time. On average, the

elementary school teachers are spending 5 to 7 hours per week preparing for daily 45-minute math classes. Middle school teachers are spending similar amounts of time preparing, and an additional 10-15 minutes per day searching for resources relevant to the math unit being taught, and checking that the content and associated problems align with relevant standards.

**Who will be served by the program/strategy you choose?**

- 3<sup>rd</sup> – 8<sup>th</sup> grade students
- Teachers

**What is your goal for this decision?**

- To raise standardized math scores on the state test for students in 3<sup>rd</sup> – 8<sup>th</sup> grade at Millbank School.
- To reduce teacher preparation time for math.
- To increase student engagement with math lessons and homework.

**Who are the stakeholders in this decision (i.e., people who will be affected by the decision)?**

- Teachers
- Students
- Math Coach
- Administrators (principal and assistant principal (AP))

**Which of these stakeholders will you invite to participate in making this decision?**

- Teachers
- Administrators (principal)
- Math Coach

With so many stakeholders weighing in on the issue, Ms. Oliva needed to pick a few representative stakeholders to participate in the decision-making process. Ms. Oliva felt it would be important to get participation from math teachers, so she decided to invite the teacher with the most years of teaching experience (a middle school teacher), and the newest math teacher (who teaches at the elementary level) to get a range of perspectives. Ms. Oliva also invited the Math Coach, who is best qualified to participate in school-level math curriculum decisions. Ms. Oliva also wanted to elicit students' perspectives, but thought this would best be done after identifying and piloting potential Solution Options.

**What are some potential sources of solutions to address this decision problem?**

Ms. Oliva identified the following sources of information about digital math tools:

- Other administrators from schools in the same district
- Teachers at Millbank School
- The district office's Data, Research and Accountability team
- Websites like [Noodle Markets](#), [Common Sense Media](#), [LearnPlatform](#) and [EdSurge](#).
- Venture Philanthropy funders such as [NewSchools Venture Fund](#) and [LearnCapital](#)

**By when do you need to make this decision?**

- September 15, 2019

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## STEP 2: IDENTIFY STAKEHOLDERS

The Project Administrator (PA) for a decision is the person in charge of facilitating the decision process, whether or not they are a key stakeholder. Here, the PA is Principal Oliva, and the invited stakeholders are:

- Math Coach: Owen Wilson
- Most experienced Millbank math teacher (teaches middle school): Sally Fields
- Newest Millbank math teacher (one year of experience teaching 4<sup>th</sup> grade): Denzel Washington.

Principal Oliva invited each of these 3 stakeholders to participate in the following tasks in the decision-making process:

- Suggest Solution Options
- Provide Screening Criteria
- Provide Evaluation Criteria
- Contribute Importance Scores.



## STEP 3: SOLUTION OPTIONS

To identify Solution Options, Ms. Oliva reached out to administrators at other schools in the district to ask about digital math tools with which they had positive experiences. She also contacted the district office which kept a list of vetted and pre-approved curricula and supplementary tools and programs. Additionally, since improving math outcomes was one of the main goals, Ms. Oliva reached out to the district's Data, Research and Accountability (DRA) unit to ask for help in identifying rigorous studies of digital math tools. Ms. Oliva also invited teachers, the Math Coach and other staff at the school to contribute Solution Option ideas. Teachers searched websites such as Noodle Markets, Common Sense Media, EdSurge and NewSchools Venture Fund product reviews, and asked around to fellow teachers at other schools in the district.

Principal Roza learned that LearnZillion IM was one of the pre-approved curricula in the district and that a few other schools had already adopted it. Several additional schools in the district were considering switching to it for the next academic year. The teachers heard from fellow teachers and administrators at other schools about LearnZillion IM and another tool, IXL. A few nearby schools said they could coordinate with Millbank for training and professional development (PD) if Millbank also decided to adopt LearnZillion IM.

DRA was able to find several studies of digital math tools for Ms. Oliva which investigated ASSISTments, eSpark Learning, DreamBox Learning and SimCalc. However, SimCalc is a tool for high school students and is therefore not relevant to Ms. Oliva's current decision.

Ms. Oliva also wanted to consider the option of adopting no digital math tools for this school year (i.e., maintaining the status quo) if the school was unable to identify tools that met stakeholder needs.

**Solution Option 1: DreamBox Learning**

**Source of idea:** District level Data, Research and Accountability unit (DRA)

**Details:** DreamBox Learning Math is an adaptive, online K-8 math program designed to complement classroom instruction. The tool tailors instruction to students' needs and provides feedback to teachers to facilitate student learning.

**Grades targeted:** K-8

**Skills addressed:** Math

**How it is implemented:** According to their website, DreamBox Learning recommends students spend at least 60-90 minutes per week completing 7-8 skill-specific lessons using DreamBox Learning. This is often implemented as 20 to 40 minutes of additional online mathematics instruction per day to reinforce specific math skills as a supplement to 100 to 110 minutes of regular face-to-face instruction.

**Technology hardware required:** Desktop/Laptop or iPad

**Internet required:** Yes

**Key staff required for implementation:** Labs are run by lab coordinators, who are non-credentialed hourly staff and play a minimal role in instruction. No specific role for teachers is prescribed, but it can be helpful to have teachers present when the program is being implemented.

**PD/training required and availability:** Customized PD available through DreamBox's "FlexPD" offerings.

**Supports needed:** Routine technical support for hardware.

**Summary of evidence of effectiveness and citations:** A rigorous evaluation of DreamBox Learning was conducted on K-1<sup>st</sup> grade classes in three schools ([Wang & Woodworth, 2011](#)). Exposure to DreamBox improved student performance on the NWEA overall mathematics test score and on the measurement and geometry subtest, but no other subtests. Another rigorous evaluation of DreamBox Learning in Grades K-5 in 12 schools found 0.12 standard deviations gain in a test of early elementary math skills, but no difference in the state end-of-grade test ([Lenard et al., 2018](#)).

**Known costs:** No information available on the vendor website. License fee is \$20/student or \$7,000 per school according to EdSurge product reviews.<sup>1</sup>

**Other resource requirements to consider:** Standard hardware accessories such as chargers, cases, electrical outlets.

**URL:** <http://www.dreambox.com/>

**Attached studies or reports:** See Reference List of Studies on the Supporting Documents page

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<sup>1</sup> <https://www.edsurge.com/product-reviews/dreambox-learning>

**Solution Option 2: ASSISTments**

**Source of idea:** DRA unit and teacher from a neighboring school in the district

**Details:** ASSISTments is a free online tool for assigning math homework and classwork. Students receive immediate feedback and teachers receive data insights to help drive instruction. ASSISTments provides timely feedback to teachers on students' performance through a four-step process: (1) teachers create assignments by assigning content from existing or custom problem sets; (2) students complete assignments and receive hints and explanations to assist them in their understanding, (3) teachers can use real-time assignment reports detailing student and class performance to inform daily instruction; (4) teachers can then focus instruction on specific areas of student need.

**Grades targeted:** Primarily middle school (6<sup>th</sup>-8<sup>th</sup> grade) with some content available for K-12.

**Skills addressed:** Primarily Math, with some curriculum and skill builders available in Science, Technology and Engineering, English Language Arts, and Social Studies.

**Current Reach:** 1,000 teachers across 42 states.<sup>2</sup>

**How it is implemented:** Can be used to enhance instruction through in-class practice time and after school as homework enhancement, typically for 10-20 minutes per day

**Technology hardware required:** Any device with a web browser and internet connection, including laptops, Chromebooks, iPads, and smartphones. Each student needs their own device.

**Internet required:** Yes, but can work offline if you begin an assignment or activity online and download it.

**Key staff required for implementation:** None while the students are working, but a teacher is needed to set up assignments and assign them to students.

**PD/training required and availability:** The recommended model is a half-day (4 hours) in-person initial training session, five 30-minute mentor sessions in a small group (1-2 teachers to one mentor), and a one-day in-person follow-up training. Ideally, this would be repeated again in the second year of implementation. However, teachers can also start using ASSISTments on their own using online tutorials.

**Supports needed:** Routine technical support for hardware. Can integrate with Google Classroom.

**Summary of evidence of effectiveness and citations:** A randomized evaluation with 2,850 7<sup>th</sup> grade students across 43 schools in Maine found that exposure to ASSISTments significantly increased student scores on an end-of-year standardized mathematics assessment compared with a control group that continued with existing homework practices ([Roschelle, Feng, Murphy & Mason, 2016](#); [Roschelle, Murphy, Feng & Bakia, 2017](#)). The use of ASSISTments resulted in 75% more learning than in a typical year. Online homework had a greater impact for students with low prior achievement. It is worth noting that the students who participated in this study were 93% white and 39% low-income. Many of the schools were in rural districts. These factors may limit the generalizability of these findings.

**Known costs:** No license fee, but there are fees for training (\$59/hr for the trainer plus travel costs).

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<sup>2</sup> <https://new.assistments.org/>

**Other resource requirements to consider:** Standard hardware accessories such as chargers, cases, electrical outlets. Headphones are useful but not required.

**URL:** <https://new.assistments.org/>

**Attached studies or reports:**

See Reference List of Studies on the Supporting Documents page.

### Solution Option 3: eSpark Learning

**Source of idea:** Math Coach, Owen Wilson, and DRA

**Details:** eSpark is an online, adaptive, web-based platform that provides a personalized sequence of curated apps, videos, and challenges for students in math and reading.

**Grades targeted:** PK – 6<sup>th</sup>

**Skills addressed:** Math and ELA

**Reach:** 100,000 students in all 50 states

**How it is implemented:** Recommended that students use eSpark 2-3 times a week for a total of 45-75 minutes per week.

**Technology hardware required:** Any device with an internet browser. Students have their own individual logins so they can share devices.

**Internet required:** Yes

**Key staff required for implementation:** Usually implemented during class time when teacher is present but students are working independently. Teachers use student performance data from eSpark to plan small group instruction for students having problems on a particular concept.

**PD/training required and availability:** 3 options: (1) 25 minute self-paced online modules, (2) 2-hour virtual live sessions, and (3) 6-hour live in-person sessions.

**Supports needed:** Headphones are recommended. Routine technical support for hardware.

**Summary of evidence of effectiveness and citations:**

[Setren \(2017\):](#)

A 2013-14 randomized controlled trial of eSpark of 438 middle school students in Boston found that eSpark significantly increased students' end-of-year math scores by 0.202 standard deviations relative to the control group.

[Hollands & Pan \(2018\):](#)

An impact evaluation of 105 4<sup>th</sup> and 5<sup>th</sup> graders utilizing propensity score matching found that eSpark increased student gains on the end of year Let's Go Learn math assessment by 0.159 points.

**Known costs:** License fee ranges from \$20-\$40/student and PD ranges from \$1,500-\$5,000 for a group of 20 teachers.

**Other resource requirements to consider:** Standard hardware accessories such as chargers, cases, electrical outlets.

**URL:** <https://www.esparklearning.com/>

**Attached studies or reports:**

See Reference List of Studies

Solution Option 4: **IXL**

**Source of Idea:** Administrator at neighboring school in the district

**Description:** IXL is a personalized learning tool that includes comprehensive K-12 curriculum, individualized guidance, and real-time analytics.

**Grades targeted:** K-12

**Skills addressed:** Math, Language Arts, Science, Social Studies, and Spanish

**How it is implemented:** IXL is a mastery-based tool that involves continuous, diagnostic curriculum guidance and analytics. It can be implemented both in the classroom as part of instruction or out of the classroom to reinforce the skills learned in class.

**Technology hardware required:** Any computer, smartphone, or tablet with an internet browser.

**Internet required:** Yes

**Key staff required for implementation:** None while students are using IXL, but teachers must do some upfront preparation to select standards or skills to assign, as well as to review student progress.

**PD/training required and availability:** IXL offers three tiers of optional professional learning that can be purchased in addition to student licenses. Districts can select a comprehensive 6-hour training session, two 3-hour training sessions that provide more narrowly-focused training for a large group of teachers, or an intensive train-the-trainer model where one staff member receives in-depth IXL training and subsequently trains others at their school. Costs for these PD packages are not available on the IXL website; interested schools must contact the IXL sales teams for more information.

**Supports needed:** Headphones are recommended. Routine technical support for hardware.

**Summary of evidence of effectiveness and citations:**

[Hollands & Pan \(2018\)](#): This impact evaluation found that using IXL math was not associated with statistically significant gains in math achievement as measured by a summative math assessment.

[Pearson \(2016\)](#): A case study of a medium-sized traditional public school in Liberty, MO, found that use of IXL math was associated with higher student engagement for both high- and low-performing students. The pilot classroom testing IXL math demonstrated deeper math content knowledge on the Missouri End of

Course exam. It is worth noting that the results of a case study are not generalizable. However, this case study provides insight into ways a school could implement IXL math.

**Known costs:** According to the IXL website, a classroom license for 25 students is available for \$299. Information about license fees and other costs for more than 25 students is not available on the vendor website but can be obtained by contacting the vendor.

**Other resource requirements to consider:** Standard hardware accessories such as chargers, cases, electrical outlets.

URL: <https://www.ixl.com/>

**Attached studies or reports:**

See Reference List of Studies on Supporting Documents page

**Solution Option 5: LearnZillion Illustrative Math (LearnZillion IM)**

**Source of idea:** Sally Fields and teachers at a neighboring school in the district

**Description:** LearnZillion IM is an openly-licensed mathematics curriculum that provides embedded, comprehensive lesson guidance, built-in differentiated supports for all learners, and comprehensive professional development for middle school leaders and teachers. Teachers gain access to easy-to-use slides and teaching notes, instructional videos, and practice activities for students. Teachers can access auto-scored formative feedback on student mastery to gauge student learning.

**Grades targeted:** 6<sup>th</sup>-8<sup>th</sup>

**Skills addressed:** Math

**How it is implemented:** The most common implementation structure involves the teacher presenting LearnZillion IM content to the class, often projecting material from her/his computer for the whole classroom to view. Students can follow along on their own devices, but this is not necessary. Teachers can assign practice problems from LearnZillion's resource bank for in-class practice or homework and later access auto-scored formative feedback on student mastery.

**Technology hardware required:** Compatible with all operating systems and browsers, but recommended browsers include Chrome, Firefox, Microsoft Edge, and Safari.

**Internet required:** Yes, although PowerPoints and other materials such as assessments or practice problems can be downloaded and used offline.

**Key staff required for implementation:** Teacher to lead the lesson.

**PD/training required and availability:** 2-day in-person training for up to 25 participants to start, an ongoing customer success manager that is included in district-wide contracts, and other ongoing support is integrated into the platform. Individual coaching sessions are also available at an additional cost.

**Supports needed:** Projector and computer for teacher. Routine technical support for hardware.

**Summary of evidence of effectiveness and citations:** None found



**Known costs:** License fee \$19.00/student per year for Illustrative Math, includes a day of training on platform for district administrators on how to create reports and review student data. PD costs \$9,000 for a two-day training session for 25 teachers. PD sessions can be shared across schools or even districts to reduce costs per school if there are fewer than 25 teachers in one school that need training.

**Other resource requirements to consider:** Standard hardware accessories such as chargers, cases, electrical outlets.

**URL:** <https://learnzillion.com/p/>

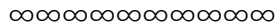
**Attached studies or reports:**

[The LearnZillion edition of Illustrative Math is highly rated by EdReports on focus & coherence; rigor & mathematical practices; usability.](#)

**Solution Option 6: Adopt no additional digital tools at this time**

**Source of idea:** Principal

**Description:** If no satisfactory digital math tools can be found to meet Millbank’s specific needs, the school would not adopt any new digital math tools for the 2019-2020 school year.



**STEP 4: SCREENING CRITERIA**

Principal Oliva and her stakeholders agreed that the following requirements or Screening Criteria must be met by a digital math tool in order to consider it further for adoption at Millbank:

- Serves elementary school and/or middle school.
- Information on implementation and costs is available online or is easily accessible through correspondence with the vendor in a timely fashion.
- Availability of training/professional development to support implementers

**STEP 5: MAPPING SOLUTION OPTIONS AGAINST EVALUATION CRITERIA**

*Table 1. Mapping table to screen Solution Options*

Screening Criteria	DreamBox Learning	ASSISTments	eSpark Learning	IXL	LearnZillion IM	Adopt no digital tools
Serves target population: elementary and/or middle school	Yes	Yes	Yes	Yes	Yes	Yes
Information on implementation and costs available online or from vendor on a timely basis	No	Yes	Yes	No	Yes	Yes
Availability of training/PD	Yes	Yes	Yes	Yes	Yes	Yes

Both DreamBox Learning and IXL were screened out of the consideration set at this point because the vendors did not provide or verify the information needed to conduct our analysis. We expect that schools or districts who are potential buyers of the tools could obtain the required information more easily by contacting the vendors. If desired, these options could then be added back into the list for further evaluation.



**STEP 6: EVALUATION CRITERIA:**

To identify Evaluation Criteria, Ms. Oliva held a meeting with the key stakeholders, including the Math Coach, Owen Wilson, math teachers Sally Field and Denzel Washington, and a few of the other math teachers at the school. One point of discussion was that different teachers had different needs, depending on the grade level and student needs. For example, the middle school math teachers suggested that a tool that could be used as a core curriculum could be really valuable given that none of the teachers particularly liked or followed the current textbook, and often spent a lot of time finding additional practice exercises or activities to engage students during class time and for homework. The elementary level teachers were more concerned with targeted instruction and having additional practice for students to make sure that they were really understanding foundational math skills. They were already seeing a wide range of math achievement, even in 3<sup>rd</sup> grade, and thought that practice tailored to each student's level would be beneficial.

Some practical issues were discussed such as on which digital devices the digital math tools work and whether they integrate with the school's LMS. But as all tools being considered met these criteria, they were not included in the analysis because they would not help differentiate among the tools. This highlights the fact that Evaluation Criteria are only useful if they can help to show up differences in how well stakeholder needs are being met.

Based on this discussion, Ms. Oliva and stakeholders narrowed in on the following six evaluation criteria:

1. Feasibility of implementation: Effect on teacher/staff workload (teacher preparation time)
2. Impact on student academic performance: Impact on math state standardized test scores
3. Meets privacy standards: Extent to which privacy policy safeguards student data and ensures student anonymity
4. Usability of data from digital tool for targeting instruction
5. Can serve as core math curriculum (not just supplemental activity)
6. Availability of technical support for implementers

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## STEP 7: IMPORTANCE SCORES

In this step, each stakeholder indicates the relative importance of the Evaluation Criteria from their own perspective. The most important criterion is scored 100 out of 100 and the others may be as or less important. An Importance Score of 0 would indicate that the stakeholder does not care at all about this criterion. Table 2 shows the Importance Scores provided by Principal Roza, Sally Fields, Denzel Washington and Owen Wilson.

- All stakeholders cared most about math achievement, and hence rated impact on math state standardized test scores as the most important Evaluation Criterion
- Availability of adequate technical support was also scored as highly important
- The teachers were slightly more concerned than the principal and math coach about being able to use data from the tools to target instruction to individual student needs
- Similarly, the teachers were slightly more concerned than the principal and math coach about data privacy although all agreed that any tools adopted should have clear policies about how student data are used and protected
- The middle school math teachers cared more than other stakeholders about the effect of digital math tools on teacher preparation time and about potentially having an option that could serve as a core curriculum.

At this stage, the PA can also choose to assign different weights to the Importance Scores provided by each stakeholder or stakeholder representative by giving them different amounts of votes. By default, *DecisionMaker* assigns 10 votes to each stakeholder, with the Project Administrator (PA) counting as one stakeholder. In this case, Principal Oliva, Sally Fields, Denzel Washington and Owen Wilson are each initially assigned 10 of the total 40 votes available (10 x the number of stakeholders listed in *DecisionMaker*, including the PA). Ms. Oliva decided to give Math Coach, Owen Wilson, the most weight since he had the most holistic perspective on the needs of math classrooms across grades. She reduced her own votes to 5 and assigned Mr. Wilson 15 votes. She kept the default 10 votes for each math teacher to give equal weight to the elementary and middle school perspectives.

Table 2. Importance scores assigned to each Evaluation Criterion

	Importance Scores			
Evaluation Criteria	Project Administrator (Principal Roza)	Middle School Teacher Representative (Sally Fields)	Elementary School Teacher Representative (Denzel Washington)	Math Coach (Owen Wilson)
EC1: Feasibility of implementation: Effect on teacher preparation time	40	60	40	55
EC2: Impact on standardized math test scores	100	100	100	100
EC3: Meets privacy standards: Extent to which privacy policy safeguards student data and ensures student anonymity	50	60	60	50
EC4: Usability of data from digital tool for targeting instruction	60	75	75	65
EC5: Can serve as core math curriculum (not just supplemental activity)	25	50	25	30
EC6: Availability of technical support for implementers in using digital tools	90	100	100	90
<b>Number of Votes</b>	<b>5</b>	<b>10</b>	<b>10</b>	<b>15</b>



**STEP 8: EVIDENCE GATHERING TO EVALUATE OPTIONS**

**STEP 8a. IDENTIFYING EVALUATION MEASURES AND DATA TO COLLECT**

Ms. Oliva tasked Owen Wilson with communicating with the teachers, assigning staff to reach out to vendors, and developing rubrics for scoring each Solution Option against each Evaluation Criterion. *Table 3* summarizes the information collected. The rubrics and scoring are shown in subsequent tables.

*Table 3. Evaluation measures table*

<b>Evaluation Criterion</b>	<b>How will you measure this?</b>	<b>Data to enter for each Solution Option</b>	<b>Where does the data come from - ASSISTments</b>	<b>Where does the data come from - eSpark</b>	<b>Where does the data come from – LearnZillion IM</b>	<b>Where does the data come from – Adopt no digital tools</b>
EC1: Effect on teacher preparation time	Estimate the increase/decrease in number of mins of work required to prepare for math classes if using each Solution Option (average mins per teacher).	Minutes	A 2020 report by McKinsey & Co. suggests that teachers spend 6.5 hours per week on student evaluation and feedback. We estimate that automated grading and feedback from ASSISTments can save teachers 2.5 hours per week.	A cost analysis of eSpark found that the use of eSpark in 2013-14 added to the teachers’ workload by 10-90 mins/wk (Hollands & Pan 2018 p. 6-7). For our analysis we assume that using eSpark will add to teacher workload by 45 mins/wk.	A written communication 8/16/19 from the Proposal Project Manager at LearnZillion estimates that Illustrative Math saves teachers up to 45 mins/day in prep time. Since no first-hand data were available from teachers we assumed time savings of 20 mins/day (100 mins/week) to be conservative.	Prior experience of Millbank teachers.
EC2: Impact on standardized math test scores	Calculate the change in average standardized test scores by comparing scores before and	Change in standardized test scores	In a randomized field trial of 2850 seventh grade students in Maine the intervention	Setren (2017): A 2013-14 randomized controlled trial of eSpark involving 438 middle school	No rigorous studies of LearnZillion IM effectiveness for improving math	NA: This is. business as usual

	after implementing each Solution Option.		increased student scores on a standardized end-of-year math assessment called the Terra Nova Math Test by 0.18 standard deviations relative to a control group that continued with existing homework practices (Roschelle et al 2016).	students in Boston found that eSpark significantly increased students end-of-year math scores by 0.202 standard deviations relative to the control group.	achievement have been conducted yet.	
EC3: Extent to which privacy policy safeguards student data and ensures student anonymity	Score security of student data using rubric.  See <i>Table 5</i> below to view the rubric.	Score of 0 to 10	Information comes from: <a href="http://www.aboutus.assistments.org/privacy-policy.php">http://www.aboutus.assistments.org/privacy-policy.php</a>	Information comes from: <a href="https://www.esparklearning.com/privacy">https://www.esparklearning.com/privacy</a>	Information comes from: <a href="https://learnzillion.com/privacy">https://learnzillion.com/privacy</a>	Current data storage practices at Millbank.
EC4: Usability of data from digital tool for targeting instruction	Use rubric to score option.  See <i>Table 4</i> below to view the rubric.	Score of 0 to 10	From phone interview with co-creator of ASSISTments 7/22/19 and personal communication 9/8/19.	From phone interview with Vice President Sales and Account Manager for eSpark Learning 7/15/19 and personal communication 9/10/19.	From personal communication with Project Manager at LearnZillion 9/5/19.	Current availability of data at Millbank.
EC5: Can serve as core math curriculum (not just supplemental activity)	Identify whether a tool can serve as core math curriculum	Yes = 1, No = 0	From phone interview with co-creator of ASSISTments 7/22/19.	From phone interview with Vice President Sales and Account Manager for eSpark Learning 7/15/19.	From phone interview with Strategic Finance Manager at LearnZillion 7/19/2019.	Existing math curriculum at Millbank.

<p>EC6: Availability of technical support for teachers</p>	<p>Identify whether technical support (phone, email, chat, and/or online tutorials) is offered to assist with implementation</p> <p>See <i>Table 6</i> below to view the rubric.</p>	<p>Score of 0 to 7</p>	<p>From phone interview with co-creator of ASSISTments 7/22/19 and personal communication 9/12/19: ASSISTments offers email support, as well as online tutorials. No chat or phone support are available. There is no cost associated with this technical support.</p>	<p>From phone interview with Vice President Sales and Account Manager for eSpark Learning 7/15/19: eSpark Learning has 24 hour email and chat technical support, phone support for any stakeholder in the district, and online tutorials are available.</p>	<p>From phone interview with Strategic Finance Manager at LearnZillion 7/19/2019: LearnZillion Illustrative Math has 24 hour email support, phone support for district-level staff, and online tutorials are available.</p>	<p>Current availability of technical support for digital tools at Millbank</p>
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RUBRICS

Table 4. Rubric to evaluate usefulness of available data for targeting instruction to meet individual needs

Scoring (Max. 10 points)	ASSISTments	eSpark	LearnZillion IM	Adopt no digital tools
<p>[2 points max]</p> <p><b>Provides data on student usage, e.g., number of logins, number of problems completed, time on task or total time spent.</b></p>	<p>[1] Teachers receive item reports on how students perform on the assigned problem sets (percent correct), including common wrong answers (Roschelle et al, 2016). The item report shows data on whether a student attempted an assignment, how long it took them to complete and what problems they got wrong. These reports show class performance on each item, highlight items that had a high percentage of wrong answers, and student performance on each individual item (Roschelle et al, 2016). Student detail reports allow the teacher to view every single action the student took to complete an assignment. Compiled usage data over time (i.e., weekly or monthly usage data for students) is not available for teachers, but teachers can figure this out with the data provided in individual item reports and student details reports.</p>	<p>[1] Data dashboard provides data on what content students have completed (Vice President Sales and Account Manager, eSpark Learning 7/15/19, Phone Interview); Student usage data such as frequency of logins is available (Hollands &amp; Pan, 2018, p.4), but not the total amount of time spent.</p>	<p>[1] Teachers can assign students to digital pre-unit assessments, and to mid-unit, end-of-unit and practice problems. Teachers can monitor student progress, see whether students have viewed assignments, and how they performed (Proposal Project Manager, 9/5/19, Personal Communication). Some data are available on student usage (when practice problems are assigned etc.), but no comprehensive reporting of student-level logins/time spent on platform etc. is provided.</p>	<p>[0] No data available</p>

<p><b>[5 points max]</b></p> <p><b>Identifies common problems among students – used for whole group instruction or to facilitate small group breakouts</b></p>	<p><b>[5]</b> Teachers receive item reports on how students perform on the assigned problem sets, including common wrong answers (Roschelle et al, 2016). The item report shows data on whether a student attempted an assignment, how long it took them to complete and what problems they got wrong. These reports show class performance on each item, highlight items that had a high percentage of wrong answers, and student performance on each individual item (Roschelle et al, 2016). ASSISTments identifies common problems among students that can be used for whole group instruction or to facilitate small group breakouts.</p>	<p><b>[5]</b> eSpark sends each teacher a weekly email identifying students who need help in specific areas, including suggestions for students to group together for specific skills, and identifying students who are mastering certain skills. Weekly emails from eSpark explicitly identify common problems among students that the teacher can use to plan whole group instruction or small group breakouts. Dashboard data provide real-time information on student performance (Vice President Sales and Account Manager, eSpark Learning, 7/15/19, Phone Interview).</p>	<p><b>[1]</b> Pre-unit diagnostic assessments allow teachers to identify each student’s level before going into each unit. Mid-unit assessments during longer units show student performance on question types, which teachers can use to infer common problems. Teachers can also assign practice problems and monitor individual student performance and progress (Proposal Project Manager, LearnZillion, 9/5/19, Personal Communication). No daily or weekly reporting explicitly identifies common problems.</p>	<p><b>[0]</b> No data available</p>
<p><b>[3 points max]</b></p> <p><b>Provides data on individual student growth</b></p>	<p><b>[1]</b> Since each teacher selects problems to assign that are relevant to their classroom instruction, ASSISTments does not aim to track growth in math achievement. Teachers can observe whether students are performing better from one set of practice problems to another.</p>	<p><b>[3]</b> Provide mid-year and end-of-year reports showing a “pre-post” analysis of student math achievement growth during the time that eSpark was used. Based on NWEA MAP, STAR, or other assessment data (Vice President Sales and Account Manager, eSpark Learning, 7/15/19, Phone Interview).</p>	<p><b>[2]</b> Pre-unit and end-of unit assessments allow teachers to see student growth (Proposal Project Manager, LearnZillion, 9/5/19, Personal Communication). Formal reports on student growth are not available.</p>	<p><b>[0]</b> No new data available</p>
<p><b>Total:</b></p>	<p><b>7</b></p>	<p><b>9</b></p>	<p><b>4</b></p>	<p><b>0</b></p>

Table 5. Rubric to evaluate extent to which privacy policy safeguards student data and ensures student anonymity

Factors considered (2 points each)	ASSISTments <sup>3</sup>	eSpark Learning <sup>4</sup>	LearnZillion IM <sup>5</sup>
<p><b>[Max 2 points]</b></p> <p><b>Requires adult consent before storing any student Personally Identifiable Information (PII)</b></p>	<p><b>Yes [2]</b></p> <p><i>“When registering a user who is under 13 years of age, we request and collect Personally Identifiable Information [PII] only if we receive prior approval from child’s parent or guardian or are authorized by the child’s school or district.”</i></p>	<p><b>Yes [2]</b></p> <p><i>“We obtain the consent of authorized school officials in order for students under 13 years of age to use our service in any manner that could result in the student submitting personal information.”</i></p> <p>eSpark also ensures that the apps on its platform do not require personal information.</p>	<p><b>Yes [0]</b></p> <p><i>“If you are a student of any age, you must get permission from your school, parent or teacher to use the Site.”</i></p> <p>This does not assure that students will comply.</p>
<p><b>[Max 2 points]</b></p> <p><b>Ensures student anonymity (which may include aggregating PII when possible)</b></p>	<p><b>Yes [2]</b></p> <p><i>“We may aggregate PII in a manner such that the end product does not personally identify you or any other user of the Site...”</i></p>	<p><b>[No] 0</b></p> <p>While it is likely that student anonymity is ensured, there is no direct mention of storing data in ways that ensure this (such as aggregating PII when possible etc.).</p>	<p><b>Yes [2]</b></p> <p><i>“We frequently aggregate information in a way that makes it impracticable to use that data to identify a particular person; we may also maintain individual records with personal identifiers removed.”</i></p>

<sup>3</sup> <http://www.aboutus.assistments.org/privacy-policy.php>

<sup>4</sup> <https://www.esparklearning.com/privacy>

<sup>5</sup> <https://learnzillion.com/privacy>

<p><b>[Max 2 points]</b></p> <p><b>Measures taken to reduce risk of PII being exposed (may include encrypting data or putting up other firewall protections)</b></p>	<p><b>Yes [2]</b></p> <p><i>“All user data are encrypted in transit...we implemented software and hardware security measures, such as firewalls, intended to protect your Personally Identifiable Information from unauthorized areas.”</i></p>	<p><b>Yes [1]</b></p> <p>Privacy policy includes text about secure service used for uploading videos to dashboard and permanent deletion from hardware, and says <i>“...have implemented reasonable efforts to secure and protect privacy, accuracy and reliability of your information...we use industry-standard Secure Socket Layer (SSL) encryption technology to safeguard student information.”</i></p>	<p><b>Yes [2]</b></p> <p><i>“All of our service providers have agreed to confidentiality and data security provisions consistent with this Privacy Policy. These parties are contractually prohibited from using any personal information for any purposes other than providing the service we request from them...We have put in place physical, electronic and administrative procedures to safeguard and to help prevent unauthorized access to and maintain the security of PII collected through the site... We take reasonable, industry standard measures to protect confidentiality, security and integrity of PII collected on our site. This includes the use of encryption, firewalls and other security technologies to prevent access to the data from unauthorized parties...”</i></p>
<p><b>[Max 2 points]</b></p> <p><b>Data are never shared for commercial use</b></p>	<p><b>Yes [2]</b></p> <p><i>“ASSISTments will never use our platform for commercial use...[and] will never sell personally identifiable or non-personally identifiable information to third parties.”</i></p>	<p><b>Yes [2]</b></p> <p><i>“...will not share, sell, rent or otherwise disclose your private personal information [eSpark Learning] collects to send marketing messages to students.”</i></p>	<p><b>Yes [2]</b></p> <p><i>“We do not share any student login information with any third party... for advertising, marketing or other purposes.”</i></p>

[Max 2 points]	Partial clarity [1]	Partial clarity [1]	Yes [2]
<p><b>Student data can only be seen by parents or teachers of the student (i.e., not other teachers, schools or districts)</b></p>	<p>Enables parents/guardians and teachers to view information about student users linked to a Teacher User class code. While it is likely that student data can only be seen by parents or teachers of the student, this is not explicitly stated. Parents can request to delete personally identifiable data about their child after the child is no longer enrolled in a class utilizing ASSISTments.</p>	<p>Ensures student video content is only accessible to the student’s teacher or authorized school officials. While it is likely that other student data (besides videos) can only be seen by teachers of the student or other authorized school officials, this is not explicitly stated. Parents/guardians of a student can request to view/inspect or delete their child’s data. <i>“Parents may request to review your child’s personal information. You may also request to correct, update, or delete your child’s personal information from our database. We are required by law to ensure anyone making such a request is a parent or legal guardian.”</i> However, it is not clear that only parents or teachers or the owner of the account can view this information.</p>	<p><i>“When the primary account belongs to a school district, the account administrator designated by the district can access all information we collect about students that we make available through our web-based user interface. District administrators can delegate the right to view student information in accordance with district policy. Each teacher within that school district can see only information relating to students’ participation in classes taught by that teacher (unless granted additional access by the district account administrator). Primary account holders who register as teachers or parents can access all information available through our user interface relating to students’ interactions with assignments created by that teacher or parent. They cannot see information that we collect in connection with a student’s interactions with assignments created by another teacher or parent.”</i></p>
<p><b>Total</b></p>	<p><b>9</b></p>	<p><b>6</b></p>	<p><b>8</b></p>

Note: PII = Personally Identifiable Information

Table 6. Rubric to evaluate availability of technical support

Type of support available	ASSISTments	eSpark	LearnZillion
<b>Online chat</b> 0 = none 1 = available during work hours 2 = available 24hrs/day	0	2	0
<b>Email support</b> 0 = none 1 = available during work hours 2 = available 24hrs/day	1	2	2
<b>Phone support</b> 0 = none 1 = available to certain users 2 = available to all users (teachers, students, admins, tech personnel, district staff)	0	2	1 District office personnel only can call Customer Support Manager
<b>Online tutorials/platform-embedded help</b> 0 = no 1 = yes	1	1	1
<b>Total</b>	<b>2</b>	<b>7</b>	<b>4</b>

**STEP 8B. ASSESSING EACH SOLUTION OPTION AGAINST THE EVALUATION CRITERIA**

Table 7 below shows the scores derived for each digital math tool from the rubrics Owen Wilson developed, information gathered from vendors and from the discussions with teachers.

Table 7. Evaluation data table

Evaluation Criterion	How will you measure this?	Data to collect	Likely lowest score	Likely highest score	Higher scores are better?	ASSISTments (Ave. rating or score)	eSpark Learning (Ave. rating or score)	LearnZillion IM (Ave. rating or score)	Adopt no digital tools (Ave. rating or score)
EC1: Effect on teacher preparation time	Calculate the increase/decrease in mins per week of teacher preparation time	Minutes	-150	45	No	-150	45	-100	0
EC2: Impact on standardized test scores	Calculate the change in average standardized test scores before and after implementing each Solution Option.	Standardized test scores	-0.2	0.22	Yes	0.18	0.202	0	0
EC3: Extent to which privacy policy safeguards student data and ensures student anonymity	Use rubric to score data privacy	Score 0 to 10	0	10	Yes	9	6	8	10

EC4: Usability of available data to target individualized instruction for students	Use rubric to score options	Score 0 to 10	0	10	Yes	7	9	4	0
EC5: Can serve as core math curriculum	Binary Yes (1)/No (0)	[0,1]	0	1	Yes	0	0	1	1
EC6: Availability of technical support	Identify whether technical support (phone, email, chat, and/or online tutorials) is offered to assist with implementation.	Score 0 to 7	0	7	Yes	2	7	4	0

∞∞∞∞∞∞∞∞∞∞∞∞∞∞∞∞



**STEP 9: COSTS**

In formal cost analysis, costs are not simply the new expenditures associated with an intervention. They are all the resources needed to implement a potential Solution Option including personnel time (paid and volunteer), training, materials (e.g., license fees), equipment (e.g., hardware devices), and facilities (classrooms, labs), plus other inputs that might be required (e.g., laptop maintenance fees or insurance). For some digital math tools, there may be credible cost studies already available that provide a good estimate of the average costs per student. However, these studies are rare so that, in most cases, the Project Administrator for the decision will need to collect information on costs by searching the vendor’s website, reviewing case studies or implementation reports if available, looking for product reviews online such as those provided by [EdSurge](#) or [Common Sense Media](#), asking staff at other schools already implementing the tools about demands on time and training or technical support needs, and contacting the vendor.

Table 8 below shows the average costs per student for the first year of implementing each Solution Option under consideration. A spreadsheet detailing the cost analysis can be found in the Supporting Documents for this decision in *DecisionMaker*. It includes a description of each resource needed, how much is needed and its cost.

Note that Millbank School was interested in robust professional development for any digital tool purchased. The cost analysis therefore assumes the school takes advantage of more than the minimum amount of PD required. For example, ASSISTments can be implemented using only online support which involves no fee. For a school pursuing the online training option instead for the for-fee training, the average cost per student could be significantly lower. Similarly, eSpark Learning and LearnZillion offer different levels of PD, coaching and support. If a school chose not to pay for live, in-person sessions, the average costs per student would be lower.

Millbank plans to coordinate with neighboring schools for training and PD if the school adopts LearnZillion IM. This will allow the schools to split the fees.

Table 8. Average cost per student for implementation in Year 1 for each Solution Option

Solution Option	Cost per student	Sources
Option 1: ASSISTments	-\$27.87	Vendor Cost analysis by Roschelle et al (2017) McKinsey & Co. (2020) report
Option 2: eSpark	\$136.86	Vendor Cost analysis by Hollands & Pan (2018)
Option 3: LearnZillion IM	\$28.81	Vendor
Option 4: Adopt no digital tools	\$0.00	Millbank



**STEP 10: MAKE A DECISION**

Below (*Table 9*) is a summary of the total utility values, average costs, and cost-utility ratios for each Solution Option. Table A1 in the Appendix shows detailed utility results for each Solution Option against each Evaluation Criterion.

*Table 9. Utility, cost, and cost-utility ratio for each Solution Option*

Option	Utility (0-10)	Average costs per student for Year 1	Cost- Utility Ratio
<b>eSpark Learning</b>	7.1	\$136.86	\$19.28
<b>ASSISTments</b>	6.6	(\$27.87)	(\$4.22)
<b>LearnZillion IM</b>	6.1	\$28.81	\$4.75
<b>Adopt no digital tools</b>	3.7	\$0.00	\$0.00

Results show that, before considering costs, eSpark yields the highest level of stakeholder satisfaction with a score of 7.1 out of 10. ASSISTments yields a stakeholder satisfaction rating of 6.6, and LearnZillion IM has a rating of 6.1. Relative to the low level of stakeholder satisfaction that would result from adopting no digital tools at this time (3.7 out of 10), all the Solution Options under consideration provide greater stakeholder satisfaction.

Although it has a high utility value, eSpark Learning has a high cost per student. At \$136.86 per student, it costs nearly 5 times more per student than LearnZillion IM. LearnZillion IM's low implementation cost is driven by the fact that it saves teachers preparation time and by Millbank's decision to share professional development with neighboring schools. ASSISTments results in net savings for the school as the license are free, the PD is inexpensive, and the tool saves teachers time in grading homework and providing feedback to students. ASSISTments also provides the best return on investment (ROI) because it saves money for the school. LearnZillion provides the next best ROI, costing \$4.75 per unit of utility (or unit of stakeholder satisfaction).

Note that the Solution Options each have unique characteristics and cannot easily be substituted for one another. Millbank School wants to implement different strategies for elementary and middle school since the teaching structure and associated classroom level issues are slightly different. Using all the information gathered and analysis conducted to this point, Principal Oliva summarized the key characteristics of each tool as follows:

**eSpark Learning:**

- Serves elementary grades (K-6) as a supplement, usually to in-class instruction
- Helps teachers use available data to target instruction for individualized learning
- Existing evidence of effectiveness for improving math test scores

**ASSISTments:**

- Primarily serves 6<sup>th</sup> – 8<sup>th</sup> grades as a supplement, especially for homework and practice
- Helps teachers use available data to target instruction for individualized learning
- Existing evidence of effectiveness for improving math test scores
- Reduces teacher time to create and grade homework assignments
- Low cost

**LearnZillion IM:**

- Primarily serves 6<sup>th</sup> – 8<sup>th</sup> grades as a core curriculum
- Reduces teacher preparation time substantially
- This reduction in teacher preparation time also contributes to substantial cost savings
- Can replace current core math curriculum
- No existing evidence of effectiveness

Principal Roza concluded that, while somewhat costlier than other digital tools, eSpark Learning is a viable curriculum supplement to help achieve Millbank School’s goal of increasing performance on standardized math scores in grades 3-5. It has proven evidence of effectiveness from a rigorous study and teachers can use data from eSpark to individualize instruction. She decided to adopt eSpark for Millbank’s elementary school classrooms to supplement current instruction.

For the middle school grades, use of ASSISTments as a curriculum enhancement for classroom and homework practice has proven evidence of effectiveness from a rigorous study and teachers can use data from ASSISTments to individualize instruction. Principal Roza decided to adopt ASSISTments for all middle school classrooms for homework and extra practice. LearnZillion IM will reduce teacher preparation time and is a full math curriculum. Given the relatively low cost of each tool and their complementary characteristics, implementing both ASSISTments and LearnZillion IM in tandem presents a promising strategy that could address all stakeholder concerns.

However, because no rigorous studies of LearnZillion IM have been conducted as yet, Principal Roza felt it would be wise to pilot it with two teachers for a semester before deciding whether to replace the school’s existing middle school math curriculum. She and the math team would then compare student math performance and teacher preparation time in the LearnZillion IM/ASSISTments classrooms with classrooms using the current curriculum and ASSISTments only and assess whether this strategy was yielding the desired results.

In brief, Principal Roza decided to implement all three Solution Options: eSpark Learning in grades 3-5, ASSISTments in grades 6-8, and a pilot of LearnZillion IM with two elementary school math teachers.



Appendix

Table A1. Evaluation measures and criterion-level utility values

Evaluation Criteria	Importance weight	Data to enter	Lowest plausible value	Highest plausible value	The higher the value is, the better (Yes/No)	ASSISTments		eSpark Learning		LearnZillion IM		No Digital Tool	
						Rating on measure	Utility value (0-10)	Rating on measure	Utility value (0-10)	Rating on measure	Utility value (0-10)	Rating on measure	Utility value (0-10)
Effect on teacher preparation time	.13	Scale	-150	45	No	-150	10	45	0	-100	7.44	0	2.31
Impact on standardized test scores	.25	Scale	-0.2	.22	Yes	.18	9.05	.202	9.57	0	4.76	0	4.76
Usability of available data to target individualized instruction for students	.17	Scale	0	10	Yes	7	7	9	9	4	4	0	0
Extent to which privacy policy safeguards student data and ensures student anonymity	.14	Scale	0	10	Yes	9	9	6	6	8	8	10	10
Can serve as core math curriculum	.08	Binary	0	1	Yes	0	0	0	0	1	10	1	10
Availability of technical support	.24	Scale	0	7	Yes	2	2.86	7	10	4	5.71	0	0
Overall Weighted Utility						5.6		7.2		5.5		2.6	

Table A2. Full costs and estimated savings associated with each Solution Option

Resource	ASSISTments	eSpark Learning	LearnZillion IM	Adopt no digital tool
Training and license fees	\$3,429	\$13,125	\$13,675	\$0
Personnel costs in Year 1 (i.e., costs or savings compared with the status quo)	(\$14,148)	\$30,193	(\$6,078)	\$0
Material costs and equipment in Year 1	\$1,161	\$1,163	\$1,776	\$0
<b>Total Cost in Year 1</b>	<b>(\$9,058)</b>	<b>\$44,481</b>	<b>\$9,364</b>	<b>\$0</b>

Note that because LearnZillion IM saves teachers 20 minutes per day in lesson preparation time, it is associated with an \$6,078/year savings on personnel costs. ASSISTments saves teachers 30 minutes per day in student evaluation and feedback.

