An Evaluation of Prodigy: A Case-Study Approach to Implementation and Student Achievement Outcomes

Jennifer R. Morrison, PhD
Kelsey L. Risman, MA
Joseph Reilly, EdD
Jane M. Eisinger, MS

January 2020

Johns Hopkins School of Education

Center for Research and Reform in Education

Contents

EXECUTIVE SUMMARY: An Evaluation of Prodigy: A Case-Study Approach to Implementation and Student Achievement Outcomes

The purpose of the present study was to gather data regarding the implementation of Prodigy in elementary schools in a mid-sized school district in the southern United States. Using a case-study approach, we visited two schools and conducted interviews, focus groups, and classroom observations to examine implementation and outcomes. We also examined student achievement and usage data from the 2018-2019 school year. The following presents major themes and conclusions from the mixed-methods study.

Implementation and Preparation

The decision to implement Prodigy in the current school district was made by a district mathematics curriculum specialist. The administrator indicated she agreed to pilot the program after Prodigy agreed to provide a "a ton of support" including a number of trainings for teachers. Indeed, educators at the two schools described Prodigy and the district curriculum specialist as responsive to and supportive of the professional development needs of teachers. They also indicated that teachers would benefit from further training, particularly related to using data and the program's reporting features.

Principals and teaching specialists at both schools described their day-to-day involvement with the program as minimal. While principals occasionally reviewed data provided by the program, it appears that teaching specialists rarely interact with the program at all. This is not surprising, as many of the teaching specialists work within RTI frameworks or as teacher coaches and/or assistants. The extent of their involvement with the program is an awareness that students like to play the game and that it is available to students on all Chromebook computers.

Student Impact and Engagement

Teachers, principals, and specialists were emphatic regarding student enjoyment of the program and students' engagement in mathematics content presented through Prodigy. Student engagement was consistently described as a key strength of the program and was consistently married with students' preoccupation and independent learning. Educators described the program as keeping students focused and engaged in mathematics content that is both challenging and relevant. Prodigy, when used as part of station rotations, requires little effort by teachers to prepare and little of the teacher's attention while students are using it. During observations, students of all abilities were engaged in the storyline of Prodigy. We observed students in deep thought, remaining on task for the large majority of observation time.

Teachers and principals in both schools were reluctant to attribute student achievement to Prodigy. School-based adults were more likely to talk about increased engagement or note that students were getting additional mathematics practice. Students nearly unanimously agreed that the program made learning mathematics easier and more fun. They described feeling motivated to defeat monsters and feeling accomplished when they succeeded in the game. Students indicated that one of their favorite parts of Prodigy is the feeling of achievement or "leveling up." They especially like the social components—they like battling their friends, being in a virtual world with their classmates, and knowing that others are playing with them when they are at home. We infer that Prodigy certainly makes a positive contribution to students' attitudes toward mathematics, which are related to achievement in a meaningful way.

Analyses explored whether or not there was a relationship between fourth grade students' use of Prodigy and their performance gains on the mathematics section of the state standardized assessment. After controlling for prior achievement and demographic characteristics, these analyses found a statistically significant positive relationship between students' fourth grade achievement gains on the assessment and how extensively they used Prodigy. A positive, statistically significant relationship was found between students' achievement gains and the number of Prodigy questions they answered during the 2018-19 school year ($p < .05$) as well as the number of questions they answered *correctly* ($p < .05$). A significant relationship was not found, however, between the number of questions students answered at home and their achievement gains. The analyses revealed that, on average, a student would need to complete roughly 888 Prodigy questions in order to achieve a one-point percentile gain in their assessment score. Similarly, students would need to answer roughly 625 questions correctly, or answer 987 questions while at home to achieve this same gain.

Analyses also examined differences in the achievement gains between fourth-grade students who had high (top-third), moderate (mid-third), and low (bottom-third) amounts of Prodigy usage. Students in the high-usage group ($M = 2206.57$ questions completed) achieved significantly greater gains on the standardized assessment than students in the low-usage group ($M = 394.94$ questions completed; effect size = +0.201). Students in the mid-usage group ($M = 920.26$ questions completed) also achieved significantly greater gains than those in the low-usage group (effect size = +0.209). Significant differences were not found, however, between the high- and mid-usage groups in terms of achievement gains.

Additional Reactions and Recommendations

Teachers in both schools noted a need for a time limit for students to shop, customize their avatar, or engage in other in-game distractions. Our observations affirm that a small number of students did appear to "wander about" the program. We affirm the recommendation made by teachers to limit the amount of time students spend in non-content aspects of the game while playing in the school-based area of the game.

Principals and teachers consistently noted the utility of teachers' ability to modify the specific mathematics content students encounter in battle. Based on our experience evaluating game-based mathematics programs, this represents a key feature of Prodigy that distinguishes the program from other products. We concur that teachers very much value the ability to customize content in supplemental curriculum products so that students practice content consistent with classroom schedules, which can vary widely between and within school buildings. Related to modifying content, teachers and teaching specialists in both schools recommended increasing teachers' ability to customize what content students see in battle. Specifically, teachers would like to choose multiple skill areas for student practice and increase the frequency of word problems for older students.

Summary and Conclusion

In sum, Prodigy is a supplementary mathematics program that is well-liked by students and teachers. Students in the current study were highly engaged in the story line of Prodigy and were motivated to complete mathematics problems in order to progress in the game. Teachers are mostly satisfied with the degree to which students remain engaged in mathematics content that is both challenging and relevant to class material. While teachers would benefit from professional development related to data and reporting features of Prodigy, they described these features as easy to use and providing useful information. School-based adults agree the program meets the needs of students with varying skill capabilities, though does not meet the needs of English-language learners.

Evaluation of Prodigy: A Case-Study Approach to Implementation and Student Achievement Outcomes

The purpose of the present study was to gather data regarding the implementation of Prodigy in elementary schools in a mid-sized school district in the southern United State. Prodigy is a free, adaptive mathematics game provided by Prodigy Education. The program integrates curriculum-aligned mathematics content (Grades 1-8) in a game-based learning program. As described by the developers, Prodigy provides teachers with a powerful set of reporting and assessment tools that allow them to easily identify trouble spots, differentiate instruction, and better manage classroom time. As a web-based game, Prodigy can be accessed at school and at home on virtually any device with internet access. The program is aligned to the Common Core State Standards for Grades 1-8.

Prodigy is a role-playing game designed to engage students using adaptive technology. Using students' responses to mathematics questions, the program identifies gaps in students' understanding and works with them by reinforcing prerequisite skills and then progressing to more difficult concepts. According to program developers, Prodigy is used by over 50 million students and 1 million teachers worldwide. The game is free to play at home and school, though there is a paid membership component that provides additional game experiences for students that parents may opt their child in to.

Prodigy involves wizards, monsters, spells, and animals. Students navigate Prodigy Island to collect keystones, which together open access to the Lamplight Academy. Students engage in battles and complete quests as they search for keystones. Battles and quests involve completing mathematics questions correctly to cast spells, defeat opponents, and move forward in the game. Mathematics content encountered in the game is customizable by teachers and data are delivered to teachers regarding student performance and progress. Members receive more tokens (gems and stars) at the conclusion of successful battles, which can be used in the game to buy spells and accessories, and have more access to certain features in the game (e.g., outfits and accessories for their avatar).

This evaluation examined implementation and use of the program in a mid-sized school district, using a case-study approach to data collection in two schools. Five research questions guided the evaluation of Prodigy:

1. How are schools in general and teachers in particular implementing Prodigy?
    a. Which program components are most strongly and frequently implemented?
    b. Which program components are least strongly and frequently implemented?
2. What are teachers' reactions to the program with regard to:

   a. Impacts on students?
   b. Support by Prodigy Education?
   c. Implementation needs (e.g., time demands, effort, etc.)?
   d. Student interest?
3. What are the program experiences and reactions of other participants and stakeholders?
4. What are the program practices and student outcomes in high-implementing schools?
5. To what extent does program usage relate to student achievement?

Method

Findings presented in the current report emerged from data collected from two site visits conducted in fall of 2019 and from student achievement data from 2017-2018 and 2018-2019. At each site visit school, researchers conducted classroom observations, principal interviews, interviews with teacher coaches and teaching specialists, and a teacher and student focus group. The research team also interviewed one district-level mathematics curriculum specialist. This study employed a post-hoc design that explored the quantitative impact of the Prodigy Program on student achievement outcomes in mathematics. Using student achievement on the mathematics section of the state standardized assessment as an outcome, this research compared the achievement gains of 4^{th} grade students who used the Prodigy program for differing amounts of time while controlling for a variety of demographic factors.

Research Design

The current study employed a correlational mixed-methods evaluation design with a case-study approach for presentation of qualitative findings. The rationale is to (a) collect evidence that can help explain outcomes such as teacher and student attitudes, experiences, and implementation fidelity at different schools; (b) have outcomes other than student achievement for both descriptive and comparative analyses; and (c) gain firsthand impressions of the program implementation and application context. For the latter purposes, data collection involved site visits to two elementary schools in the district for one day each. The evaluation design addresses the summative needs of providing evidence of implementation and the formative needs of providing recommendations for program improvement.

Participants

The case study school district serves roughly 11,000 students in 13 schools including seven PK-4 elementary schools, three schools serving students in grades 5-6 (middle schools), two junior high schools (grades 7-8), and one high school. Students are predominantly Hispanic (~50%) and white (~28%), and nearly two-thirds (~63%)

of the student population is economically disadvantaged. In terms of performance and achievement, between 61-83% of students in the district met grade-level standards in all subjects in state testing in 2018, which is notably higher than pass rates for all students in the state. The district employs roughly 1,500 teachers who are predominantly white (~70%), have over 5 years of experience teaching (~60%), and do not have advanced degrees (~75%). Case-study schools were selected by convenience sampling. Prodigy developed a list of four schools in the district with fairly high implementation based on usage data. The research team invited those schools to participate and two agreed.

Measures

Data sources included in the current report include classroom observations, principal interviews, interviews with teacher coaches, teaching specialists and one district-level curriculum specialist, teacher and student focus groups, and student achievement on a standardized assessment.

Classroom Observations. Observations occurred in four classrooms in School A and five classrooms in School B. Classroom observations lasted approximately 20 minutes each and focused on instructional strategies, student activities, classroom environment, and perceptions of student engagement. The observation protocol is presented in Appendix A.

Principal and administrative interviews. Interviews were conducted with both school principals (n = 2) and one (n = 1) district administrator. An interview protocol (see Appendix B) was developed to provide opportunity for principals and administrators to describe their role in implementation and support of the program, as well as overall perceptions of program components, teacher and student reactions, and impact of use. Principal and administrator interviews lasted approximately 30 minutes.

Teacher coach and teaching specialists' interviews. Interviews were conducted with teaching staff (n = 9) at both schools who were involved with mathematics instruction. An interview protocol (see Appendix C) was developed to provide an opportunity for additional staff to describe their role in implementation and support of the program, as well as overall perceptions of program components, teacher and student reactions, and impact of use. Staff interviews lasted approximately 30 minutes.

Teacher focus groups. A teacher focus group was conducted at both site-visit schools. Teachers (n = 9) were invited to attend the focus group by their school principal. Each focus group included 4-5 teachers and lasted approximately 45 minutes. The interview protocol (see Appendix D) solicited teachers' descriptions of and reactions to professional development, implementation by the district, teaching experiences, and perceived impact of the program.

Student focus groups. A student focus group was conducted at both site-visit schools. Students were selected by their school principal to participate. Each focus group included 7 students and lasted approximately 30 minutes (n = 14). The student focus group protocol (see Appendix E) solicited students' descriptions of and reactions to the program, including likes, dislikes, and the impact of the program on their math learning.

Usage data. To measure student usage of the Prodigy program, Prodigy Education provided student level data to the district which described total questions completed, total questions completed correctly, and total questions answered at home. Usage data were de-identified and merged with students' achievement data by research staff in the school district and transferred to members of the research team at the Johns Hopkins University. These data were used to explore the extent to which all district elementary schools used Prodigy and to ascertain if any correlation existed between the extent of program usage and improved student achievement.

Student achievement data. Student achievement data emerged from fourth-grade students' performance on the mathematics section of the state standardized assessment at the end of SY 2018-2019. Students' growth on this exam was measured from students' performance on the same assessment taken a year prior, at the conclusion of their third-grade year during SY 2017-18. Data concerning student performance on this exam was provided by district administrators in the form of student percentile scores and performance levels.

Analytical Approach

All qualitative data were analyzed using a grounded theory approach (Glaser & Strauss, 1967). Recorded data were transcribed and handwritten observation notes were compiled using analysis software NVivo (QSR International). For the case study analysis, qualitative data were collated and analyzed by school. To determine general findings, qualitative data were organized by data source and analyzed using an iterative coding process. The qualitative findings reported on in the current preliminary report are themes which emerged prominently from our analysis.

Analyses of covariance (ANCOVA) were conducted to examine whether there was a relationship between students' math achievement growth on the standardized assessment and the amount of time they spent using Prodigy during the 2018-19 school year[1]. For these analyses, treatment students were divided into three groups based on

[1] Analysis was conducted with ANCOVA (General Linear Model) using SPSS statistical analysis software. Estimated adjusted mean was used to compare treatment groups and mean scores were adjusted at the grand mean of students' prior scores.

the total number of questions they were recorded answering during the study window[2]: those in the top third of program usage, those in the middle third, and those in the bottom third. These analyses compared the spring 2019 mathematics achievement of these groups while controlling for the following covariates: baseline mathematics performance[3], race/ethnicity[4], school[5], economic disadvantaged status, and limited English proficiency status (LEP). To explore whether the program had differential impacts for select subgroups of students, interactions were also incorporated for student economic disadvantage, LEP status, and whether students were designated as proficient or non-proficient on the baseline assessment.

Case Study Results

We begin with a presentation of case studies. Case study schools have been given pseudonyms to protect the identity of study participants. We discuss general findings following the presentation of case studies and the student achievement and usage analysis.

Case Study – Rossi Elementary

Enrollment at Rossi Elementary is approximately 700 students, which is near capacity. School leaders indicated enrollment was growing each year. School leaders also indicated that the community has changed rapidly, with significantly more Hispanic and Spanish-speaking families moving to the area following the flight of middle-class families and young professionals from the community in recent years. This school serves a greater proportion of bilingual, Hispanic, and economically disadvantaged students than are enrolled in the district overall. The research team noted that campus grounds were manicured and pleasant and the building and classrooms were functional, clean, and welcoming. We estimate a 1:3 technology (Chromebooks) ratio among students. At the time of data collection, the principal's tenure was three years in the building as principal and over 20 years in the profession. At this school, the research team conducted four classroom observations, an interview with the school principal, a focus group with classroom teachers (n = 4), a focus group with intervention specialists and teacher coaches (n = 4), and a focus group with students (n = 7).

---

[2] The total number of Prodigy questions answered was selected as a proxy for overall student program usage, as this variable was viewed as the most comprehensive measure of students' exposure to the program.
[3] Baseline math performance was measured by the Spring 2018 administration of the standardized assessment.
[4] To facilitate a more parsimonious analysis, ethnicity was simplified from a vector of dummy variables to a single dichotomous variable (non-White/Asian minority status).
[5] The school each student was reported as attending was controlled for via a vector of dummy variables.

Implementation and preparation. Teachers in this school have been using Prodigy for at least three years. The principal suggested that some teachers may have used the program sparingly prior to district-wide implementation, if they found the product on their own. A specialist affirmed this rollout, noting that one teacher found the product 5-6 years ago through a Facebook group and began using it in their classroom. The principal and teachers indicated that the decision to implement in all schools was made by a district curriculum specialist.

Regarding preparation to implement the program, the principal felt that teachers were generally prepared to implement the program but could use program features more effectively, especially data and reporting features, if they had more training. She noted that while tenured teachers benefitted from district-wide professional development provided at initial implementation three years ago, high turnover within the school among teachers meant a revolving need for training. Teachers at this school affirmed that the initial training provided was adequate and that subsequent (optional) training was helpful. One teacher commented that she recently attended one of the optional webinars after school and learned new things by attending, even though she was at the school during initial implementation and attended initial district-wide training.

In this school, Prodigy is primarily used during a stations or rotations approach to instruction during regular mathematics blocks (e.g., students rotate through a number of stations, staying at each for 15-20 minutes). It is also available to students who arrive early to school, as a reward, and as an option for students who have completed their work early. We infer that it is used relatively frequently (at least twice per week) as part of planned instructional time during mathematics blocks. This school has an ongoing competition within the building between classrooms and among students related to total questions answered in a classroom and percentage of grade-level content completed by students. Progress and standards are reviewed and announced weekly, monthly, and by semester by the school principal. This review and announcement routine are the sum of the school principal's current involvement with the program. She indicated, "Day-to-day, I'm not really involved. I monitor progress but day-to-day, I'm on reading. Mathematics here takes care of itself." Coaches and intervention specialists also indicated in interviews that they are not involved with implementation day-to-day but are aware of the school-wide competition.

Student use. The research team observed four mathematics blocks at this school. We observed one classroom at each grade level, grades 1-4. In each classroom, the program was used as part of a stations/rotations approach to instruction. We observed that students logged into and operated the program with ease. They appeared to be familiar with program features and characters. While students occasionally shared their success with peers, turned their attention to other students' computers or associated with other students during peer-to-peer battles, the overwhelming majority of students remained "on task."

Our observations revealed that students at this school need little from their teachers during use of Prodigy. The research team observed pervasive perseverance in the game among students. Students appeared to be fully engrossed in the storyline and motivated to succeed in the program. Students were observed activating the help feature in their efforts to perform spells; they expressed what appeared to be genuine excitement at their successes and disappointment with their failures. This fact—that students remain attentive to program content and motivated to persevere in battles and through the larger storyline—emerged as central to teachers' satisfaction with the program. Teachers noted that Prodigy allowed them to have more small-group time because students remain engaged in the program ("We don't have to monitor those students much."). The school principal said, "The kids like it and it's easy for the teachers, they know this is a station they can use and it's academic. It's like it takes care of itself."

Our observations noted that distractions from mathematics content come from within the game. Both members of the research team indicated at some point that some Rossi students spend time dressing their avatar, rearranging their house, traveling or wandering around various rooms or worlds, swapping out tools and/or reviewing options available for purchase with gems. The research team noted several instances where students would have benefitted from teacher oversight (e.g., technical errors, consistently failing in battle, and working in the "home" world instead of "school" world) but, essentially no interaction was observed between teachers and students using Prodigy.

Teacher use and teacher reactions. Teachers at this school describe the program as easy to use, well-liked by students, and engaging. Teachers noted that students are eager to get to the Prodigy station during rotations. Teachers noted that the program "keeps students focused on math content" and "prompts mathematical conversations between kids." They also indicated that "playing it is like a reward or incentive for students." One teacher noted that she has one student who "will only get his work done if Prodigy is the reward."

Teachers and administrators also noted that the usage and performance data provided to teachers is easy to find and understand ("I like that it's not over-sophisticated."). Teachers described using the information provided about student usage and performance as "a good way to see where students are by skill" and that based on the information, teachers "can target that skill for small group or for a whole class reteach." Teachers also noted that the information "helps with RTI as well, and parent conferences," and that they are able to see (after the fact) if students have been guessing during use. Teachers also described using the teacher dashboard to modify the type of questions students receive. The ability to modify content and differentiate among students is described as one of the product's strengths and central to adults' perceptions of the program's ability to meet the needs of all students. The principal said, "I like that we can manipulate the grade level. Students can have successful experiences and feel good about themselves. Meeting the needs of those students is never easy and Prodigy is not the smoking gun but it's part of the puzzle." The ability of the program to adapt to student responses while they are using the program was also described as a strength.

Student response. Rossi students expressed much enthusiasm for the program and used words like "amazing" and "awesome" to describe Prodigy. One student said, "I always want to play it." Another said, "It makes me have a really happy feeling, like I accomplished something." Students agreed that the game is especially good for students who do not like mathematics or are not good at math, because Prodigy makes mathematics fun and "makes you like it [math] more." Students nearly unanimously agreed that the program makes learning mathematics easier and more fun. They indicated their engagement in the storyline and that working through the storyline is motivation for completing mathematics problems. The majority of students indicated their favorite aspect of the program is their pet and/or ability to customize their life in the game's virtual world.

The most prominent concern among Rossi Elementary students is related to the membership component of the game. Their comments tended to revolve around the additional rewards that members receive, and the additional capacities those students have to conduct spells and customize their avatar and pets. Students also commented on outdated graphics, too few chat functions, and a desire for more customizable options for their avatar and pet.

Summary. Based on multiple data sources, we conclude that routines in this school are strong and that students and teachers are highly satisfied with the program. Mathematics achievement in this school is generally pretty high and while adults do not attribute students' high achievement to Prodigy specifically, they are satisfied with its role in teachers' mathematics instruction. Prodigy is used as a curriculum tool by teachers at this school; teachers and the principal affirmed their intention to continue to use the program. The extent to which students are engaged in the program and the ease of implementation and use during class time are described as the greatest strengths of the program. School-based adults at the school unanimously affirmed they would recommend its use to other educators. Students were also unanimously positive overall about Prodigy and their desire to keep using the program.

Participants at Rossi Elementary made the following recommendations to improve the program:

- More options to customize the avatar
- More options to communicate with others in the program
- Set limits on how long students can engage in non-content related activities

- Enable teachers to set more than one skill/standard so that students are given questions related to multiple areas, as they would on an assessment
- Incorporate more word problems for third grade students, as that is when word problems appear on state assessments
- Introduce a Spanish or bilingual version
- Allow parent access to dashboard
- Provide data at the content area level (e.g., geometry, algebra) in addition to skill level (e.g., area of a shape, addition/subtraction)

Case Study – San Dominic Elementary

Enrollment at San Dominic is approximately 700 students and, similar to Rossi Elementary, the principal indicated the school is near capacity with enrollment growing each year. San Dominic Elementary is a bilingual campus, and there are English-only, Spanish-only, and bilingual classrooms at each grade level. Spanish-speaking students from throughout the district attend school here. The principal described a relatively high proportion of turnover in students each year (roughly 20%) as students who do not live in the surrounding community matriculate out of bilingual education at San Dominic and enroll in their regular neighborhood school. The research team noted that campus grounds were manicured and pleasant and classrooms were functional, clean, and welcoming. We estimate a 1:2 technology (Chromebooks) ratio among students. At the time of data collection, the principal's tenure was five years in the building as assistant principal and four as principal, and over 20 years in the profession. At this school, the research team conducted five classroom observations, an interview with the school principal, a focus group with classroom teachers (n = 5), a focus group with intervention specialists and teacher coaches (n = 5), and a focus group with students (n = 7).

Implementation and preparation. Prodigy has been available to students at San Dominic for three years, though it was initially only available through technology classes that occurred in the school's computer lab. In the first year of implementation, students were also able to access the program on desktop computers in their classroom after they finished other work or during free time. San Dominic teachers indicated it became a popular choice among students almost immediately and they began to use Prodigy as an incentive for students to complete classwork ("Completion of work jumped dramatically.") Similar to Rossi Elementary, the San Dominic principal and teachers both indicated that the decision to implement the program was made by the district-level mathematics curriculum specialist at that time.

Overall, the principal felt that teachers were generally prepared to implement the program. She noted that, "Our [San Dominic] teachers saw immediately how to use it for instruction and remediation. We never felt like it was just a game." She also noted that as teachers have used the program more, they have more questions about how to expand its application and use its features more effectively stating, "The more they use it, the more questions they have."

The principal described Prodigy and the district-level mathematics curriculum specialist as responsive to and supportive of the professional development needs of San Dominic teachers. In the focus group, though, teachers expressed some hesitation about using the program. One teacher, new to the district, implied that she actually had not yet had time to explore the program, so she had not integrated the program at all in her classroom. She said, "There were a few demo videos I've watched but I'm trying to learn it before I let my students on it." Another teacher said, "We had a webinar but we had to learn by doing." Yet another teacher added, "Sometimes I don't know how to pull the data that's there. I don't really know how to use it."

Teacher use. Based on multiple data sources, including teacher and staff focus groups and classroom observations, we conclude that Prodigy is primarily used as a supplemental curriculum tool rather than a regular component of mathematics instruction. Teachers described using it "only on Fridays" and "only if everything else is done for the week." They also described using it as a reward or something students can do if they arrive early to school. One teacher estimated they "try to do it once a week." The principal indicated it was also made available when recess is forced indoors during inclement weather.

All three adult groups at San Dominic—teachers, specialists, and the principal—indicated that teachers did not use the reporting and data features within the program to capacity. The principal said, "We have a lot of data that teachers have access to so I wouldn't say Prodigy data is our very best source. It's another report they can look at but it's not central." She added, "The skill bar graph is helpful, it shows what skill they [students] are lower on. It's brand new and it's a good conversation starter." One teacher indicated they "look at it [the teacher dashboard] to see who is on task." Another said they check to see if students have completed questions over the weekend, for which students are rewarded.

There is some evidence, though, that routines may be changing and that San Dominic is a school where Prodigy has the potential to become a more frequently used curriculum tool. We infer that the principal was committed to the use of the program more consistently in mathematics blocks. In addition to showering the program with praise throughout her interview, she said,

> *There is something wonderful about being able to pull a small group and knowing that this [Prodigy] can be a station rotation that is beneficial and pushes kids as well as reflects what is being taught in regular instruction, it's very important.*

Teachers and specialists both indicated, at some point in their focus groups, that the fact that students remain engaged in the game is perceived as central to its utility in the classroom. One teacher said, "It's something that I didn't have to create and it frees me up for small group. If I have them on that, I can meet with other kids." Similarly, an instructional specialist noted, "They [students] aren't growing tired of this program. Students are intrinsically motivated to play so it keeps students engaged so that the teachers are freed-up."

School-based adults also consistently noted that students love to play Prodigy ("They choose it during recess, that's their preferred activity.") The principal said, "They love it, very much. If I took it away, we'd have a problem. They'd sit there and play it all day if I let them." Teachers described it as "good for the kids" because "it does reinforce content and they stay focused on it," and it's "not just a math worksheet." Teachers felt the program "helps them [students] socially, they talk to each other about math during battle." A specialist said, "They'd rather do Prodigy than anything else."

Student use. The research team observed mathematics blocks in five different classrooms in this school. We observed one second grade, two third, and two fourth-grade classrooms. Three classrooms were English-only classrooms. One classroom was Spanish-only and one was bilingual. In one English-only classroom and in the Spanish-only classroom, we observed all students working in Prodigy at the same time. The other three classrooms used the program as one of several stations that students rotated through during the mathematics block. In these classrooms, our impressions echo many of the findings presented in the case study of Rossi Elementary. Students generally operated the program with ease and remained on task even if they occasionally engaged with nearby peers. Students rarely needed assistance or redirection from their teachers. We observed students lingering in non-content sections of the game (e.g., the general store, customizing their house and avatar, etc.) though, again, it was not pervasive. Also similar to observations at Rossi, we observed perseverance among students in the game even after they experienced failure.

Our observations in English-only classrooms at San Dominic Elementary revealed similar routines and impressions to those observed at Rossi Elementary. However, they are in stark contrast to findings that emerged from bilingual and Spanish-only classrooms in the same school. Members of the research team concluded that the program generally does not meet the needs of Spanish-speaking students, as these students are largely unable to participate intentionally in the game due to the inability to read English text. Members of the research team noted that students sometimes "figured things out" or created ways to work around the language-related barrier. For example, students in the Spanish-only classroom were working with area and perimeter. These questions were often solvable by students as they inferred what the prompt was asking them to do and, with the shape and measurements displayed, were able to answer questions correctly. However, students were not able to participate if the prompt deviated from "What is the area of the rectangle below?" The research team noted frequent instances of students in the Spanish-only and bilingual classrooms who appeared to be guessing and clicking through questions they did not understand.

The high proportion of bilingual and Spanish-speaking students enrolled in San Dominic Elementary may help explain why routines in this school were generally not as strong or consistent as observed at Rossi Elementary and why the program is less prominent in regular mathematics instruction. In the Spanish-only classroom, at least two students did not have correct login information, further evidence that students rarely used the program prior to our visit. Importantly, Spanish-speaking students who clearly did not operate the program as intended remained engaged in their screen even as they consistently failed to cast spells by answering questions correctly. While these students remained engaged in the game, they weren't as engaged in the actual doing of mathematics as students without a language barrier.

Teacher and administrator reactions. School-based adults at San Dominic affirmed that the program was not entirely suitable for their student population. One teacher said, "For me, I wish there was a Spanish version. I have a few kids who can't function in that program. They have to buddy up with someone." The principal said, "If it was in Spanish, it'd be better. Those kids still want to play but I would like to see it in Spanish." In the group of instructional specialists, one participant noted, "They turn to their friends for help when they need to. Even if they don't understand it, they still want to do it. They're still getting computation practice."

In terms of student achievement, teachers and administrators both acknowledged the importance of extra mathematics practice but avoided attributing their students' mathematics achievement to Prodigy ("It's hard to say about direct impact. It's just 10 minutes in a day sometimes. It's hard to say."). The principal said, "I can't say about student achievement. They practice more, so that's good, that's going to have an impact. Any time we say, 'go do 15 minutes of Prodigy,' that's 15 minutes of practice. The practice has to be helpful." While teachers and administrators were critical of the program's capacity to meet the needs of Spanish-speaking students, they did compliment the program's ability to meet students of varying abilities and level of mathematics skills ("It works for all kids.") School-based adults at San Dominic unanimously agreed that they would recommend the program to other educators.

Student reactions. In the focus group, San Dominic students described the program as fun and challenging. One student said, "Everyone is happy at the Prodigy station." Students at San Dominic were more critical of program features than students at Rossi. One student felt that the game was boring and repetitive. Another student didn't like that they had to hurt characters in order to proceed in the game. Overall, though, student feedback was positive—students indicated they wanted to play Prodigy more than they currently did. They agreed that it makes learning mathematics easier and more fun. One student said, "When I'm battling a monster, I want to do the math." They all thought that students at other schools should play the game because, "it can help you focus on math." Students indicated their favorite aspect of the program was their pets and "leveling up." Similar to students at Rossi Elementary, their least favorite component is that some students have memberships while others do not.

Summary. We conclude that routines at San Dominic stand to improve. While teachers and administrators recognize that student engagement in the program is high and that the program may be leveraged to free teachers up for small-group teaching, a significant barrier to implementation at this school is the high population of bilingual and Spanish-speaking students who do not have typical experiences in the game. Teachers also did not appear to see Prodigy as a robust curricular tool, as all teachers we spoke to indicated it was not a regular component of mathematics instruction. We also infer that San Dominic teachers may be underprepared to use the program in their classroom *and* that the San Dominic principal may be unaware of the extent to which her teachers may benefit from additional training related to the program.

Participants at San Dominic made the following recommendations to improve the program:

- Introduce a Spanish or bilingual version
- Improve help button (too wordy, does not teach students who are visual learners)
- Provide quick view of individual progress of all students in a classroom
- Set limits on how long students can engage in non-content related activities
- Recognize and send alert to teacher if program recognizes a student clicking through
- Align format of questions with state assessments (e.g., more word problems)

Student Achievement Results

We begin the results of our student achievement analyses by presenting implementation and usage patterns across the participant sample. We discuss the extent to which students used Prodigy during the 2018-2019 school year in terms of total questions answered, total questions answered correctly, and total questions answered at home. We then present the student achievement analysis. The analysis included (a) a description of overall achievement among all fourth-grade students in the district; (b) an exploration of the relationship between students' achievement and usage of the program; and (c) exploratory analyses examining achievement outcomes of student subgroups (i.e., students who are economically disadvantaged, English-language learners, and students proficient and non-proficient on the baseline assessment).

Usage and Implementation of Prodigy

Implementation of Prodigy was measured in terms of the total number of questions answered, total number of questions answered correctly, and total number of questions answered at home. On average, fourth grade students in the district answered just under 1,212 questions in Prodigy in the 2018-2019 school year. The average district student answered approximately 83% of those questions correctly. The average fourth-grade student answered roughly 25% of all questions at home.

For the purpose of the current analysis, fourth-grade students were evenly divided into three groups based on the total number of questions answered during the study window: those in the top third of program usage (high-usage), those in the middle third (mid-usage), and those in the bottom third (low-usage). Students in the low-usage group (N = 177) completed 658 or fewer questions in SY 2018-2019. The mid-usage group (N = 197) completed between 658 and 1248 questions, and the high-usage group (N = 203) completed 1248 or more questions. Table 1 summarizes the usage patterns of students in each school and the district overall.

Table 1
High-, Mid-, and Low-Usage Groups

	Low Usage		Medium Usage		High Usage	
	N	%	N	%	N	%
Elementary School A	12	12.6	34	35.8	49	51.6
Elementary School B	13	25.0	20	38.5	19	36.5
Elementary School C	45	47.4	17	17.9	33	34.7
Elementary School D	32	34.0	42	44.7	20	21.3
Elementary School E	34	55.7	14	23.0	13	21.3
Elementary School F	11	13.4	42	51.2	29	35.4
Elementary School G	30	30.6	28	28.6	40	40.8
All District Elementary Students	177		197		203	

Note. *The information presented incorporates usage statistics for the sample inclusive of all students with 2019 achievement data. Students with irreconcilable usage/achievement data are not included in this sample.*

Table 1 illustrates the variation of program usage between and within schools in the district. Variation is observed by considering the range of information in each usage group. For example, while roughly 55% of all fourth-grade students at School E were designated as low frequency users, just under 13% of School A fourth graders were. Likewise, high frequency usage ranged from 51.6% of fourth- grade students at School A to roughly 20% of students in School D and School E.

Student Mathematics Achievement and Usage of Prodigy

Students performed nearly the same, on average, on the state standardized assessment at the end of fourth grade in 2019 as they did at the end of third grade in 2018. The proportion of students who qualified as proficient on the assessment was greater in 2019 than in 2018. Overall achievement of participants in terms of proficiency and average percentile score on the assessment is presented in Table 2[6].

Table 2
Average Score and Percent of Students Proficient in Mathematics in 2018 and 2019

		Not proficient		Proficient	
	Average Score	N	%	N	%
2018	.693 (.21)	251	48.55	266	51.45
2019	.687 (.21)	253	43.85	324	56.15

For this study's main regression analysis, student usage data was examined alongside student achievement data in order to ascertain whether there was any relationship between how extensively students used Prodigy and their achievement gains on the mathematics section of the state standardized assessment. Table 3 summarizes the overall relationship between Prodigy use and achievement gains on the mathematics section of the assessment. Increased program use, in terms of both total questions answered and total questions answered correctly, was associated with significantly greater achievement gains among fourth-grade students in the district.

Table 3
Program Usage and Achievement

	Total Questions Answered			Total Questions Answered Correctly		
	Estimate	*p*	Questions Needed for 1-Point Gain	Estimate	*p*	Correct Questions Needed for 1-Point Gain
4th Grade Students	0.00113	0.037	888	0.00160	0.012	625

After controlling for the covariates, on average, each additional Prodigy question students answered was associated with a statistically significant ($p < .05$) increase in assessment score of 0.00113 points. Furthermore, each additional question students answered *correctly* was associated with a statistically significant ($p < .05$) increase in assessment score of 0.00160 points. Last, directionally, each additional question students completed at home was associated with a non-significant increase in assessment score of 0.00101 points. Based on these calculations, a student would need to complete roughly 888 Prodigy questions in order to achieve a one-point gain in their assessment score. Similarly, students would need to answer roughly 625 questions correctly, or answer 987 questions while at home to achieve this same gain.

Analyses also explored differences between thresholds of program usage. Fourth-grade students were evenly divided into three groups based on the total number of questions answered during the study window: those in the top third of program

[6] Student scores on the state exam are reported in terms of percentile level. A score of .687 reflects a score at roughly the 69th percentile.

usage (high-usage, 1248 or more questions answered), those in the middle third (mid-usage, between 658 and 1248 questions answered), and those in the bottom third (low-usage, 658 or fewer questions answered). Usage patterns of each group are presented in Table 4.

Table 4
Average Usage of Low-, Mid-, and High-Usage Groups

	Low Usage	Medium Usage	High Usage
Average Questions Completed	394.94	920.26	2206.57
Average Questions Completed Correctly	305.29	754.49	1849.55
Average Questions Completed at Home	38.64	146.13	689.84

Note. *The information presented incorporates usage statistics for the sample inclusive of all students with 2019 achievement data. Students with irreconcilable usage/achievement data are not included in this sample.*

Significant differences were observed in some demographic characteristics and the baseline achievement of these three usage groups (see Table 5).

Table 5
Demographic and Baseline Achievement Characteristics of High-, Mid-, and Low-Usage Groups

	Low Usage	Medium Usage	High Usage
Race/Ethnicity			
White or Asian	30.50%	23.90%	30.00%
Non-white, non-Asian	69.50%	76.10%	70.00%
ED	68.90%	66.00%	54.70%
LEP	24.30%	21.30%	28.10%
Baseline Assessment Score (Average)	0.630	0.695	0.741

Independent samples *t*-tests and Chi-square analyses revealed significant differences in the proportion of economically disadvantaged (ED) students, as well as the baseline achievement between the groups. The low-usage group was comprised of a greater proportion of ED students than the mid- and high-usage groups ($p < .05$). Directionally, the opposite trend emerged when considering LEP students: the high-usage group was comprised of a greater proportion of LEP students than the mid- and low-usage groups. No significant difference was observed between the high-, mid-, and low-usage groups in terms of proportion of non-white/Asian minority students.

Baseline achievement (i.e., performance on the mathematics section of the standardized assessment at the end of 3rd grade) was significantly higher among high-usage users than baseline achievement of both mid- ($p < .05$) and low-usage students ($p < .001$). The mid-usage group also demonstrated significantly higher baseline achievement than the low-usage group ($p < .01$).

Analyses of the performance of these usage groups revealed several trends. After controlling for covariates, pairwise comparisons revealed significant differences in the adjusted average score of low-, mid-, and high-usage students on the standardized assessment in 2019 (see Table 6). Students in the low-usage group performed, on average, significantly worse on the assessment at the end of 4th grade than students in the mid- (*p* <.01) and high-usage groups (*p* <.01). No significant difference was observed in the adjusted average score of students in the high- and mid-usage group, however (effect size = -0.005). The high-usage group outgained the low-usage group by a significant effect size margin of +0.201, while the mid-usage group outgained the low-usage group by a significant margin of +0.209[7].

Table 6

Comparison of End of 4th Grade Performance of High-, Mid-, and Low-Usage Groups

Pairwise Comparison		Average Adj. Score in 2019	Mean Difference	Effect Size	*p*
Low-usage		.664			
	Mid-usage	.705	-.042	-0.209	.004
	High-usage	.704	-.040	-0.201	.005
Mid-usage		.705			
	Low-usage	.664	+.042	+0.209	.004
	High-usage	.704	+.002	+0.005	.902

Analyses also explored whether or not program usage was correlated with achievement gains for select subgroups of students (see Tables 7 and 8). These analyses explored program impacts for economically disadvantaged students and non-economically disadvantaged students, LEP and non-LEP students, and students who were proficient and non-proficient on the mathematics section of the standardized assessment at baseline (2018). These analyses did not find significant differences in the achievement gains of these groups based on their amount of Prodigy usage. Tables 7 and 8 below provide the adjusted mean scores for students within these subgroups for the high-, mid-, and low-usage groups.

Table 7

Subgroup Adjusted Mean Scores by Usage Group

		Low-Usage		Mid-Usage		High-Usage	
		M	Std. Error	M	Std. Error	M	Std. Error
Economically Disadvantaged							
	Not ED	.665	.019	.717	.017	.713	.014
	ED	.662	.013	.699	.011	.699	.012
LEP Status							
	Not LEP	.668	.012	.712	.010	.710	.011
	LEP	.653	.020	.687	.019	.686	.017

[7] Effect sizes were calculated using the formula for Cohen's *d*.

Proficiency at Baseline						
Not Proficient in 2018	.674	.015	.702	.015	.690	.016
Proficient in 2018	.647	.017	.709	.014	.713	.014

Note. Adjusted means are the mean posttest scores modified to accommodate the covariates incorporated in the analysis.

Table 8

High-, Mid-, and Low-Usage Groups: Growth Comparisons by Subgroup

	High- vs. Low-Usage (Effect Size)	High- vs. Mid-Usage (Effect Size)	Mid- vs. Low-Usage (Effect Size)
Economically Disadvantaged			
Not ED	+0.260	-0.023	+0.311
ED	+0.185	0.000	+0.185
LEP Status			
Not LEP	+0.215	-0.010	+0.220
LEP	+0.171	-0.005	+0.189
Proficiency at Baseline			
Not Proficient in 2018	+0.086	-0.063	+0.151
Proficient in 2018	+0.596	+0.037	+0.545

General Themes Analysis and Discussion

The case study analyses highlight important differences between the two schools involved in the current evaluation, which we will discuss in more detail below. Taken together, and considered alongside the student achievement and usage analysis, much can be learned about the implementation and use of Prodigy.

Implementation and Preparation

The decision to implement Prodigy in the current school district was made by a district mathematics curriculum specialist. According to the mathematics curriculum specialist who was integral to bringing the program to the district, a representative from Prodigy Education offered to introduce the program to her and, over a one-hour meeting, demonstrated features of the program. The administrator indicated she agreed to pilot the program after the organization agreed to provide a "a ton of support" including a number of trainings for teachers. This fact, that Prodigy Education agreed to provide the level of support needed to do a district-wide implementation, appears to be the primary reason for their decision at the time. Principals, teachers, and specialists indicated they trusted the decision made by the district-level curriculum specialist. We did not observe any pervasive criticism or rejection of the product.

Principals and teaching specialists at both schools described their day-to-day involvement with the program as minimal. While principals occasionally reviewed data provided by the program, it appears that teaching specialists rarely interact with the program at all. This is not surprising, as many of the teaching specialists work within RTI frameworks or as teacher coaches and/or assistants. The extent of their involvement with the program is an awareness that students like to play the game and that it is available to students on all Chromebook computers.

Adult participants from both schools described Prodigy Education and the district curriculum specialist as responsive to and supportive of the professional development needs of teachers. Respondents from both schools also indicated that teachers would benefit from further training, particularly related to using data and reporting features. Regarding teacher preparation, we recommend providing teachers with on-demand access to professional development that enables teachers to use the product effectively. Teachers described attending live, webinar-based professional development hosted by Prodigy Education staff. This means that access to information about the program has depended on synchronized scheduling. We recommend leveraging technology to allow teachers to access shorter, more specific training at their convenience.

Our analysis of usage data suggest that overall implementation varied between and within schools in the case-study school district. The percentage of users within a school designated as high-usage students ranged from roughly 20% of the student population to just over 50% of the student population. This is important considering the positive findings to emerge related to usage and achievement. Prodigy Education may consider offering educators usage guidelines so as to better ensure the program is used frequently within schools.

We also noticed variation in subgroup representation within usage groups. In the current sample, economically disadvantaged students were over-represented in the low-usage group. In the current context, this means they have fewer opportunities to engage with mathematics content via Prodigy. In contrast, the high-usage group was over-representative of LEP students. During site visits, we observed LEP students struggle to navigate the program as intended. Bilingual classrooms appeared to be the least familiar with the program in general, and we noted that in some instances, students did not have their login information, which suggested that teachers had not been using the program at all. Given the high usage of this student subgroup, it is possible that the challenges observed in the case study school are isolated and not representative of the district overall. More research is needed to understand how non-traditional students, especially LEP students, use Prodigy.

Student Impact and Engagement

Teachers, principals, and specialists were emphatic regarding student enjoyment of the program and students' engagement in mathematics content presented through

Prodigy. Student engagement was consistently described as a key strength of the program and was consistently married with students' preoccupation and independent learning. School-based adults described the program as keeping students focused and engaged in mathematics content that is both challenging and relevant. Prodigy, when used as part of station rotations, requires little effort by teachers to prepare and little of the teacher's attention while students are using it.

Teachers and principals in both schools were reluctant to attribute student achievement to Prodigy. School-based adults were more likely to talk about increased engagement or note that students were getting additional mathematics practice. Students nearly unanimously agreed that the program made learning mathematics easier and more fun. They described feeling motivated to defeat monsters and feeling accomplished when they succeeded in the game. Students indicated that one of their favorite aspects of the game is the feeling of achievement or "leveling up." They are genuinely attached to their pets and invested in their own progress in the game. They especially like the social components—they like battling their friends, being in a virtual world with their classmates, and knowing that others are playing with them when they are at home. We conclude that Prodigy certainly makes a positive contribution to students' attitudes toward mathematics, which are related to achievement in a meaningful way.

Our observations in both schools affirm that student engagement and students' perseverance in the program is remarkable. Students of all abilities, even those who were unable to read the language the program is written in, remain engaged in the storyline of Prodigy. We conclude from observations and focus groups that students are genuinely motivated to preserve the life of their avatar and pets. Students in both schools displayed authentic emotional responses to the plight of their avatar and pet and they engaged in dynamic social interactions with their in-class peers with whom they battled. Members of the research team felt that students were genuinely happy to show off their abilities in the program. We observed students in deep thought, remaining on task for the large majority of observation time.

The unintended consequence of extraordinarily high student engagement in screen-based content is that students persist when remediation and/or direct contact with a teaching adult is what the student actually needs. Our observations noted that students who consistently answered questions incorrectly were still able to move about the world, engage in battles, and were often presented with the exact same questions they previously answered incorrectly and were subsequently given the answer to. Researchers, and teachers, noted the lack of remediation and actual teaching provided by Prodigy. We recommend an increase in the frequency and quality of remediation within the game and notifying teachers of students who are struggling. Multiple data sources suggest that struggling students are not going to stop playing Prodigy to ask for help.

Our findings from the achievement and usage analysis suggest that increased program use, in terms of both total questions answered and total questions answered correctly, was associated with greater achievement gains among fourth-grade students in the current school district. Two important qualifications should be considered. First, the current analysis is a post-hoc design and not an experiment or quasi-experiment. This means that while a positive and significant relationship is observed, we cannot demonstrate direct causation between usage and achievement. Furthermore, Prodigy has been available to students in this district since 2016. It is impossible for us to determine, based on the current research, how much of the relationship observed (if any) can be explained by a cumulative impact of usage. In other words, the findings may be related to students' use of the program over multiple years. Further research is needed to determine the one-, two-, and three-year impacts of usage on achievement. Our research indicated that no significant differences in the achievement gains of student subgroups (i.e., ED, LEP, and baseline proficiency status) were observed based on their amount of usage. Importantly, our analysis of subgroups supports teachers' perceptions and our firsthand observation regarding the remarkable accessibility of Prodigy to all students regardless of ability.

Second, our results indicate that a student would need to complete roughly 888 questions in order to achieve a one-point gain in their standardized assessment score. Similarly, students would need to answer roughly 625 questions correctly, or answer 987 questions while at home to achieve this same gain. In other words, overall impact is statistically significant but quite small, and the implication is that students would need to spend substantially more time in the program for it to make a meaningful impact on their performance on a standardized test.

Our findings also suggest that the relationship between usage and achievement is not exactly linear. More and more usage of Prodigy may not result in more and more achievement, based on the findings that emerged from the current study. In the current study, no significant difference was observed in the adjusted average score of students in the high- and mid-usage group. This means that students in the high-usage group did not perform significantly better than students in the mid-usage group.

Additional Reactions and Recommendations

Teachers in both schools noted a need for a time limit for students to shop, customize their avatar, or engage in other in-game distractions. Our observations affirm that a small number of students did appear to "wander about" the program. While this sort of observation was not pervasive in either school, it is worth mentioning that teachers may not be aware of the extent to which students are off task and may benefit from re-direction because students remain engaged with their screen even though they are not engaged with mathematics content. We affirm the recommendation made by teachers to limit the amount of time students spend in non-content aspects of the game while playing in the school-based area of the game. Additionally, students in both schools made references to the game using words such as "kill" and "weapons." While also not pervasive, we draw attention to this finding to demonstrate that some students may experience the storyline differently than intended by Prodigy Education.

Principals and teachers consistently noted the utility of teachers' ability to modify the specific mathematics content students encounter in battle. Based on our experience evaluating game-based mathematics programs, this represents a key feature of Prodigy that distinguishes the program from other products. We concur that teachers very much value the ability to customize content in supplemental curriculum products so that students practice content consistent with classroom schedules, which can vary widely between and within school buildings. Related to modifying content, teachers and teaching specialists in both schools recommended increasing teachers' ability to customize what content students see in battle. Specifically, teachers would like to choose multiple skill areas for student practice and increase the frequency of word problems for older students. These recommendations reflect teachers' focus on preparing students for standardized testing and the desire for in-class practice to reflect the format of these high-stakes assessments ("That's how it's going to be on their tests.")

Two important differences in implementation emerged from the case studies above. The first is the implementation in a school environment with a relatively high population of Spanish-speaking students. Our observations in bilingual and Spanish-only classrooms in San Dominic Elementary highlight the demand for bilingual or Spanish versions of curriculum tools. Providing a Spanish version should increase the ability of Prodigy to meet the needs of diverse student populations.

Based on multiple data sources, we also conclude that initial implementation differed in important ways in each school. At Rossi Elementary, Prodigy was described and observed as a regular feature of mathematics blocks, used primarily in a stations approach to mathematics instruction. At San Dominic, while we did observe five classrooms using the program, teachers described the program as a supplemental resource that was used primarily before and after school, during recess, as a reward, or only after students had finished everything else they needed to do during a day or week. Teachers at Rossi Elementary seemed more familiar with the program and more complimentary of program features—they spoke specifically about the different type of reports available and appeared more confident in how to use program features to maximize its contribution to their classroom. We suspect the current difference in use is partially related to the difference in the student population of each school—the program is simply less useful to San Dominic teachers—but also stems from how Prodigy was first implemented at each school. At Rossi, the program was always available to classroom teachers via Chromebooks. At San Dominic, however, it was initially only available to students through a computer lab or on desktop computers. This may have impacted San Dominic teachers' initial impression of the program as extracurricular rather than a regular instructional tool. This is something for Prodigy Education to be thoughtful about as they support future implementations.

Summary and Conclusion

In sum, Prodigy is a supplementary mathematics program that is well-liked by students and teachers and, in the current sample, appears to positively relate to student achievement on a standardized assessment. Students in the current study were highly engaged in the story line of Prodigy and were motivated to complete mathematics problems in order to progress in the game. Teachers are mostly satisfied with the degree to which students remain engaged in mathematics content that is both challenging and relevant to class material. While teachers would benefit from professional development related to data and reporting features of Prodigy, they described these features as easy to use and providing useful information. School-based adults agree the program meets the needs of students with varying skill capabilities, though does not meet the needs of English-language learners.

To summarize our recommendations, we offer the following based on our observations and feedback from stakeholders in the case-study district:

- Introduce bilingual or Spanish version of the program
- Introduce features and content that are consistent with high-stakes testing (e.g., multiple skills presented to students and word problems for older students)
- Use a time-limiting feature for non-content areas of the game while students are at school
- Introduce in-class visuals for tracking individual and classroom progress to promote competition and celebration while increasing visual presence in the classroom
- Improve remediation for students who are struggling; notify teachers of students who are consistently failing to cast spells
- Provide on-demand training for teachers that is short and specific (e.g., short video on how to access reports)

Appendix A: Classroom Observation Protocol

School Name: ________________________________ Grade: ______________

Comment on the following aspects of Prodigy implementation as applicable to the session.

1. **Classroom Environment:**
(Number of students, room arrangement, technology devices available)

2. **What did you observe?**
General description of classroom setting/activity observed.

3. **PM activity description**
Describe what you observed specifically related to Prodigy.

4. **Teacher Activities**
What did the teacher do?

5. **Student Activities**
What did the students do?

6. **Student Engagement**
Describe impressions of student engagement.

7. **Anything else?**
Describe overall impressions, including what went well and what seemed to be challenging.

Appendix B: Principal Interview Protocol

Implementation

1. Why did you decide to implement Prodigy in your school?

2. To what degree and how are you and other school administrators involved?

3. Were your teachers adequately prepared to implement the program?

Student Impact

4. How is Prodigy being used by students in your school?

5. To what degree do students enjoy participating in this program?

6. To what degree do you believe this program benefits your school? In specific, to what degree has the program had a positive impact on student achievement (e.g. grades, test scores)?

7. To what degree has the program had a positive impact on students' attitudes toward mathematics? What about their engagement in mathematics in general?

8. To what degree does program meet the needs of most of your students?

Teacher Impact

9. How have teachers responded, generally, to the program?

10. How has implementation impacted your staff's teaching practices during mathematics?

11. To what degree do you and your teachers use the teacher-facing components of the program (data, reporting, assessments in Prodigy)? How useful do you find the teacher and administration tools?

Overall Perceptions

12. What do you see as the strengths of Prodigy?

13. What suggestions would you have to improve the program?
    a. Improvements to student-facing features/content
    b. Improvements to teacher dashboard

14. Would you recommend this program to other educators? Why or why not?

15. Is there anything else you would like to add?

Appendix C: Teaching Specialist Interview Protocol

Implementation

1. Describe implementation of Prodigy at your school. How were you involved?

2. To what degree are you currently involved with day-to-day of Prodigy?

3. How are teachers in your school currently using Prodigy? (example: daily independent skills practice)

4. Do you feel teachers were adequately prepared to use Prodigy when your school first began using it? Why or why not?

Student Impact

5. To what degree do students enjoy using Prodigy? How do students generally respond to the program?

6. To what degree has the program had a positive impact on student achievement (e.g., grades, test scores)? On student attitudes toward mathematics? What about their engagement in mathematics?

7. To what degree does the program meet the needs of most of your students?

8. Does Prodigy make it easier to determine student progress and needs? Why or why not?

Teacher Impact

9. How have teachers responded, generally, to the program?

10. How has implementation impacted your staff's teaching practices during mathematics?

11. To what degree do you and your teachers use the teacher-facing components of the program (data, reporting, assessments in Prodigy)? How useful do you find the teacher and administration tools?

Overall Perceptions

12. What do you see as the strengths of Prodigy?

13. What suggestions would you have to improve the program?

14. Would you recommend this program to other educators? Why or why not?

15. Is there anything else you would like to add?

Appendix D: Teacher Focus Group Protocol

Implementation

1. How are you currently using Prodigy? (example: daily independent skills practice)

2. Do you feel you were adequately prepared to use Prodigy when your school first began using it? Why or why not?

Student Impact

3. To what degree has the program had a positive impact on student achievement (e.g., grades, test scores)?

4. To what degree has the program had a positive impact on students' attitudes toward mathematics? What about their engagement in mathematics in general?

5. To what degree do students enjoy using Prodigy?
    a. In general, how do students respond to the program?
    b. How do parents respond to the program?

6. To what degree does the program meet the needs of most of your students?

Teacher Practices

7. Does Prodigy make it easier to determine student progress and needs? Why or why not?

8. Does Prodigy increase the time available to you for teaching individual students or groups of students (or completing other relevant instructional activities)?

9. To what extent have you used the teacher dashboard and/or the reporting features embedded in the program? Features used most? Used least?
    a. How useful do you find these tools?

Overall Perceptions

10. What do you see as the strengths of Prodigy?

11. What suggestions would you have to improve the program?
    a. Improvements to student-facing features/content
    b. Improvements to teacher dashboard

12. Would you recommend this program to other educators? Why or why not?

13. Is there anything else you would like to add?

Appendix E: Student Focus Group Protocol

1. Let's start by you all telling me a little bit about Prodigy. What is it like to play?
    a. When you first started using Prodigy, what did you think about it? Now that you've had some time to get used to using it, what do you think about it?

2. Do you think using Prodigy has made learning math easier? Why or why not?

3. Do you think using Prodigy has made learning math more fun? Why or why not?

4. What do you like most about using Prodigy?

5. What do you like least about using Prodigy?

6. How often do you play Prodigy? How do you feel about the amount of time you use Prodigy —too much, too little, just right?

7. Do you think that students in other schools should use Prodigy? Why or why not?