Improving the Effectiveness of Digital Educational Tools in Increasing Student Achievement and Reducing Achievement Gaps

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Preliminary Findings on Edgenuity Use in Milwaukee Public Schools (MPS), 2013-14, 2014-15 and 2015-16 School Years

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Introduction

This report summarizes preliminary findings from analyses of Milwaukee Public Schools (MPS) student use of Edgenuity (a K-12 online learning and credit recovery tool) and their academic outcomes across three school years: 2013-14, 2014-15 and 2015-16. This research is a major part of a larger project that aims to understand what constrains or supports the use of educational technology in promoting critical thinking and new ways of learning, tailoring instruction to student experiences and skill levels, and fostering greater student engagement and motivation for learning, as well as improving student educational outcomes and reducing racial and socioeconomic gaps in educational opportunity. The data analysis presented here draws on records of student Edgenuity use that combine information from Edgenuity session log-ins, course grades, progress and performance with MPS student records by school year.

- In 2013-14, a total of 78,770 MPS student records, including information on 6,173 Edgenuity users, were linked with 1,648,380 Edgenuity records (with a match rate of 81.4%).

- In 2014-15, a total of 99,530 MPS student records, including 7,007 Edgenuity users, were linked with 2,142,340 Edgenuity records (with a match rate of 86.6%).

- In 2015-16, a total of 101,233 MPS student records, including 6,017 Edgenuity users, were linked with 1,599,852 Edgenuity records (with a match rate of 83.3%).

Appendix Table A.1 presents a summary of the characteristics of all MPS *high school* students, as Edgenuity is primarily used at the high school level, and compares them with the characteristics of matched Edgenuity users. The number of matched MPS-Edgenuity (unique) student records is shown by school year. Edgenuity users are generally representative of the high school population, although they are more frequently absent from school; are more likely to be black and free lunch-eligible and less likely to be English language learners, and they typically have lower standardized test scores (except for 2014-15).

Table A.2 in the appendix shows the number of students in each MPS high school (by school year), the proportion of students who have used Edgenuity in those schools, and the proportion of all Edgenuity-using students in MPS that attend a given high school. The 2014-15 school year is distinguished from 2013-14 and 2015-16 by having a larger number and proportion of Edgenuity users in the high schools.

The foci of the quantitative and qualitative analyses we present here include:

- Who among MPS high school students are using Edgenuity (what are their characteristics), and how are they using this online instructional tool?
- How are Edgenuity-using students progressing academically—as measured by credits earned, grade point average (GPA) and standardized test scores—compared to other students in these high schools who are not using Edgenuity?
- Among those using Edgenuity, what types of behaviors do we see emerging in student Edgenuity use, and how do these behaviors contribute to Edgenuity course performance (i.e., passing rates, on-time completion and rates of course disablement) and relate to student academic outcomes?

- What are the common: i) patterns in what Edgenuity looks like in practice? and ii) challenges and opportunities in implementing Edgenuity in MPS schools?

We perform these analyses by school year, examining patterns in Edgenuity use and outcomes over time, and also relate these patterns to policy changes being implemented in MPS over time. In addition, through our qualitative analyses of data collected in interviews and observations of instructional sessions in Edgenuity across MPS high schools, we illuminate the patterns in Edgenuity use with rich, descriptive examples of Edgenuity being enacted by students and instructors in classrooms. The qualitative analyses also draw out information on instructor goals for Edgenuity use and the constraints to realizing those objectives in the varying classroom environments. Particularly because we observe considerable variation in Edgenuity across schools, and even within the classroom, it is important to have this in-depth perspective on how this online instructional tool is enacted in varying classroom environments.

Who is Using Edgenuity, and is Edgenuity Use Associated with Student Academic Outcomes?

We begin by examining the "baseline" characteristics of MPS students using Edgenuity over time (i.e., student characteristics before they start using Edgenuity in a given school year). As shown in Table 1, Edgenuity users have lower baseline math and reading test scores, GPAs and credits earned than students not using Edgenuity in MPS high schools where it is offered. The sample sizes for standardized test score measures are lower because not all students have fall (MAP or STAR) test scores in reading and mathematics; also, credits earned (at the end of the 2012-13 school year) were not available for comparison for the 2013-14 cohort.

In estimating the relationship between Edgenuity use and student outcomes, our estimation methods attempt to account for these baseline differences in student outcomes, as well as differences in student demographic characteristics and absences. In all of the empirical analyses we perform, we adjust for student "baseline" characteristics (i.e., student characteristics before they begin use of Edgenuity in a given school year), in light of the substantial variation in users and non-users we observe. In most of our analyses, we also restrict our comparison of Edgenuity users to non-using students attending MPS high schools where Edgenuity is offered. The primary methods of estimation we employ include: 1) fixed-effect models, which examine student changes in outcomes over time while adjusting for "fixed" (i.e., stable) school and grade factors, along with student characteristics and the percentage of Edgenuity users in each school; and 2) inverse propensity score weighting with regression adjustment (IPWRA) that aims to align the observed characteristics of Edgenuity users and non-users at baseline in assessing the relationship of Edgenuity use to student outcomes. For brevity, we primarily present estimates from the fixed effects regressions, given that they were very comparable to the IPWRA estimates, although we caution that because Edgenuity users select into use of this online instructional tool based on very distinct characteristics, limitations with the validity of inferences remain in the analysis.

Table 1: Baseline Academic Outcomes of Edgenuity Users vs. Non-users by School Year

2015-16	**No Edgenuity use**			**Edgenuity user**		
Baseline measure	N	Mean	Std. Dev.	N	Mean	Std. Dev.
Math test score	12,159	-0.006	0.555	1,845	-0.093	0.657
Reading test score	12,131	-0.009	0.610	1,848	-0.043	0.764
GPA	17,379	1.930	1.115	4,289	1.419	0.870
Credits earned	15,577	5.356	2.270	4,070	4.643	2.153
2014-15	**No Edgenuity use**			**Edgenuity user**		
Baseline measure	N	Mean	Std. Dev.	N	Mean	Std. Dev.
Math test score	7,781	0.022	1.030	2,532	-0.097	0.902
Reading test score	7,904	0.012	1.017	2,537	-0.073	0.948
GPA	11,697	1.962	1.070	4,553	1.473	0.887
Credits earned	15,741	5.336	2.253	4,440	4.764	2.208
2013-14	**No Edgenuity use**			**Edgenuity user**		
Baseline measure	N	Mean	Std. Dev.	N	Mean	Std. Dev.
Math test score	19,832	0.049	1.021	4,394	-0.235	0.852
Reading test score	19,767	0.036	1.014	4,393	-0.174	0.905
GPA	10,856	2.011	1.057	4,086	1.374	0.870

Table 2 shows that if we simply estimate the average association between any Edgenuity use (compared to no use) and academic outcomes among MPS students (controlling for student characteristics and baseline outcome measures), we see very few statistically significant relationships and negative associations between Edgenuity use and student academic outcomes. We describe these as associations, because it is possible that other unmeasured differences between Edgenuity users and non-users could bias these estimates. Also, we saw in our classroom observations widely varying student behaviors and classroom environments that lead us to expect some variation in student outcomes by student users and settings. In the analyses we present below, we identify different types of student users and then examine their course-taking behaviors and performance, as well as the associations between their use of Edgenuity and the outcomes shown in Table 2.

Table 2: Estimated Average Associations between Edgenuity Use (Compared to No Use) on Student Academic Outcomes by School Year

	2015-16			2014-15			2013-14		
Outcomes	N	Coef.	S.E.	N	Coef.	S.E.	N	Coef.	S.E.
Math test score	7,250	-0.052	0.028	4,802	**-0.073**	0.024	11,003	-0.031	0.017
Reading test score	7,162	-0.050	0.026	4,759	-0.059	0.030	10,905	**-0.053**	0.023
GPA	13,476	**-0.080**	0.017	10,072	-0.020	0.020	11,997	-0.032	0.020
Credits earned	12,537	-0.086	0.053	10,582	-0.042	0.056	8,530	-0.087	0.062

Note: estimation method is inverse probability weighting with regression adjustment; coefficient estimates in bold are statistically significant at α=0.05.

Student Edgenuity user typologies

In light of the observed differences in how students use Edgenuity in diverse MPS classroom environments, we also constructed "typologies" of student users and examine variation in student use of Edgenuity and their academic outcomes across these user groups. This approach recognizes that estimating average effects across diverse types of student Edgenuity users could mask important variation in the association between Edgenuity and student outcomes, and it accordingly relies on user behaviors and short-term outcome variables (aggregated to the student-level) to develop user types (using k-means cluster analysis).[1]

As user behavior and outcomes varied across school years, likely due in part to changes in policy that MPS was making to improve its effectiveness, we estimated typologies of student users by school year. The cluster analysis determined the number of types or user groups, three in the 2015-16 and 2014-15 school years, and four in the 2013-14 school year. Altogether, we identified the following four user types: "dedicated strugglers", "nominal exerters", "moonlighters" and "engaged learners" (see Figure 1).

Table 3 describes the user behaviors of the most productive user group in Edgenuity, the "engaged learners." One of the most consistent predictors of lower Edgenuity course performance across the school years—the ratio of idle to active minutes per session—has been steadily reduced over time (by about 40%, from 0.25 to 0.15) among "engaged learners." "Engaged learners" are also completing more activities with less session time, and accordingly, are completing their courses in fewer sessions. Other analyses (also not shown below) found that

[1] The K-means cluster analysis is an iterative process that divides the available cases into k number of groups and then assigns each case to the cluster with the closest centroid, minimizing the Euclidian distance between each case and its assigned cluster. After each assignment, the procedure updates the cluster centroids, reassigning cases as needed, as it proceeds through the data, with the resulting clusters selected to minimize the error sum of squares (using Ward's hierarchical method and discriminant function analysis).

Figure 1: User Group Prevalence across School Years (2013-16)

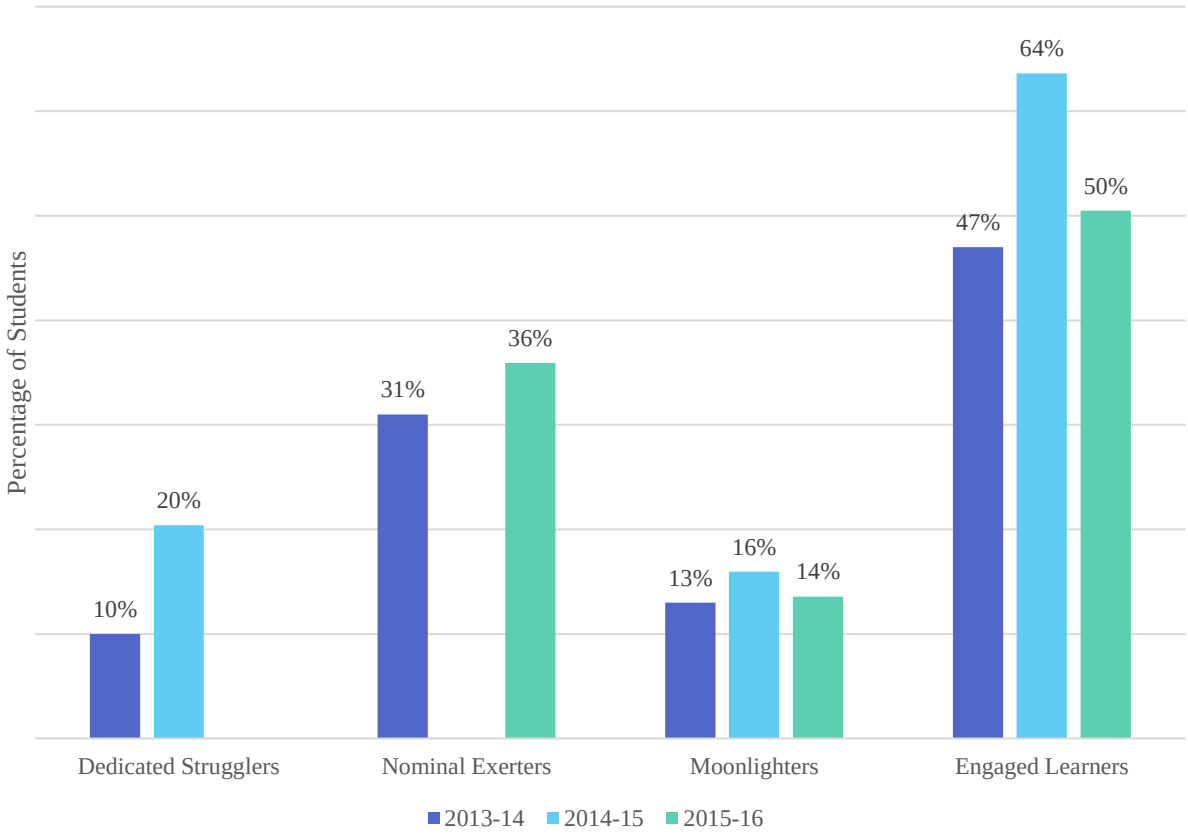


Table 3: User Behaviors of Engaged Learners across Time (2013-16)

	2013-14 (N=1,653)		2014-15 (N=3,572)		2015-16 (N=2,293)	
	Mean	SD	Mean	SD	Mean	SD
Course Duration (Minutes)	8,312.36	7,258.04	7,019.93	5,682.68	7,957.66	5,724.93
Completed Activities (Per Day)	6.55	11.62	5.13	8.56	6.66	8.92
Session Time (Minutes)	138.78	74.96	145.41	124.59	114.68	84.96
Idle/Session Time Ratio (Per Session)	0.25	0.23	0.18	0.19	0.15	0.19
Number of Sessions (Per Course)	37.66	29.36	45.11	30.89	36.70	22.28
Number of Courses	4.93	4.40	3.96	3.38	4.65	3.62
Percentage Night School	2.74	16.32	2.96	16.95	2.92	16.85

idle time is significantly higher in elective courses than in other subjects, and it is lowest in science courses.

Appendix Tables A.3-A.11 present additional details on the characteristics of these different student Edgenuity user types by school year, including their course-taking behaviors, subjects studied in Edgenuity and demographic characteristics. The "moonlighters" are characterized primarily by their high rate of course-taking (more than 80 percent) outside of the regular school day. The "moonlighters" are also less likely to be students with special needs or to be economically disadvantaged, and they are more likely to be in 12th grade. Their prior year academic performance (as measured by standardized test scores) also appears to be stronger than students in the other user groups.

The "dedicated strugglers" and "nominal exerters" (the two lower-performing user groups) are both identified in school year 2013-14, which allows for a comparison of their user behaviors and other characteristics across the user types (see Tables A.9-A.11). As shown in Table A.9, students in these groups were accomplishing less in Edgenuity, particularly the "dedicated strugglers"—fewer completed activities per day, more idle time in the system, and fewer courses but more sessions per course. It is also notable that the "dedicated strugglers" were more likely to be taking a math course and to be in an earlier high school grade (9^{th} or 10^{th} grade) in 2013-14; they were also slightly more likely to be English language learners and to qualify as economically disadvantaged. These patterns are somewhat less distinctive in 2014-15 (see Tables A.6-A.8), where the "nominal exerters" were no longer identified as a distinct group. In 2014-15, the "dedicated strugglers" were more likely to be students with special needs.

In the 2015-16 school year (see Table A.5), the "dedicated strugglers" were no longer identified as a distinct user group, and the profile of the "engaged learners" looked different as well. Although we will be able to understand more through analyses that follow specific students from year to year (among the 30% or so who engaged with Edgenuity across multiple school years), Table 4 shows that more students who were economically disadvantaged and African-American and with special needs were classified in the "engaged learners" user group in 2015-16 (relative to previous school years). And despite this profile of greater disadvantage, including lower prior year test scores, the "engaged learners" in this school year were exhibiting the most productive course-taking behaviors of all years and groups (see again Table 3).

Table 5 presents results that show how these student user behaviors in Edgenuity relate to their Edgenuity course performance—the rate at which courses are disabled, course pass rates, on-time completion of courses, and course grades—controlling for student demographic characteristics, their prior test score performance, course subjects, grade level, school attended. As noted above, a higher proportion of idle time per session is a strong, statistically significant predictor of higher rates of course disablement, lower rates of course passing and on-time completion and lower course grades. For example, *for each additional percentage point of time idle*, on average, course pass rates and on-time rates fall by about one half to 2/3 of a percent, and course grades (on a scale of 0 to 100) are about .13 to .30 points lower. Figure 2 shows the average percentage time idle across sessions by school for the top 10 Edgenuity-using schools (in terms of number of sessions) for 2013-14, 2014-15 and 2015-16. In most of these schools, the proportion of student idle time is decreasing with each school year.

Table 4: Student Characteristics of Engaged Learners across Time (2013-16)

	2013-14 (N=1,653)		2014-15 (N=3,572)		2015-16 (N=2,293)	
	Mean	SD	Mean	SD	Mean	SD
Percent Absent	25.22	21.85	22.00	20.02	31.27	23.50
Special Education	22.22	41.58	20.76	40.57	26.69	44.25
English Language Learner	4.94	21.67	6.37	24.43	4.42	20.57
Free/reduced lunch	82.83	37.73	87.37	33.23	78.00	41.44
Female	45.27	49.79	45.30	49.79	43.21	49.55
Black	72.06	44.88	70.42	45.65	71.36	45.22
Hispanic	17.75	38.22	19.03	39.26	19.22	39.41
White	8.14	27.35	7.41	26.20	6.71	25.03
9th Grade	24.42	42.97	22.30	41.63	25.45	43.57
10th Grade	22.74	41.93	23.62	42.48	21.39	41.01
11th Grade	33.77	47.31	32.00	46.65	33.35	47.16
12th Grade	19.07	39.29	22.08	41.49	19.82	39.87
Standardized Fall MAP Reading SS	-0.26	0.94	-0.10	0.96	-0.15	0.90
Standardized Fall MAP Math SS	-0.32	0.86	-0.10	0.90	-0.23	1.00

More time spent in a given Edgenuity session (as measured by session duration) and the number of sessions per course are positively associated with course performance, while a longer overall time to complete a course is negatively associated with student performance, possibly reflecting student struggles or disengagement with the online course-taking system. Not surprisingly, more activities completed per day is positively associated with course performance. Course-taking at night generally appears to be positively linked to course performance, although only one of these associations is statistically significant (in 2014-15).

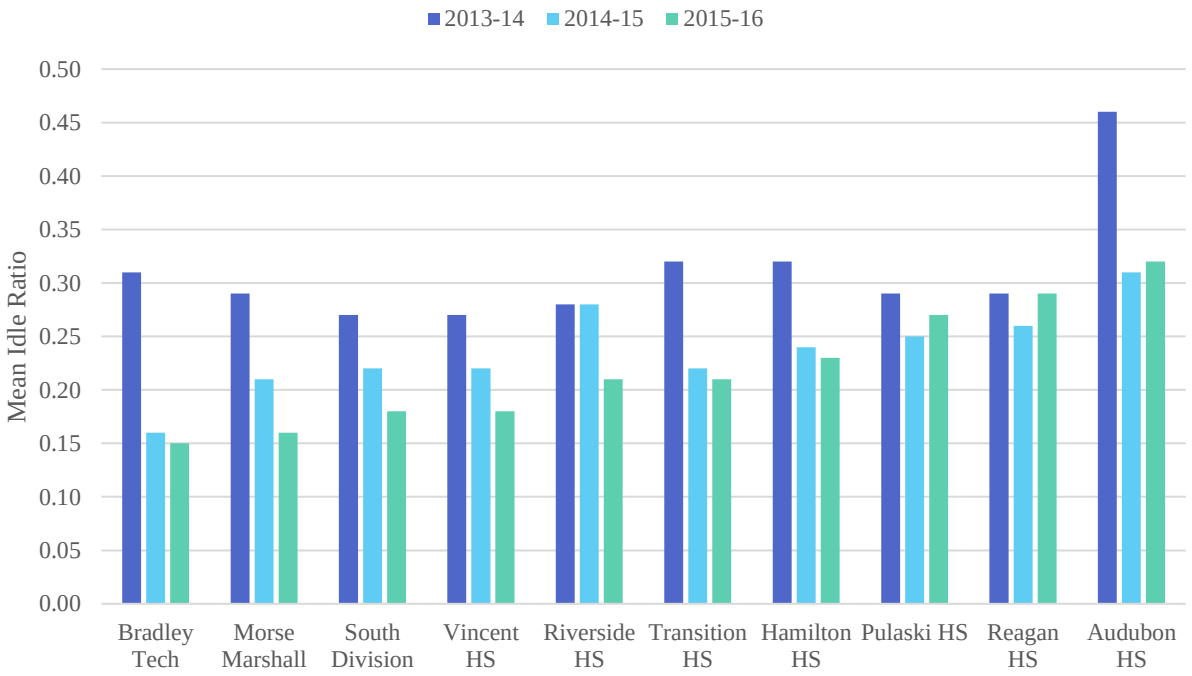
Although we don't report the relationship between student characteristics and course performance in Table 5, there were several consistent associations. Students in 11th or 12 grade performed better than 9th graders on all measures in all years, while students absent more often performed more poorly on all measures of course performance. In addition, there were a few statistically significant associations between free lunch status and the course disabled rate (a positive relationship) and passing rate and on-time completion rate (negative associations) in 2015-16. The only differences in course performance by gender were in the Edgenuity course grades. In both 2013-14 and 2015-16, females received significantly higher (1.79 and 1.27 points on average) courses grades; the positive association in 2014-15 was not statistically significant.

Table 5: Relationship of Student Edgenuity User Behaviors to Course Performance

Outcome:	*2013-14*		*2014-15*		*2015-16*	
Course disabled rate	(n=133,340)		(n=83,753)		(n=61,107)	
Predictors:	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Class duration	-0.002	0.005	0.015	0.010	**0.041**	0.016
Completed activities/day	**-0.218**	0.026	**-0.265**	0.040	**-0.785**	0.085
Mean % idle time	**0.233**	0.064	0.166	0.100	**0.671**	0.090
Mean session duration	**-0.201**	0.029	**-0.138**	0.049	**-0.225**	0.059
Number sessions/course	**-0.147**	0.018	**-0.106**	0.028	**-0.433**	0.040
Night school use	-1.514	1.263	-1.888	1.902	-1.066	2.693
Day & night use	-0.656	1.654	-3.231	2.363	0.692	2.980
Course pass rate						
Predictors:	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Class duration	0.001	0.006	**-0.051**	0.011	**-0.077**	0.015
Completed activities/day	**0.585**	0.039	**0.519**	0.069	**0.796**	0.085
Mean % idle time	**-0.527**	0.136	**-0.679**	0.137	**-0.710**	0.087
Mean session duration	**0.365**	0.043	**0.423**	0.059	**0.238**	0.060
Number sessions/course	**0.241**	0.022	**0.220**	0.033	**0.505**	0.041
Night school use	0.894	1.677	**4.535**	2.176	0.571	2.694
Day & night use	1.819	2.097	**7.600**	2.961	-1.900	2.946
On-time completion rate						
Predictors:	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Class duration	**-0.013**	0.005	**-0.059**	0.011	**-0.134**	0.015
Completed activities/day	**0.270**	0.031	**0.385**	0.059	**0.580**	0.083
Mean % idle time	**-0.217**	0.079	**-0.561**	0.120	**-0.637**	0.081
Mean session duration	**0.194**	0.036	0.114	0.061	-0.024	0.050
Number sessions/course	**0.122**	0.020	**0.100**	0.033	**0.266**	0.043
Night school use	1.525	1.621	0.750	2.253	-0.261	2.532
Day & night use	-3.053	1.915	4.859	3.182	-0.689	3.002
Course grade						
Predictors:	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Class duration	**0.008**	0.001	**0.006**	0.003	**0.016**	0.004
Completed activities/day	**0.135**	0.013	**0.101**	0.016	**0.173**	0.024
Mean % idle time	**-0.129**	0.036	**-0.212**	0.051	**-0.303**	0.035
Mean session duration	**0.067**	0.011	**0.087**	0.014	**0.055**	0.015
Number sessions/course	**0.014**	0.004	-0.003	0.006	**0.048**	0.009
Night school use	0.035	0.352	0.890	0.458	-0.257	0.579
Day & night use	0.354	0.495	-0.685	0.563	-0.092	0.720

Note: Estimation method is OLS regression. Coefficients in bold are statistically significant at α=0.05.

Figure 2: Mean Idle/Session Time Ratio for the Top Ten Schools (by Number of Sessions, 2013-14 through 2015-16 School Years)



Appendix Figure A.1 shows graphically the estimated relationship between students' total time in Edgenuity sessions across the school year and credits earned, which was estimated using a "dose-response" function that controls for student characteristics, grade level, percent of days absent and prior year credits earned. The vertical line on each of the graphs (for the 2013-14, 2014-15 and 2015-16 school years) marks a total session time of 10,000 minutes (about 166 hours); it shows that the "response" or returns in terms of credits earned to a given level of dosage appear to increase over time, at the same time that total time spent using Edgenuity is becoming shorter, declining from an average of 8,025 minutes in 2013-14 to 6,873 minutes in 2015-16. Appendix Figure A.2 shows the dose-response function estimated to assess the relationship between students' total session time across the school year and end-of-year GPA, controlling for student characteristics, grade level, percent of days absent and prior year GPA. This graph suggests that the average returns to a given total session time in terms of GPA are diminishing over time, even as average total idle time is declining (as shown in the table notes).

The more effective user behaviors of "engaged learners" and the "moonlighters" among the Edgenuity-using students appear to be reflected in their academic outcomes in comparison to the other student user types. Table 6 shows the associations between Edgenuity use by student user type across the school years, estimated using fixed-effects regressions with the session-level data. Although there are no statistically significant associations between Edgenuity user types and student test scores, the "engaged learners" generally gain more in grade points and course credits through their use of Edgenuity than the other three types of student user groups, with the

"moonlighters" a close second in terms of these two outcomes. When students successfully complete a course in Edgenuity that they are repeating due to a previous course failure, the Edgenuity course grade replaces the failing grade on their transcript, which appears to be reflected in their increased GPAs and credit attainment.

Table 7 presents the results of fixed-effects regressions that compare the academic outcomes of different types of student Edgenuity users to non-Edgenuity users (i.e., students in schools with Edgenuity available who are not taking courses online). In the two more recent school years, there appears to be very little difference in academic outcomes associated with Edgenuity use (vs. non-use), regardless of user type. However, in 2013-14 and 2014-15, the "dedicated strugglers"—those who were more likely to be in 9th or 10th grade, taking a math course online, English language learners, economically disadvantaged or students with special needs—did worse academically than similar students who were not using Edgenuity. In addition, in 2013-14, students in each of the four user groups performed more poorly in terms of their standardized reading test scores compared to similar students who did not use Edgenuity. These patterns in associations between Edgenuity use (by Edgenuity user type) and academic outcomes were also confirmed in models estimated using inverse propensity score weighting with regression adjustment.

The fact that the "dedicated strugglers" user type is no longer identified in the analysis of linked MPS-Edgenuity data in the 2015-16 school year (see again Figure 1) suggests that MPS has made progress in addressing problematic Edgenuity user behaviors. In 2015-16, policy changes that identified and disabled use among students who were not engaging or making progress in the system and that provided supports to encourage students to improve their use of the online course-taking tool—such as setting activity completion goals and monitoring students' progress weekly—may have contributed to this shift. Average course passing rates have increased from approximately 59-60% in 2013-14 and 2014-15 to 64% in 2015-16, and on-time course completion (meeting established goals) increased from 30% in 2013-14 to 37% in 2014-15 and then to 46% in 2015-16.

Table 6: Comparison of Academic Outcomes of Edgenuity Users by Student User Type and Year

Outcomes		**Engaged Learners**		**Moonlighters**		**Nominal Exerters**		**Dedicated Strugglers**	
	N	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Math test score	180,355	0.153	0.110	0.064	0.110	(reference group)		n.a.	
Reading test score	176,111	0.063	0.080	-0.084	0.107			n.a.	
GPA	978,873	**0.248**	0.038	**0.223**	0.047			n.a.	
Credits earned	900,207	**1.191**	0.170	**0.662**	0.189			n.a.	
	N				2014-15				
Math test score	254,743	0.055	0.065	0.055	0.090	n.a.		(reference group)	
Reading test score	262,559	0.068	0.081	0.158	0.110	n.a.			
GPA	1,145,210	**0.218**	0.040	**0.199**	0.053	n.a.			
Credits earned	1,102,840	**0.699**	0.161	**0.615**	0.183	n.a.			
	N				2013-14				
Math test score	723,434	0.013	0.049	0.051	0.060	-0.085	0.044	(reference group)	
Reading test score	723,542	-0.066	0.066	0.013	0.088	-0.105	0.060		
GPA	575,167	**0.408**	0.082	**0.448**	0.084	**0.290**	0.078		
Credits earned	974,357	**0.648**	0.234	0.349	0.297	0.158	0.185		

Estimation method: school and grade-level fixed effects regressions (N=number of Edgenuity sessions analyzed)
Note: Coefficients (estimates) in bold are statistically significant at α=0.05.

Table 7: Comparison of Academic Outcomes of Edgenuity Users vs. Non-Users by Student User Type and Year

		Engaged Learners		**Moonlighters**		**Nominal Exerters**		**Dedicated Strugglers**	
Outcomes		Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
	N				**2015-16**				
Math test score	6,977	-0.058	0.050	-0.081	0.050	-0.041	0.074	n.a.	
Reading test score	6,898	-0.034	0.042	-0.054	0.036	-0.054	0.068	n.a.	
GPA	13,557	-0.008	0.038	**-0.109**	0.043	0.026	0.064	n.a.	
Credits earned	12,606	0.104	0.073	-0.206	0.125	0.217	0.139	n.a.	
	N				**2014-15**				
Math test score	4,802	-0.076	0.043	-0.001	0.069	n.a.		**-0.129**	0.048
Reading test score	4,987	-0.063	0.029	0.035	0.081	n.a.		-0.094	0.052
GPA	10,582	-0.019	0.041	-0.007	0.058	n.a.		-0.089	0.059
Credits earned	10,072	-0.036	0.080	0.103	0.144	n.a.		**-0.320**	0.148
	N				**2013-14**				
Math test score	11,003	-0.030	0.022	0.011	0.036	**-0.085**	0.024	**-0.047**	0.023
Reading test score	10,905	**-0.050**	0.014	**-0.060**	0.037	**-0.071**	0.029	**-0.052**	0.021
GPA	11,997	0.016	0.034	0.094	0.061	0.012	0.036	**-0.139**	0.048
Credits earned	8,530	-0.068	0.116	0.018	0.145	-0.122	0.101	-0.185	0.103

Estimation method: school and grade-level fixed effects regressions (N=number of students in schools with Edgenuity use)
Note: Coefficients (estimates) in bold are statistically significant at α=0.05.

Student Edgenuity use and academic outcomes across MPS high schools

We also present information on student use of Edgenuity across MPS high schools. Figure 4 shows graphically the distribution of the different types of student users by school—for the ten schools with the highest number of Edgenuity users—across the 2013-14, 2014-15 and 2015-16 school years. For example, across the three school years, Pulaski H.S. and Bradley Tech stand out has having consistently higher percentages of "engaged learners" among their Edgenuity users. Table 8 provides greater detail on the percentage of "engaged learners" by school year across all MPS high schools with Edgenuity users over this period.

Figure 5 presents the estimated differences in student Edgenuity course performance—rate of courses disabled, pass rates and on-time completion rates—by school for the top five performing schools on these dimensions. These (marginal) school effects are estimated in regressions that also control for student characteristics, prior test score performance, course subjects, grade level and user behaviors (session and class duration, idle-time ratio and night-school use). Figure 6 presents the estimated differences in student Edgenuity course performance for the five lowest performing schools on these dimensions.

As indicated in the introduction, we have also seen considerable variation in Edgenuity use within MPS high schools (in our classroom observations), as well as widely differing classroom environments and instructional practices that may support or constrain its use. In the next major section of this report, we present information and insights from our field research and qualitative analyses that further illuminate the patterns we identified empirically in Edgenuity use and student academic outcomes.

Figure 4. Percentage Engaged Learners for Top Ten Schools Serving Edgenuity Users (2013-16)

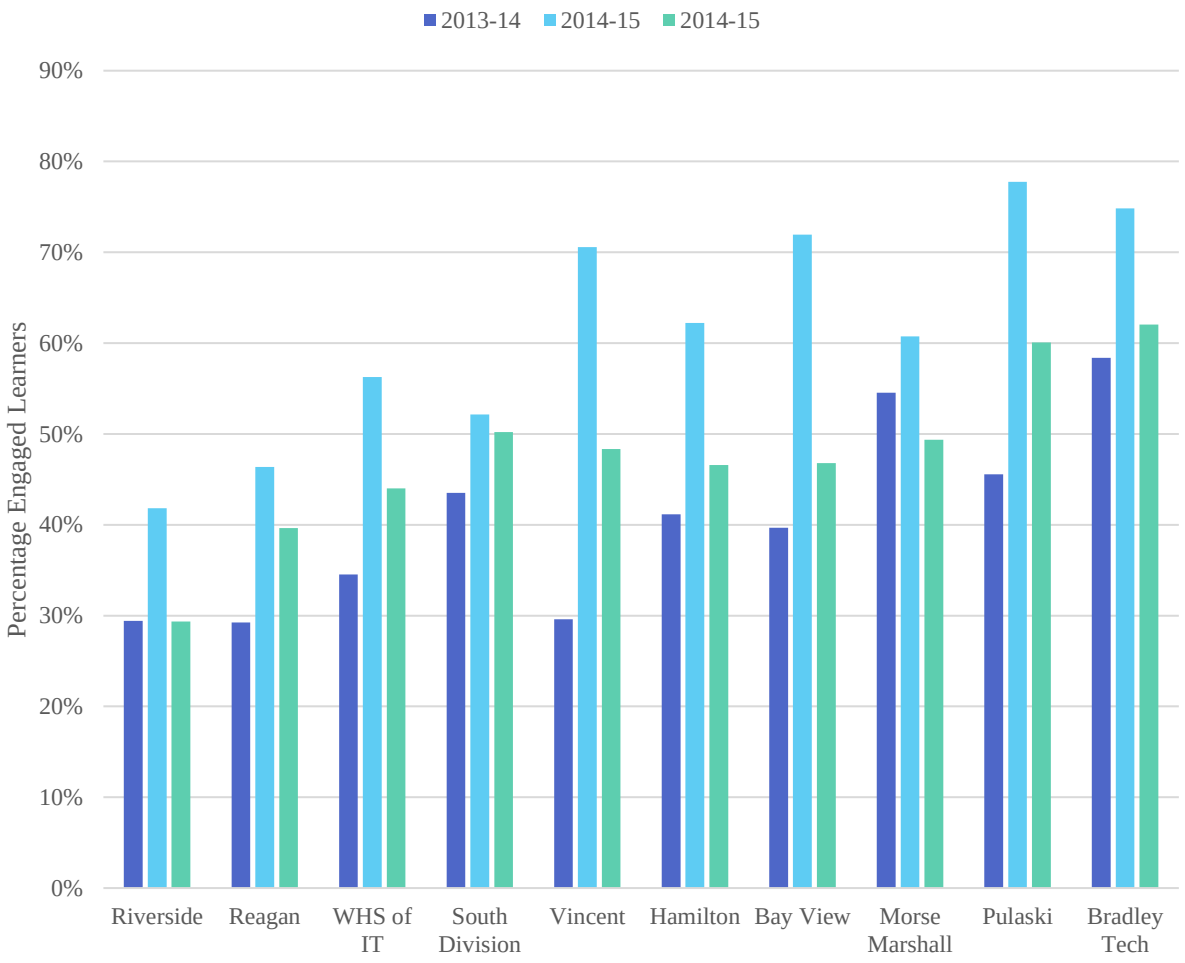
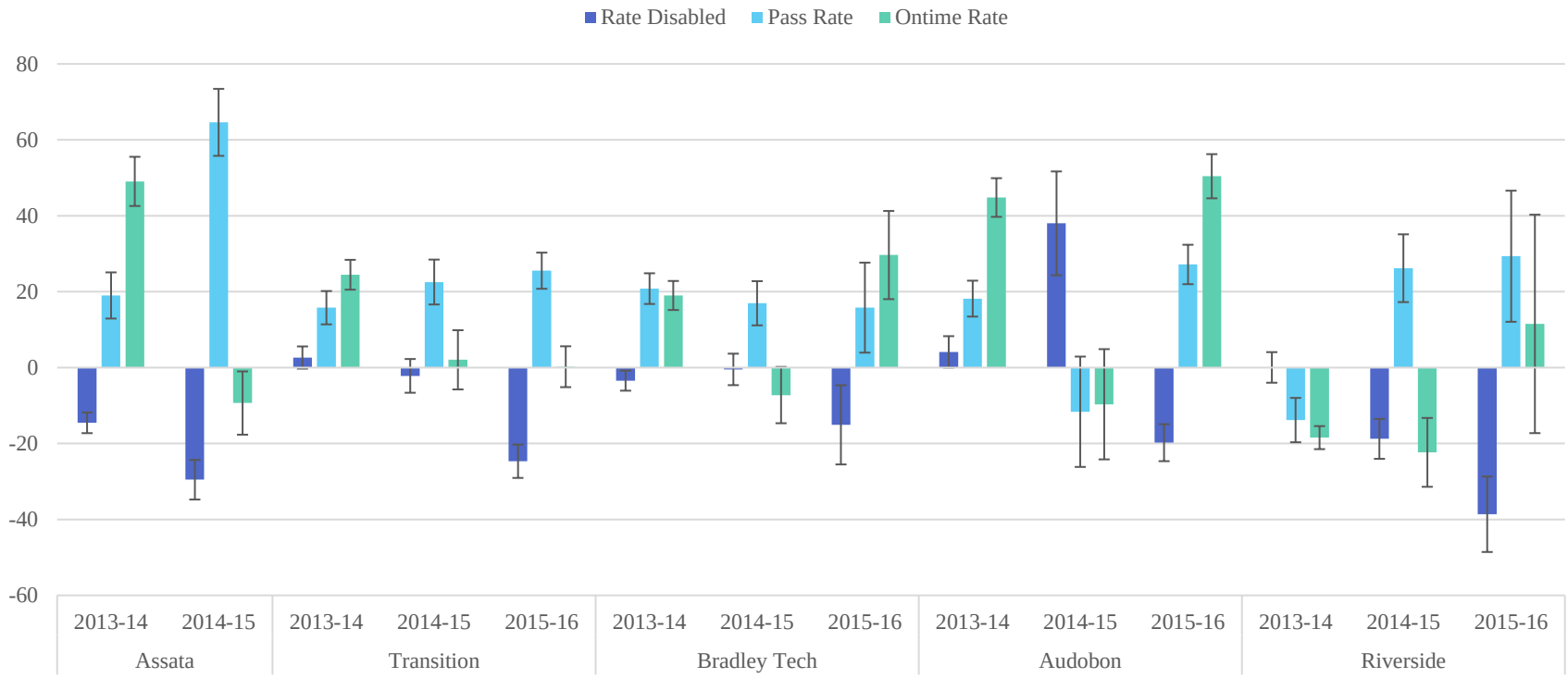


Table 8: Number of Edgenuity Students and Percentage Engaged Learners by School (2013-2016)

	2013-14		2014-15		2015-16	
	% Engaged	Total N	% Engaged	Total N	% Engaged	Total N
Hamilton HS	41%	452	62%	471	47%	393
Pulaski HS	46%	472	78%	337	60%	243
Riverside University	29%	272	42%	476	29%	293
Reagan HS	29%	311	46%	317	40%	348
Vincent HS	30%	206	71%	231	48%	389
Bradley Tech	58%	257	75%	330	62%	195
South Division HS	44%	131	52%	347	50%	229
WHS of IT	35%	333	56%	215	44%	119
Morse Marshall	55%	77	61%	275	49%	241
Bay View	40%	179	72%	139	47%	124
Transition HS	50%	108	79%	123	78%	167
Groppi HS	61%	114	63%	137	34%	126
Madison HS	57%	100	69%	84	42%	179
Audubon HS	27%	124	35%	167	16%	67
Project STAY HS	62%	89	82%	130	53%	115
Community HS	62%	102	69%	154	56%	66
North HS	75%	157	78%	64	63%	60
New School	63%	104	88%	105	72%	58
Obama SCTE	---	---	68%	120	65%	140
Wis Conservatory	14%	121	53%	83	40%	30
King HS	20%	5	53%	110	39%	107
Alliance School	52%	101	69%	26	100%	1
Transformation	66%	95	---	---	---	---
Milw HS - Arts	65%	40	69%	45	100%	1
Meir School	---	---	---	---	40%	70
Milw Excel HS	82%	55	---	---	---	---
School of CTE	59%	44	---	---	---	---
NOVA Tech	68%	40	100%	2	---	---
Alas HS	49%	39	---	---	---	---
Assata HS	93%	15	50%	2	14%	7
MacDowell	---	---	---	---	58%	24
Milw Co Youth Educ	100%	7	100%	15	100%	1
Milw Co Cyber	89%	18	---	---	100%	2
Shalom HS	60%	5	---	---	67%	3
Banner Prep School	0%	1	67%	3	67%	3

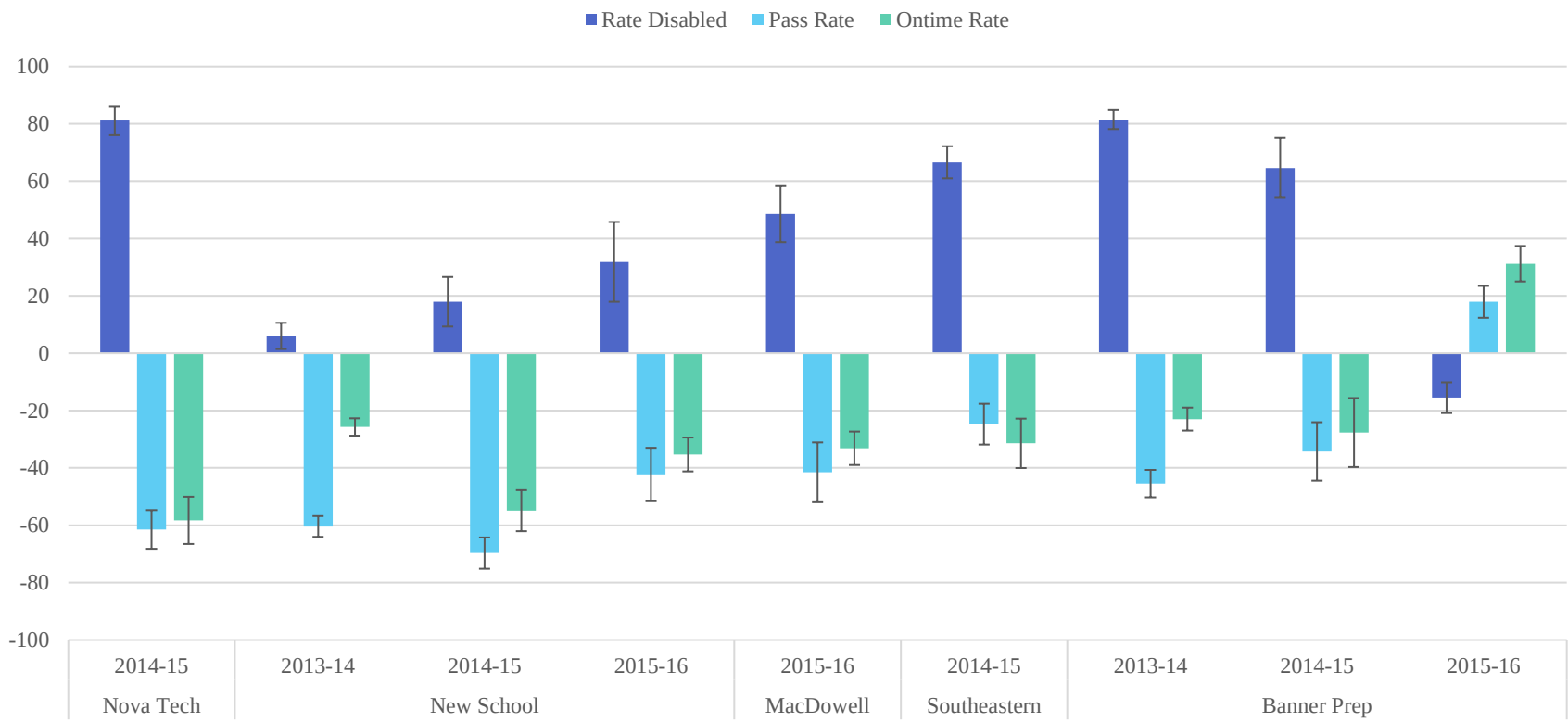
* Sorted descending by the number of students enrolled; schools with five or fewer students enrolled across all three school years excluded.

Figure 5: Edgenuity Course Performance by School Year among the Top Five Performing High Schools



Standard error bars denote statistical significance (at α=0.05); bars that cross 0 indicate the estimated effect is not statistically significant.

Figure 6: Edgenuity Course Performance by School Year among the Five Lowest Performing High Schools



Standard error bars denote statistical significance (at α=0.05); bars that cross 0 indicate the estimated effect is not statistically significant.

Information and Insights from Qualitative Analyses of Classroom Observations and Instructor Interviews

In this section of the report, we describe emerging questions from our qualitative fieldwork in Edgenuity classrooms across MPS. These questions are intended to be points of entry for conversations with MPS staff serving as Edgenuity instructors and administrators, which are drawn from our time observing Edgenuity use in MPS classrooms.

Although the data excerpts below are from the 2015-16 school year, the patterns are from interviews and observations of instructional sessions in Edgenuity across MPS. Since the 2015-16 school year, we have completed 140 observations across 19 schools in MPS, and we are currently completing analysis of observation and interview data from 2016-17. We analyze data in NVivo coding software using thematic nodes including: physical environment, curriculum, instructional model, assessment, engagement, digital citizenship, and digital tools. Triangulation across data is used to confirm the validity and reliability of the resulting analytic themes.

What does "engagement" in Edgenuity courses ideally look like?

If a student were to be actively engaged in an Edgenuity instructional session, what would it look like? Of course, there is a broad spectrum of student engagement in Edgenuity labs. There are some students who make little to no effort to engage with instruction:

> *The student did not interact much at all with the software (i.e. didn't progress through the screen). The aide checked in with her at the beginning of class and told her to get going, that "she is smart and can do it". There was no direct interaction with a teacher after that point. Student just talked to another student next to her. Student would click on a screen when the teacher walked by, otherwise would just stare at the screen and talk with her friend.*

There are others who are somewhat engaged, but in completion – not necessarily learning. We observed an important difference between active and passive engagement, where students are moving the program through but not engaged in the content. The observations suggest that many students complete Edgenuity courses, but without much engagement in the content or themes. The following example highlights how students can be involved in certain aspects of the session (e.g. taking notes), while not being engaging in the central instructional tasks:

> *She moved onto a video "Richard Wright's struggle with racism", which was five-minute video segment where the student didn't have the audio on. She only kind of watched it. It was an African American woman talking next to historical photos. Then there was a "Think about perspectives" screen with the prompt, "What might cause on individual's perspective to change over time? Check any of the boxes you agree with: The acquisition of knowledge, personal experiences, world events, changing times." The student quickly checked all four and then asked for a pass to go down to the personalized blended learning lab. She came back 8 minutes later, put headphones on and plugged them into the computers. There was a text slide, some lecturing in a small window, student can take*

notes in a small side window. The student would copy exactly what was on the slides into her notes.

And some observations highlighted how students may gain credits without much active engagement in the content:

> *The student was working on a lesson on the Mongol Empire when the observation began. The student was reading a source document and taking notes. The student entered an assessment mode (about halfway through the observation) and went to Google to search for answers to the questions. In some cases, the student copied and pasted the exact assessment question into Google to find the answers. The student was working quietly and was continuously focused on the lesson and assessment.*

What are the common goals of the Edgenuity program?

Common themes emerged in what school level staff saw as the goals of Edgenuity.

- The explicit goal was for students to *recover credit* and therefore improve their chances at graduating. This goal was written on boards in classrooms, discussed by teachers in interviews, and emphasized in how the program measures success. It should be noted that learning the content itself was often mentioned as an explicit goal.
- Interestingly, an implicit goal of the Edgenuity program emerged in that it provides *a safe space for students to be who otherwise wouldn't be in school.* This theme came out in interviews and observations, where lab instructors were managing the intersection of their classroom with the complicated lives of the students with whom they worked. In one observation, the teacher said if there is a kid making progress, she does not harass them. "This lab becomes a place for EBD (emotionally, behaviorally, disabled) students to decompress for a period so they are better able to deal with their other classes." She is fine with this as long as she isn't on the hook from administration to have them finish courses.

Given the goals of the program, what knowledge and competencies do Edgenuity lab instructors need to be effective in supporting Edgenuity use?

Edgenuity lab instructors were observed and reflected on a number of different skill sets needed to navigate the work. For example, the following two excerpts illustrate these varied roles:

> *The instructor helped the student set up an account, checking if their headphones work, answering doors and reminding students about the next day's schedule; the instructor also worked with student when they have problems with the quiz. At one point, the instructor handed out snacks for the students.*
>
> *Usually there are three instructors in the classrooms. Two are in the main room and another one sat in the second room. The instructors have administrative roles. They also help students when students voluntarily ask for checks or help with problems. One time they worked together and found that Edgenuity's supposed-to-be correct answer is not*

correct. The instructors also monitor students' progress and keep record of students' activities. Sometimes instructors walk around the room to check on students and to remind them to go back to work. Some students were playing with their cell phones during the online instruction. But the instructors cannot take them away.

In particular, instructors need capacity in the following areas:

- General tech skills to assist with internet connectivity, hardware (i.e. Chromebooks, desktops, headphones etc)

- Navigating the Edgenuity platform
    - Administrative: Enrollment process, monitoring course completing status, unlocking quizzes, etc. Instructors did note that the training by Edgenuity is an important part of capacity building in this area.
    - Instructional: Although the program is self-contained instructional module, there are times when instructors need to draw on instructional resources to fill in the gap. For example, one teacher talked about the problem of Edgenuity science classes, where they are supposed to do real, live labs. They do not have the equipment (Bunsen burner, test tubes, etc) let alone the staffing to safely have kids actually do that, so their solution is to have kids look up the labs on YouTube to watch instead.

- Providing social/emotional support for students in Edgenuity labs: Instructors talked about having to be counselors, as well as be able to make adjustments to allow for students to work around various schedules and needs. Many teachers wanted to be responsive to these needs, to develop a relationship of trust with students. For example, in one observation:

    - *The teacher is making a list of students in "the red" who probably won't be able to finish a course before the end of the semester. At the beginning of the class, the teacher talked about if they wanted to work after class they can do that on their own until 9:00 pm, they just have to email him to unlock courses .Teacher said, "Who's going to pass a class today?" He checked in with individual kids to amp up and see if they are going to be able to be productive where they are sitting. Teacher will take emails from kids until 9:00pm at night (and often much later) to unlock or progress through a course. He showed me an email from 12:30 am the previous night and said, "If kids are motivated enough to work at home the least I can do is respond."*

- Classroom management and student engagement: Many instructors talked about their primary role as motivating students to finish courses. Many created systems specific to their own classrooms to monitor, report back out to students, and create incentives for students to keep working. For example in one observation:

    The teacher worked the first 20 minutes to do individual check-ins with students about progress, redirected via verbal comments to students ("turn around", no

phones, etc); some comments to individual students were positive and encouraging, redirections were not positive. She got up twice to walk around and the rest of the time worked on her computer to update progress reports, etc.

- How to access content knowledge: In MPS, some instructors struggled to provide assistance for challenging modules, particularly modules in subjects outside their content expertise. Some schools have content teachers in the lab, with mixed success. For example, one school grouped the subjects by period so all were working on math modules that session, which allows content teachers to come down and help more kids. The role of the content teacher is to come down during their duty to provide extra instructional help to students. The lab instructors reporting that one of these content teachers is good and engaged, while another sits in the corner and works on their own stuff, and the third just gives the students the answers.

  In the absence of content teachers, teachers may have to improvise and seek outside resources to provide the student assistance.

  - *The teacher said most students have trouble with the math and science modules because they don't get the concepts, but online makes it even harder to grasp. They gave the example of a 12th grade student in a genetics module with an equation to work out. Teacher and student had to look at video lecture, then the web and YouTube to figure it out. They report getting no help from content teachers at the school.*

  - *[Student] requested assistance from the instructor in answering a question, and the instructor asked if he took notes during the course. The student replied that he just listened to the lesson, and the instructor noted that it is in the Edgenuity orientation materials that they are supposed to be taking notes. The student does not appear to have the information he needs to answer the questions. The instructor pulls up a source document on the screen (from a hyperlink) for the student to use in completing the assessment.*

Where are spaces for student-centered learning in Edgenuity?

Although we did not see many examples of Edgenuity personalizing learning for students, there certainly are aspects of the program we observed that created opportunities for *individualization*. For example:

- Pacing of coursework through the course sequence
- Opportunity to repeat sections or quizzes at the teachers' discretion
- When and where students log in and work on Edgenuity (i.e. at home or school)

Observing accommodations made for students with disabilities is challenging, but instructors did give us some insight into the kinds of adjustments they can make. For example, one teacher described a student who is in special education and it worked well for him. The teacher prints the transcripts of the videos and then has him highlight instead of writing. She also mentioned that some special education students work on Edgenuity with their IEP teacher in their resource room

and then call up with tech questions. This level of accommodation is entirely up to the lab instructors to manage, and does not appear to be embedded into the Edgenuity system itself.

What are important structural issues in implementation of Edgenuity?

Technology itself
Approximately 90% of Edgenuity sessions observed in 2015-16 had no technical problems in terms of internet connectivity or software. When there are problems with technology, it tended to be slow loading of video lectures.

Very few of the classrooms observed universally provided *headphones* to students, and when they did it was because the instructor purchased them with personal funds. For example, one teacher spent about $130 per year buying ear buds for students. Otherwise, students brought their own or listened at a very low volume through the computer speakers.

Type of classroom set-up
Some classrooms were very crowded with students right next to one another at long rows of tables, while others purposely had students spread out with seats or partitions between them. Edgenuity instructors did not have much control over how many students were placed with them during any one period. We observed a wide variety of ways in which schools arranged space and infrastructure for Edgenuity use. Many used desktop computers lined up along tables or in pods of tables. Some schools have Chromebook carts, so students could sit in alternative seating (e.g. floor, couch, bean bag etc). One teacher described the purposeful set up of her room. She designed the lab so that she can see all the monitors from her desk and can use LanSchool [Classroom Management Software], e.g., from her own device, she can log into one of the student's desktops and see a screen shot of their desktop at that moment).

Concluding Notes

As this report suggests, Edgenuity is being enacted in MPS by instructors and students in a variety of ways that vary both across and within schools and over time. Our analyses show some clear associations between how Edgenuity is being used and student academic outcomes, as well as changes in these relationships over time that appear to be responsive to MPS policy actions. We look forward to discussing these findings with MPS staff and to continuing to explore your questions about student Edgenuity use and educational outcomes over time.

Appendix

Table A.1: MPS Student Characteristics	**2013-14**		**2014-15**		**2015-16**	
	All MPS High School Students	MPS-Edgenuity Linked Records	All MPS High School Students	MPS-Edgenuity Linked Records	All MPS High School Students	MPS-Edgenuity Linked Records
Total number of students	20,984	4,676	20,581	5,175	21,922	4,976
Asian	0.06	0.02	0.06	0.02	0.06	0.02
Black	0.62	0.68	0.62	0.66	0.60	0.68
Hispanic	0.20	0.20	0.20	0.22	0.22	0.20
White	0.10	0.10	0.12	0.08	0.10	0.08
Other race	0	0	0	0	0	0
Female	0.48	0.46	0.48	0.46	0.48	0.46
English language learner	0.08	0.06	0.08	0.06	0.08	0.04
Free lunch-eligible	0.78	0.82	0.82	0.86	0.73	0.75
Student with special needs	0.22	0.22	0.22	0.22	0.22	0.24
Percent of days absent	0.18	0.22	0.17	0.20	0.20	0.26
Average Test Score-Fall Math	222.13	218.95	216.72	216.30	727.58	714.81
Average Test Score-Fall Reading	214.99	213.04	209.90	209.49	677.78	656.32
Average Test Score-Winter Math	222.99	219.35	217.65	217.23	737.27	714.03
Average Test Score-Winter Reading	215.15	212.69	210.21	209.70	695.74	637.78
Average Test Score-Spring Math	224.36	220.28	219.49	217.13	738.54	716.80
Average Test Score-Spring Reading	216.04	213.20	210.73	208.62	669.80	636.41

Appendix

TABLE A.2: EDGENUITY PARTICIPANTS	**2013-14**			**2014-15**			**2015-16**		
NAME OF HIGH SCHOOL	Total # of students	Edgenuity users (%)	% of all Edgenuity users	Total # of students	Edgenuity users (%)	% of all Edgenuity users	Total # of students	Edgenuity users (%)	% of all Edgenuity users
COMMUNITY H.S.	242	42.56	0.5%	245	68.16	0.8%	257	36.19	0.4%
REAGAN H.S.	1227	30.40	1.8%	1267	32.28	2.1%	1329	31.30	2.0%
BAY VIEW MIDDLE & H.S.	727	26.27	0.9%	822	19.95	0.8%	962	14.97	0.7%
BRADLEY TECHNOLOGY AND TRADE	1041	27.47	1.3%	889	39.37	1.8%	918	25.82	1.1%
HAMILTON H.S.	1690	26.75	2.1%	1688	28.73	2.4%	1822	22.89	2.0%
GROPPI H.S.	248	52.42	0.6%	245	64.90	0.8%	247	62.75	0.7%
KING IB SCHOOL	1482	0.34	0.0%	1477	7.58	0.6%	1467	16.84	1.2%
NORTH H.S.	507	29.78	0.7%	518	14.48	0.4%	562	13.35	0.4%
PULASKI H.S.	1345	37.62	2.4%	1147	31.91	1.8%	1094	29.98	1.6%
NEW SCH FOR COMMUNITY SERVICE	167	67.66	0.5%	159	69.18	0.6%	194	38.66	0.4%
RIVERSIDE UNIVERSITY H.S.	1593	17.70	1.3%	1592	34.74	2.8%	1562	34.06	2.5%
SOUTH DIVISION H.S.	1191	12.51	0.7%	1323	26.46	1.8%	1524	20.21	1.5%
VINCENT H.S.	1314	16.13	1.0%	1393	18.09	1.3%	1350	30.96	2.0%
ALAS H.S.	246	18.29	0.2%						
MILW H.S. - ARTS	947	4.86	0.2%	934	5.03	0.2%	940	0.64	0.0%
WHS OF INFORMATION TECHNOLOGY	797	45.42	1.7%	711	39.52	1.4%	696	19.83	0.7%
ALLIANCE SCHOOL	159	86.16	0.6%	177	41.81	0.4%	199	4.02	0.0%
MORSE - MARSHALL	786	10.81	0.4%	810	35.06	1.4%	864	30.09	1.2%
MADISON ACADEMIC H.S.	998	12.83	0.6%	870	10.00	0.4%	860	23.14	0.9%
MILW SCH. OF LANGUAGES	561	0.18	0.0%	569	0.18	0.0%	592	0.51	0.0%
TRANSITION H.S.	122	93.44	0.5%	161	87.58	0.7%	209	86.60	0.9%
AUDUBON H.S.	337	38.58	0.6%	353	51.56	0.9%	368	49.46	0.9%
SCH. OF CAREER & TECH ED	443	10.38	0.2%						

Appendix

(TABLE A.2 (CONT.) NAME OF HIGH SCHOOL	Total # of students	Edgenuity users (%)	% of all Edgenuity users	Total # of students	Edgenuity users (%)	% of all Edgenuity users	Total # of students	Edgenuity users (%)	% of all Edgenuity users
TRANSFORMATION LEARNING COMM	132	77.27	0.5%						
OBAMA SCTE				430	28.14	0.6%	470	49.79	1.1%
MEIR SCHOOL							241	29.46	0.3%
MACDOWELL MONTESSORI	163	1.84	0.0%	160	0.63	0.0%	199	13.07	0.1%
WISCONSIN CONSERVATORY	246	53.66	0.6%	253	46.64	0.6%	230	19.13	0.2%
LAD LAKE SYNERGY	56	1.79	0.0%	22	4.55	0.0%	47	6.38	0.0%
MILW CO YOUTH EDUC. CENTER	31	22.58	0.0%	41	58.54	0.1%	68	8.82	0.0%
ASSATA	128	11.72	0.1%	119	1.68	0.0%	138	5.80	0.0%
CYD SCH. OF EXCELLENCE	32	3.13	0.0%			0.0%			
MATC EMERGING SCHOLARS PROGRAM	63	1.59	0.0%	51	3.92	0.0%			
BANNER PREP SCHOOL OF MILW	29	3.45	0.0%	62	4.84	0.0%	79	6.33	0.0%
GRANDVIEW H.S.	221	0.45	0.0%				270	1.11	0.0%
SHALOM H.S.	110	4.55	0.0%				120	3.33	0.0%
ST CHARLES - DTC							29	6.90	0.0%
ACHIEVEMENT CENTER				40	2.50	0.0%			
NOVA HS/MS	105	42.86	0.2%	103	0.97	0.0%			
PROJECT STAY	271	35.42	0.5%	200	64.00	0.6%	238	51.26	0.6%
NOVA TECH				98	1.02	0.0%			
UNIVERSAL ACADEMY							142	0.70	0.0%
MILW COMMUNITY CYBER	199	11.06	0.1%				215	1.40	0.0%
MILW EXCEL H.S.	131	45.04	0.3%						
CARMEN NORTHWEST CAMPUS							348	0.29	0.0%
HMONG AMERICAN PEACE ACAD				256	0.39	0.0%			
CARMEN SOUTH CAMPUS	325	0.31	0.0%						
RESIDENTIAL CARE CENTER				35	2.86	0.0%			

Appendix

Table A.3: Course-Taking Behaviors by User Type (2015-16)

	Nominal Exerters (N=496,942)		Moonlighters (N=205,393)		Engaged Learners (N=581,394)	
	Mean	SD	Mean	SD	Mean	SD
Course Duration (Minutes)	5,778.86	3,514.69	7,378.86	4,679.10	7,957.66	5,724.93
Completed Activities (Per Day)	3.85	4.73	5.84	7.89	6.66	8.92
Session Time (Minutes)	70.37	63.47	102.76	92.6	114.68	84.96
Idle/Session Time Ratio	0.16	0.21	0.17	0.22	0.15	0.19
Number of Sessions (Per Course)	74.25	43.85	58.18	43.18	36.70	22.28
Number of Courses	2.09	1.18	3.37	2.35	4.65	3.62
Percentage Night School	3.85	19.24	82.53	37.97	2.92	16.85

Table A.4: Course Subject by User Type (2015-16)

	Minimal Exerters (N=496,942)		Moonlighters (N=205,393)		Engaged Learners (N=581,394)	
	Mean	SD	Mean	SD	Mean	SD
Percentage Math	21.61	41.16	20.46	40.34	17.72	38.18
Percentage LA	18.99	39.22	19.32	39.48	20.31	40.23
Percentage Science	14.29	35.00	14.69	35.40	13.63	34.31
Percentage SS	26.39	44.08	20.97	40.71	22.64	41.85
Percentage Elective	18.71	39.00	24.57	43.05	25.70	43.7

Table A.5: Student Characteristics by User Type (2015-16)

	Minimal Exerters (N=1,631)		Moonlighters (N=617)		Engaged Learners (N=2,293)	
	Mean	SD	Mean	SD	Mean	SD
Percentage Absent	22.57	19.76	26.73	22.44	31.27	23.50
Percentage Special Education	24.86	43.24	17.19	37.76	26.69	44.25
Percentage English Language Learner	4.85	21.49	3.43	18.21	4.42	20.57
Percentage Free/reduced lunch	77.16	41.99	70.36	45.71	78.00	41.44
Percentage Female	43.78	49.63	52.15	50.00	43.21	49.55
Percentage Black	66.92	47.07	64.26	47.97	71.36	45.22
Percentage Hispanic	19.89	39.93	24.02	42.76	19.22	39.41
Percentage White	8.63	28.09	9.18	28.90	6.71	25.03
Percentage 9th Grade	21.27	40.94	17.19	37.76	25.45	43.57
Percentage 10th Grade	25.28	43.47	21.88	41.38	21.39	41.01
Percentage 11th Grade	31.01	46.27	34.18	47.48	33.35	47.16
Percentage 12th Grade	22.44	41.74	26.76	44.31	19.82	39.87
Standardized Fall MAP Reading SS	-0.13	0.94	0.01	0.91	-0.15	0.90
Standardized Fall MAP Math SS	-0.22	0.97	0.00	0.83	-0.23	1.00

Appendix

Table A.6: Course-Taking Behaviors by User Type (2014-15)

	Dedicated Strugglers (N=364,370)		Moonlighters (N=303,510)		Engaged Learners (N=887,467)	
	Mean	SD	Mean	SD	Mean	SD
Course Duration (Minutes)	5,897.95	4,094.71	7,703.49	5,251.31	7,019.93	5,682.68
Completed Activities (Per Day)	3.25	4.89	5.42	9.02	5.13	8.56
Session Time (Minutes)	108.94	112.57	174.17	157.46	145.41	124.59
Idle/Session Time Ratio	0.19	0.20	0.20	0.21	0.18	0.19
Number of Sessions (Per Course)	105.22	66.14	71.33	63.33	45.11	30.89
Number of Courses	1.83	1.22	3.24	2.38	3.96	3.38
Percentage Night School	4.05	19.71	81.28	39.01	2.96	16.95

Table A.7: Course Subject by User Type (2014-15)

	Dedicated Strugglers (N=364,370)		Moonlighters (N=303,510)		Engaged Learners (N=887,467)	
	Mean	SD	Mean	SD	Mean	SD
Percentage Math	16.36	36.99	15.84	36.51	17.99	38.41
Percentage LA	20.03	40.02	19.87	39.90	19.27	39.44
Percentage Science	16.81	37.39	15.83	36.50	14.08	34.78
Percentage SS	16.32	36.95	17.54	38.03	19.50	39.62
Percentage Elective	30.49	46.04	30.92	46.22	29.16	45.45

Table A.8: Student Characteristics by User Type (2014-15)

	Dedicated Strugglers (N=1,146)		Moonlighters (N=896)		Engaged Learners (N=3,572)	
	Mean	SD	Mean	SD	Mean	SD
Percentage Absent	18.37	17.03	16.31	16.74	22.00	20.02
Percentage Special Education	24.14	42.82	15.87	36.56	20.76	40.57
Percentage English Language Learner	6.97	25.48	5.61	23.02	6.37	24.43
Percentage Free/reduced lunch	85.96	34.76	83.45	37.19	87.37	33.23
Percentage Female	47.11	49.94	50.27	50.03	45.30	49.79
Percentage Black	60.76	48.85	61.16	48.77	70.42	45.65
Percentage Hispanic	26.69	44.26	23.66	42.53	19.03	39.26
Percentage White	8.57	28.00	11.02	31.34	7.41	26.20
Percentage 9th Grade	28.48	45.16	18.60	38.94	22.30	41.63
Percentage 10th Grade	29.90	45.80	22.98	42.10	23.62	42.48
Percentage 11th Grade	30.20	45.94	31.33	46.41	32.00	46.65
Percentage 12th Grade	11.41	31.81	27.09	44.47	22.08	41.49
Standardized Fall MAP Reading SS	-0.06	0.93	0.00	0.95	-0.10	0.96
Standardized Fall MAP Math SS	-0.13	0.88	-0.04	0.95	-0.10	0.90

Appendix

Table A.9: Course-Taking Behaviors by User Type (2013-14)

	Dedicated Strugglers (N=86,662)		Nominal Exerters (N=632,415)		Moonlighters (N=258,121)		Engaged Learners (N=531,976)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Course Duration (Minutes)	4,182.47	3,148.07	7,813.18	5,710.25	8,306.99	5,919.75	8,312.36	7,258.04
Completed Activities (Per Day)	2.63	4.43	4.28	6.74	6.52	10.86	6.55	11.62
Session Time (Minutes)	89.29	56.98	107.64	59.85	144.27	75.08	138.78	74.96
Idle/Session Time Ratio	0.26	0.25	0.22	0.21	0.24	0.23	0.25	0.23
Number of Sessions (Per Course)	76.18	60.16	76.34	51.87	63.31	52.33	37.66	29.36
Number of Courses	1.70	1.09	2.81	2.14	3.60	2.75	4.93	4.40
Percentage Night School	11.37	31.75	3.46	18.27	84.83	35.88	2.74	16.32

Table A.10: Course Subject by User Type (2013-14)

	Dedicated Strugglers (N=86,662)		Nominal Exerters (N=632,415)		Moonlighters (N=258,121)		Engaged Learners (N=531,976)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Percentage Math	27.49	44.65	18.12	38.52	12.09	32.6	13.64	34.32
Percentage LA	16.11	36.76	18.17	38.56	19.54	39.65	21.83	41.31
Percentage Science	17.5	38	13.97	34.66	11.28	31.64	12.66	33.25
Percentage SS	22.66	41.86	21.73	41.24	21.91	41.37	18.89	39.14
Percentage Elective	16.25	36.89	28.01	44.91	35.17	47.75	32.98	47.02

Appendix

Table A.11: Student Characteristics by User Type (2013-14)

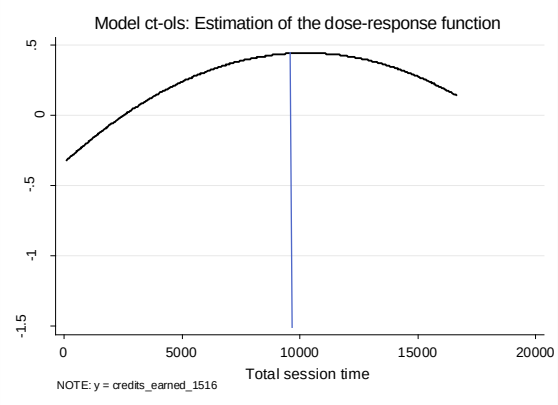
	Dedicated Strugglers (N=512)		Nominal Exerters (N=1,653)		Moonlighters (N=701)		Engaged Learners (N=2,523)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Percentage Absent	15.26	15.68	19.99	17.51	18.48	17.93	25.22	21.85
Percentage Special Education	23.64	42.53	22.14	41.53	15.94	36.65	22.22	41.58
Percentage English Language Learner	6.36	24.44	4.97	21.74	6.10	23.96	4.94	21.67
Percentage Free/reduced lunch	83.64	37.04	81.55	38.80	75.79	42.88	82.83	37.73
Percentage Female	45.68	49.87	47.36	49.95	49.41	50.05	45.27	49.79
Percentage Black	64.09	48.03	64.98	47.72	65.35	47.63	72.06	44.88
Percentage Hispanic	23.86	42.67	21.91	41.38	20.87	40.68	17.75	38.22
Percentage White	8.86	28.45	9.26	29.00	10.04	30.08	8.14	27.35
Percentage 9th Grade	42.27	49.46	20.63	40.48	16.34	37.01	24.42	42.97
Percentage 10th Grade	30.00	45.88	23.34	42.32	20.28	40.24	22.74	41.93
Percentage 11th Grade	25.23	43.48	35.92	47.99	38.39	48.68	33.77	47.31
Percentage 12th Grade	2.50	15.63	20.11	40.09	25.00	43.34	19.07	39.29
Standardized Fall MAP Reading SS	0.02	0.83	-0.16	0.87	-0.02	0.89	-0.26	0.94
Standardized Fall MAP Math SS	-0.03	0.85	-0.22	0.81	-0.11	0.89	-0.32	0.86

Appendix

Figure A.1: Dose-response Estimation of the Relationship between Total Session Duration and Credits Earned

Relationship between total session time in the academic year and credits earned (student level analysis)

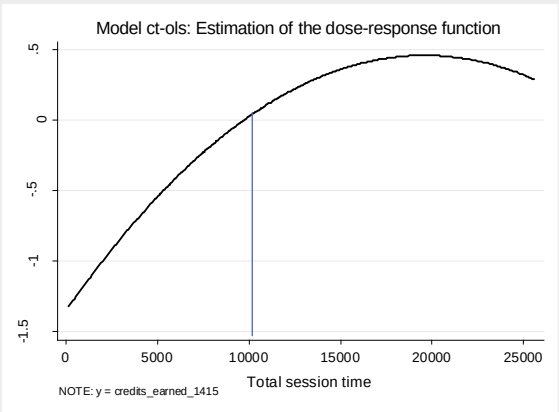
2015-16 (n=12,927)



Mean total session time = 6,873 minutes

Mean total idle time = 1,192 minutes

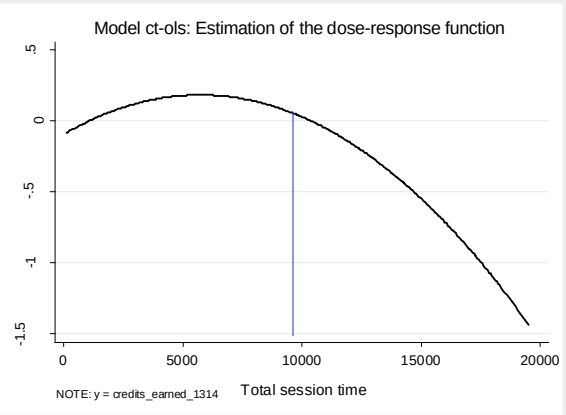
2014-15 (n=12,641)



Mean total session time = 6,966 minutes

Mean total idle time = 1,287 minutes

2013-14 (n=9,841)



Mean total session time = 8,025 minutes

Mean total idle time = 5,437 minutes

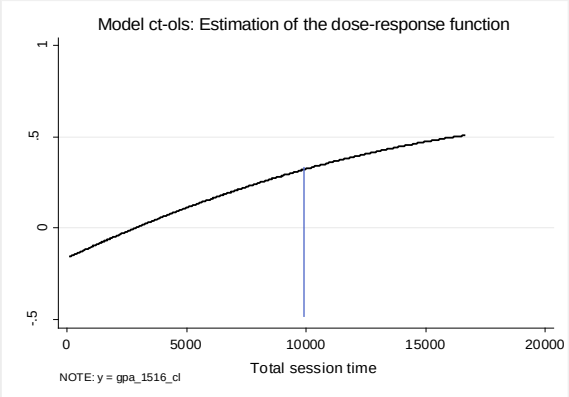
Note: estimated change in credits is in comparison to non-Edgenuity users.

Appendix

Figure A.2: Dose-response Estimation of the Relationship between Total Session Duration and Grade Point Average (GPA)

Relationship between total session time in the academic year and GPA

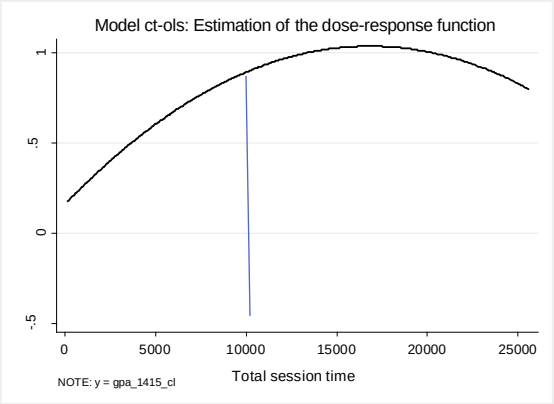
2015-16 (n=13,947)



Mean total session duration = 6,873 minutes

Mean total idle time = 1,192 minutes

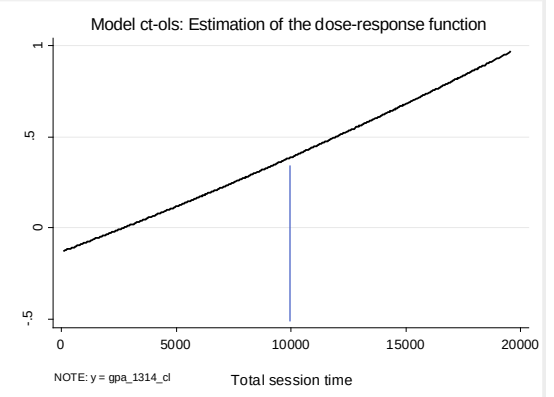
2014-15 (n=13,215)



Mean total session duration = 6,966 minutes

Mean total idle time = 1,287 minutes

2013-14 (n=13,807)



Mean total session duration = 8,025 minutes

Mean total idle time = 5,437 minutes

Note: estimated change in GPA is in comparison to non-Edgenuity users.