

LOCUS Evaluation Report

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LOCUS is an NSF funded project¹ that used an evidence-centered design process to develop assessments of statistical understanding based on the *Guidelines for Assessment and Instruction in Statistics Education (GAISE) Report: A Pre-K-12 Curriculum Framework*. Multiple forms were developed at both Beginning/ Intermediate and Intermediate/ Advanced levels to address the four aspects of statistical problem solving described in GAISE: Formulating statistical questions, Collecting data, Analyzing data, and Interpreting results. The target populations for the assessments are students in grades 6 to 12 including AP Statistics, as well as students in college level introductory statistics courses, and both preservice and in-service teachers. The project also developed a website that supported users to administer assessments, and provided professional development materials for educators to appreciate the nature of statistical understanding under GAISE and how the LOCUS assessments address that. The evaluation of LOCUS focused on use of the website.

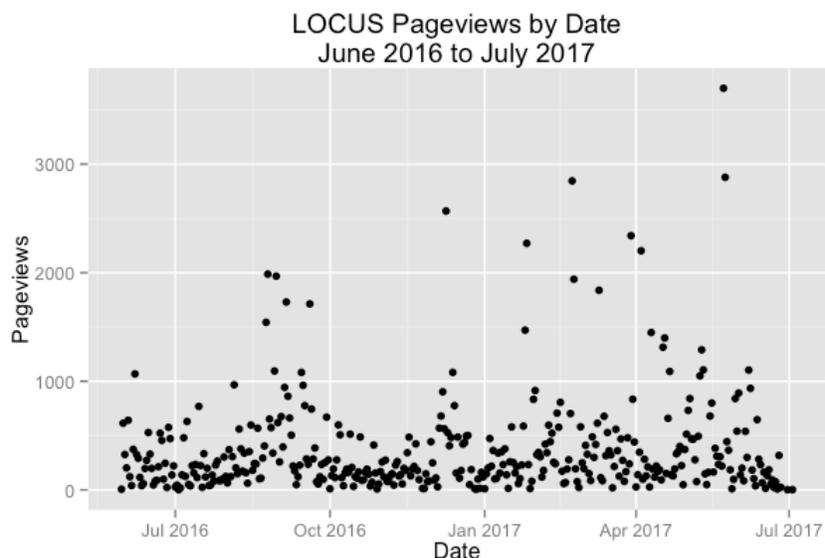
There are three sources of data that contribute to this report on user experience with the LOCUS website:

- Analytics – The project team set up analytics on the LOCUS website to track user behavior starting on 30 May 2016, though the website was up and running well before that, and some of the survey and interview responses come from users who interacted with the site before the date when analytics were fully installed.
- Survey responses – A sidebar pop-up appeared between 1 and 3 minutes of user interaction with the LOCUS website, asking people to complete a short survey. The survey asked about purposes for using the website, satisfaction in accomplishing those purposes, some background/ demographic information, and willingness to be contacted for an interview.
- Interviews – We contacted those who had said they were willing to be interviewed to gather more detailed information about their experiences on the website and their impressions of its value.

Overall Analytics

The following analyses cover the time period from 30 May 2016 through 4 July 2017. Of these 399 days, there were page views on 393 of them (days with no page views included Thanksgiving (11/24) and Christmas (12/25) days in 2016, and a few days towards the end of the analytic period (6/27-29 and 7/1-2/2017). Number of page views per day is skewed right, with median views per day of 224, mean of 373, IQR from 113 to 472, and a maximum of 3699 page views on May 23, 2017. (Log transforming normalizes the distribution, with untransformed mean of 205.1 and 1 SD range around the mean of 60.9 to 690.4). Graphing page views by date, we see some variability amidst a fairly steady stream of traffic:

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Several identifying tags were created to track both logged in users (ID1), and those identified by anonymous cookies (ID2).² The latter are device and browser specific, so it's possible for the same user to be identified with a number of different ID2s, but when the user also has a logged in ID1, we can link ID2s that have ever been associated with that ID1. While most ID1s are associated with only a single ID2 (median = 1, mean =1.8) there are 64 ID1s with multiple ID2s, some with as many as 27 of them! There was only one case where the same ID2 was associated with two different ID1s, but only for one 3 minute interval. The second ID1 has several ID2s associated with it, so we chose to associate the overlapping ID2 with the first ID1.

There were a few individual users – Tim Jacobbe and Eric Hochberg – that we decided to try to identify and exclude from analyses. Eric was easy, as his ID1 (50644) and several ID2s were recorded on the survey. Tim was harder as he never took the survey, but one user (ID1 = 52) who logged in from Gainesville, FL had an unusual pattern of 151 sessions from 14 different log in locations including several to which Tim has travelled in the course of the project (Atlanta, Charleston, Chicago, Columbia, SC, Gainesville, Jacksonville, Montgomery/ Selma, New Orleans, Orlando/Daytona Beach/ Melbourne, San Antonio, Seattle/Tacoma, Tulsa, Washington DC/ Hagerstown MD, West Palm Beach/ Pierce FL). Based on this, we excluded ID1 = 52 from further analyses.

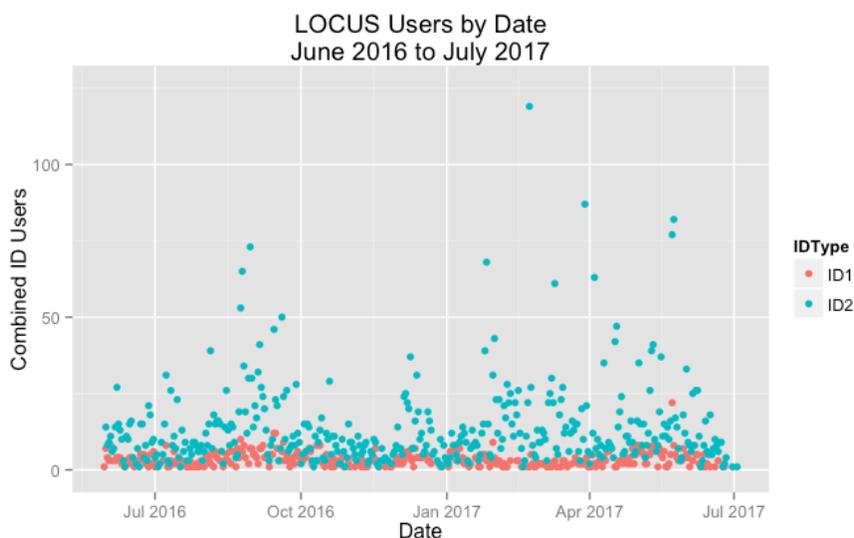
Days and Time on Site

The number of unique users on each day ranged from 1 to 120 (on 22 Feb 2017) with median of 12 unique users, mean of 16.3 and IQR of 7 to 20 users. ID1-identified users (who had created a log in, even if not currently logged in) were on the LOCUS site 335 of the 399 days, with a range of 1 to 22 (on 23 May 2017) users per day (median of 3 unique ID1 users). Users who only had ID2 identifiers were on the site 389 of the 399 days, with mean of 13.5 ID2 users per day (median 9 users). A table of descriptive statistics and a graph with separate values for ID1 and ID2 users is below.

² Analytics were set up with two different “Profiles.” We sorted through these to see if there were redundancies, or other reasons to include or exclude one or the other from our analyses. In the end, it seems that one of the profiles was primarily used by developers and doesn't include additional useful information.

Users Per Day on the LOCUS site by Identifier Type

ID Type	N days	Mean	sd	min	Q1	median	Q3	max
ID1	335	3.43	2.39	1	2	3	5	22
ID2	389	13.50	13.79	1	6	9	16	119



There are 4335 users who were only identified by an ID2 identifier. The vast majority, 3774 of these (86%), only logged onto the site on a single day, with only a handful logging on for more than 5 days, with distribution of number of days for other users as follows:

Days Spent on the LOCUS site by Identifier Type (% of users by ID Type)

ID Type	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	> 15 days
ID1	54 (27%)	29 (15%)	35 (18%)	15 (8%)	13 (7%)	6 (3%)	7 (4%)	1 (1%)	3 (2%)	6 (3%)	2 (1%)	5 (3%)	2 (1%)	3 (2%)	3 (2%)	15 (8%)
ID2	3744 (86%)	424 (10%)	110 (3%)	22 (1%)	14 (0%)	8 (0%)	4 (0%)	0 (0%)	2 (0%)	3 (0%)	1 (0%)	2 (0%)	1 (0%)	0 (0%)	0 (0%)	0 (0%)

The 199 ID1 logged in users were on the site an average (mean) of 5.8 different days (median of 3) though 54 of these folks who took the time to create a log in were only on the site during a single day. While it's no surprise that the vast majority of those who didn't create a log in (ID2-identified users) only visited the site for a single day, the majority of even the more committed logged in (ID1-identified) users didn't come back to the site more than 3 different days. Not surprisingly, non-parametric statistical tests show significant differences in the shape of the distribution of the number of separate days on which ID1 and ID2-identified users logged in (Wilcoxon rank sum $W=713435$, $p<.0001$).

Distribution of Days Spent on the LOCUS site by Identifier Type

ID Type	n	mean	sd	min	Q1	median	Q3	max
ID1	199	5.77	8.09	1	1	3	6	53
ID2	4335	1.22	0.73	1	1	1	1	13

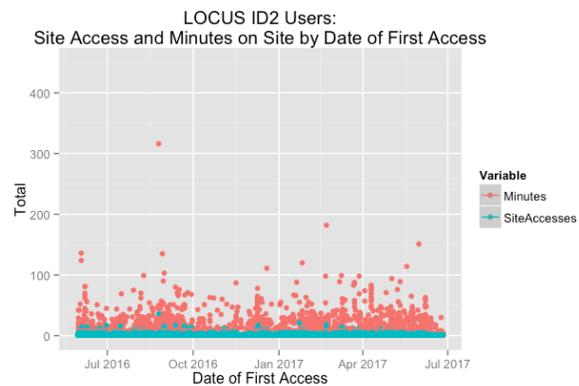
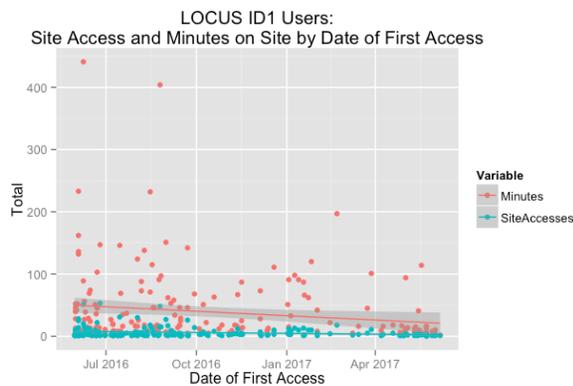
The 4335 ID2-only users logged in an average (mean) of 1.2 times with a maximum of 13 logins, but the vast majority logging in only 1 time. These users spent a median of 3 minutes on the site (mean = 10.1) with 1280 (29.5%) spending over 15 minutes, 314 (7.2%) spending over 30 minutes, and just 35 of them (0.8%) spending over an hour on the site.

Distribution of Total Minutes Spent on the LOCUS site by Identifier Type

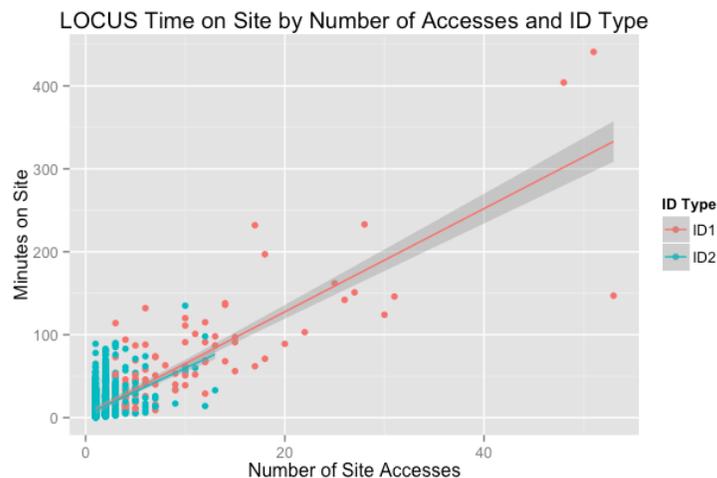
IDType	n	mean	sd	min	Q1	median	Q3	max
ID1	199	39.00	58.29	1	7.5	16	48.5	441
ID2	4335	10.12	12.91	1	1.0	3	19.0	135

The 199 ID1-identified users logged in an average (mean) of 5.8 times (median 3, maximum 53) and spent a mean of 39.0 minutes on the site (median 16 minutes). These were more committed users, with 101 (50.8%) spending more than 15 minutes; 68 (34.2%) spending more than 30 minutes; and 42 (21.1%) spending over an hour on the site.

There is a small but statistically significant relationship between when ID1 users initially logged onto the LOCUS website, and their total number of logins ($\beta = -0.0149$, $t=3.23$, $p=.0015$) as well as their total time on site ($\beta = -0.0775$, $t=2.31$, $p=.022$). For ID2 users, number of logins is statistically significant ($\beta = -0.0007$, $t=4.11$, $p<.0001$) but practically insignificant, with a difference of less than 1 login for those who started a year later; there is no statistically significant difference in total minutes on the site for ID2s by when they first logged in.



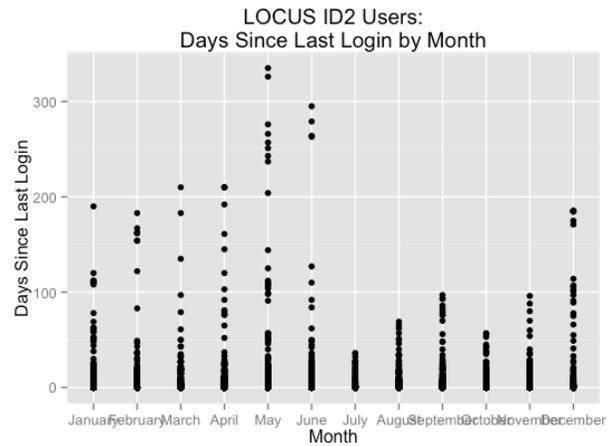
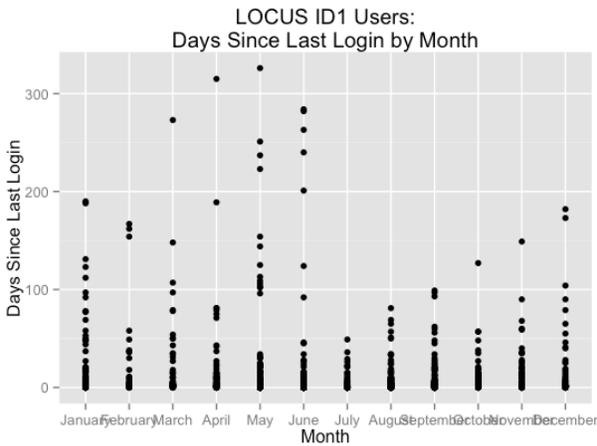
As users access the LOCUS website more often, their total time active on the site (minutes in which the site recorded some action for them) increases (mean 6.13 minutes per time accessing the LOCUS site). A model with an Accesses x ID Type interaction term suggests that ID1 users spend an additional 6.22 minutes per time accessing LOCUS, and ID2 users spend an additional 5.62 minutes per access and this difference is significant ($t=1.98$, $p=.048$). However, model diagnostics suggest that the three ID1 users with over 40 logins highly influence this finding, and removing them eliminates the user type difference.



We looked at whether the time lag between logins for ID1 identified users varies by month of the year. For logged in ID1 identified users, there is an overall significant difference ($F(df=11, 1136)=2.07, p=.020$) with users coming back more frequently during the summer and early school year (July through October), suggesting they may be preparing assessments to administer during the school year, though there are no differences by month in time spent on the site. For ID2 identified users, there is also an overall significant difference in number of logins ($F(df=11, 6453)=4.18, p<.0001$) as well as in minutes per month ($F(df=11, 6453)=26.92, p<.0001$) with some month-to-month significant differences in both (as determined by a Tukey Honest Significant Differences test).

Time on site and days since last log in by calendar month and identifier type

Month	Avg Days Since Last Access	
	ID1	ID2
January	17.81	14.94
February	24.50	18.79
March	26.35	13.01
April	21.40	18.31
May	21.78	22.87
June	20.70	16.80
July	9.18	7.81
August	10.53	9.00
September	10.28	10.59
October	9.00	8.60
November	18.94	16.44
December	17.00	29.85
Overall	16.67	15.68



Log in locations

Users of the LOCUS site came from a wide variety of geographic locations. The Google Analytics “regions” for ID1 identified users includes 38 of the 50 US States, Puerto Rico and the District of Columbia, and 9 regions in foreign countries. (Appendix A shows the location of ID1 identified users by Google Analytics “Metro regions.”)

Google Analytics identified “regions” for ID1 identified LOCUS site users

region	N ID1s	region	N ID1s	region	N ID1s	region	N ID1s
California	43	Maryland	7	Minnesota	3	Maine	1
Florida	24	Texas	6	South Carolina	3	Montana	1
New York	19	Michigan	5	Arizona	2	New Hampshire	1
Georgia	17	Ohio	5	Arkansas	2	Oklahoma	1
Illinois	15	Virginia	5	Idaho	2	Ontario	1
Massachusetts	11	Alabama	4	Louisiana	2	Oregon	1
Washington	11	Colorado	4	Mississippi	2	Provence-Alpes-Cote d'Azur	1
North Carolina	9	Kentucky	4	Nevada	2	San Juan	1
Wisconsin	9	Missouri	4	Utah	2	Shanghai	1
Indiana	8	Tennessee	4	Bavaria	1	Shiga Prefecture	1
New Jersey	8	(not set)	3	Kansas	1	Tianjin	1
Pennsylvania	8	Connecticut	3	Lucerne	1	Utrecht	1
		District of Columbia	3			Zeeland	1

Referring Sites

LOCUS users found their way to the site in a variety of ways. There were 395 URLs that “referred” users to LOCUS, with associated number of users, number of sessions, and number of page views as listed below. Half (50%) of those who came to the LOCUS site did so by directly entering the LOCUS URL. Another 21% used one of several search engines – Google, Bing, and Yahoo as well as minor sites such as DuckDuckGo, AOL, Ask, Baidu and Ecosia. For organizations or institutions, or institution types that seemed to have many referrals, we aggregated all the separate pages and summarize in the table on the following page. These 20 sites and site types, in addition to direct access, account for 97.5% of all the referrals to the LOCUS site. There are some specific colleges, school districts, websites, and other institutions who seem to be important sources of traffic for LOCUS. Learning management and communications platforms such as Google Classroom, Schoology and Edmodo account for about 10% of the LOCUS user referrals. Universities account for 7.5% of the traffic to the LOCUS site, and K-12 school districts in both the US and China account for just over 5% of the LOCUS site referrals. Professional organizations and teaching sites such as the AP Stats site, the Statistics Teacher, the American Statistical Association, TERC, and the College Board site account for about 2.5% of the user referrals.

Survey Results

Although these basic analytics provide important information about time and frequency of use of the LOCUS site, they do not tell us directly about the types of people who are using the site or their reasons for doing so.

To address these questions, at least for a subset of users, the LOCUS site was configured with a survey that popped up from the side between 60 seconds and 180 seconds. Users could respond immediately or defer their response till later, though they were reminded each time they returned to the site. The survey asked them to identify their professional roles, their reasons for being on the site, and the extent to which the content and format of the LOCUS site enabled

Referring websites or institution types, in decreasing order of number of users referred

SITE	Users	Sessions	Page Views
TOTAL	11446	16770	349846
Direct	5688	8177	178358
Search (Google 2251, Bing 121, Yahoo 67, etc.)	2454	3867	69887
Google Classroom (classroom.google)	956	1186	32098
City University of NY (cuny)	512	661	13108
North Carolina State (ncsu)	279	404	4891
K12 institutions (.k12 and those including “high” excluding others on this list –e.g., madison, Cobbk12, Sheboygan, lausd)	254	387	13978
Schoology (schoology)	147	183	8077
AP Stat (apstat)	139	170	2945
Madison WI (madison)	114	138	1856
Sheboygan WI Area School district (sasd)	107	204	5901
Los Angeles CA Unified School District (lausd)	66	76	1479
Higher education institutions (.edu excluding others on this list –cuny, ncsu, ufl, terc)	65	97	1536
American Statistical Association (amstat)	53	112	1753
EdModo (Edmodo)	50	65	1753
TERC (terc)	40	52	849
Tianjin (China) Int'l School (tiseagles)	29	110	2975
Statistics Teacher (statisticsteacher)	26	36	304
The College Board (collegeboard)	23	26	675
Aberdeen WA School District (Winterland AP Stats class)	22	31	455
Cobb County, GA School District (cobbk12)	20	25	121
U Florida (ufl)	16	17	326
Remaining	290	544	4838
Pct remaining	2.5%	3.2%	1.4%

them to achieve their goals for being on the site. Respondents were also asked if they were willing to be interviewed and, if so, to provide their contact information.

A total of 350 people responded to the survey during the period 3 December 2015 to 13 July 2017. Seventy-one (71) of them responded before the Google analytics identifiers were set up. Of the remaining 279, 19 responded to the survey multiple times, for a net of 260 unique identified respondents, which included 79 with ID1 identifiers, and 181 with only ID2 identifiers. Eleven (11) of the survey respondents viewed the informed consent text on the LOCUS site (see Appendix B) – the rest consented without explicitly reading it.

Respondents were asked to describe their primary professional role(s) — a majority (60%) identify as K-12 teachers, with all other roles identified by less than 15% of respondents each. For the most part, people identified a single role, though 34 people identified two (2) or more roles, and 26 did not identify any professional roles. Those who described themselves as in the “Other” category included students (high school, undergraduate, and graduate in a variety of departments and programs), people who work in schools in other roles (math department chair, middle school math resource teacher, secondary program specialist, regional math instructional

coach, and state level math consultant), those who work as curriculum and software developers, and some parents who homeschool their children.

Which of the following are your primary professional role(s)?

Profession	Percentage Responding
K-12 teacher	60.3
College or university faculty member or instructor outside of a department or school of education	13.4
Faculty member or instructor in a college or university department or school of education	11.4
Professional development provider	7.4
Researcher	7.4
K-12 school or district supervisor or administrator	4.6
Other	9.7

We also asked people to identify their reasons for visiting the LOCUS website. These are described in the table below with three options (“*To learn general information about LOCUS*”; “*To view sample LOCUS assessment questions and responses*”; and “*To learn about or get ideas for teaching statistics*”) garnering one-third or more of the responses. (Totals add to more than 100% since respondents could give more than one reason).

Which of the following are your primary reasons for visiting the LOCUS website today?

Reason	Percentage Responding
To learn general information about LOCUS	45.7
To view sample LOCUS assessment questions and responses	39.4
To learn about or get ideas for teaching statistics	35.4
To register for a LOCUS account	23.1
To create a LOCUS test	16.3
To view or download results of a previously administered LOCUS test	14.9
To learn about statistical ideas generally	14.9
To learn about how LOCUS questions are scored	10.0
To take a LOCUS test	9.1
Other	4.0

Half of respondents only gave one reason for being on the site, but another 40% gave 2 to 4 reasons. There were moderate correlations among several of these reasons, with those saying they wanted to learn about or get ideas for teaching statistics also wanting to learn about statistical ideas generally ($r=.40$), to view a sample LOCUS assessment ($r=.39$) and to learn more general information about LOCUS ($r=.30$).

Number of reasons given for being on the LOCUS site

Reasons	0	1	2	3	4	5	6	7
# Responding	7	175	62	44	34	10	12	6
% of Users	2.0%	50.0%	17.7%	12.6%	9.7%	2.9%	3.4%	1.7%

When respondents specified their other reasons for being on the site, these included people who were learners in face-to-face or online classes and were asked to come as part of class, those who are teachers wanting to remind themselves how the assessment can work for them,

researchers considering use of LOCUS in their research (and one trying to figure out how to cite LOCUS), or just because they were referred to the site (by Chris Franklin, the AP Stat Teachers College Board website, or a friend).

Reasons for being on the LOCUS site vary by roles, with MANOVA showing that K12 Teachers' reasons are different from those of others (Pillai's trace = 0.077, approx $F(df=9, 335) = 3.09, p=.0014$). Specifically, K12 teachers more often come to the site wanting to register or view a sample test than do those with other roles (there are no other significant differences).

Percent of Respondents in Each Role who Described Each Reason for Being on the LOCUS Site

Role	Gen Info	Register	Create Test	Take Test	View Results	View Sample	Scoring	Tchg Ideas	Stats Ideas
K12 Teacher	49.29	27.49	18.01	8.53	13.74	35.07	9.48	38.86	12.32
K12 Admin	37.50	37.50	6.25	6.25	12.50	43.75	12.50	43.75	25.00
Ed Faculty	50.00	17.50	25.00	7.50	17.50	50.00	15.00	40.00	22.50
Other Faculty	42.55	10.64	12.77	6.38	21.28	44.68	6.38	29.79	10.64
PD Provider	38.46	15.38	3.85	3.85	19.23	61.54	11.54	46.15	15.38
Researcher	46.15	15.38	15.38	7.69	26.92	38.46	15.38	30.77	11.54

Finally, we asked respondents about their satisfaction with the LOCUS website to meet their needs, specifically, *“To what extent has the content and format of the LOCUS website enabled you to achieve your primary purpose(s) on the website today?”*

We wanted the pop-up survey to appear quickly because we know that many people spend very little time on websites and we wanted information about a broad range of LOCUS users. However, because the survey appeared so quickly, we offered respondents an option to say they weren't yet sure how well the site helped them achieve their purposes and, in fact, 54% of survey respondents chose this option, suggesting that they hadn't had enough time to work on the site before the survey popped up. The remaining 46% (N=161) provided ratings on a scale from 0 to 4 (0= Not at all; 1= To a small extent; 2= To a moderate extent; 3= To a large extent; 4= To a very large extent). Mean (2.85) and median (3.00) responses suggest the content and format of the LOCUS website enabled users to achieve their primary purpose(s) a moderate to large extent, with only 13 respondents (8%) saying it served their purposes only to a small extent or not at all.

Survey Satisfaction Ratings Table

Rating	0	1	2	3	4
# Respondents	6	7	34	72	42

We tested to see if satisfaction ratings vary by roles. Those who identified as Researchers gave significantly lower ratings on average (2.33) than those who didn't (2.90) ($t=2.17, p=.032$). There were marginally significant differences in ratings of satisfaction for those who identified as K-12 Teachers (higher, 2.97) than those who didn't (2.69) ($t=1.78, p=.078$) and for those who identified as PD Providers (lower, 2.47) and those who didn't (2.90) ($t=1.70, p=.092$).

A model testing whether satisfaction varies by interactions in roles and reasons for coming to the site finds significant differences ($F(df=59, 101)= 1.70, p=.0098$). Given that there are 6 roles and 9 possible reasons for coming to the LOCUS site, the number of predictors in this model is quite high. Several interaction variables do not even have enough data to predict beta values including:

Role-Reason combinations with too little data to fit regression parameters

Role	Reason
K12 Administrator	View Results, Scoring, Statistics Ideas
PD Provider	Create Test, Take Test, Scoring
Researcher	Register, Create Test, Scoring
Other Faculty	Scoring

The variables with statistically significant t-statistics (and their associated one-way predictors) within the omnibus F-test are as in the table below. Interpreting these interaction effects requires attention to both the one-way effects (e.g., a negative coefficient for those scoring assessments) and the interactions effects (e.g. positive coefficients for the interactions with those on the site to score assessments). Ultimately, while those who identify with most roles are less satisfied when they came to the LOCUS site to score assessments, this didn't have an impact on K12 teachers, and education faculty were significantly more satisfied with the site if they were there to score assessments.

Significant Predictors for Role by Reason Interaction Model

Predictor	Estimate	SE	t	p
(Intercept)	2.36	0.56	4.25	4.9E-05 ***
Profession-K12 Teacher	0.71	0.60	1.19	0.236
Profession-Ed Faculty	-0.27	0.77	-0.35	0.727
Reason-Scoring	-2.36	1.04	-2.28	0.025 *
Profession-K12 Teacher x Reason-Scoring	2.67	1.13	2.37	0.020 *
Profession-Ed Faculty x Reason-Scoring	7.69	3.79	2.03	0.045 *

Respondents were asked “*What suggestions do you have for improving the website to better serve your needs?*” 207 of 350 didn't respond and another 29 said None or N/A, leaving 114 responses. For those who did give substantive responses, their suggestions are included with the more detailed qualitative feedback from the interviews, which are reported in detail below.

Site Usage

We were especially interested in which parts of the website people used, and whether that varied by role or other user characteristics. The interviews suggested that there was a split between people who used the test administration portions of the website, and those who used the professional development³ portions of the website. For the most part this is true – only 3.6% of users had more than 10% of their page hits on both test administration related and professional-development related pages. An analysis of this split occurs after we describe usage of each part.

There are 13 major “branches” of content on the LOCUS website. Several of these seem to serve administrative purposes for site creation, user password management, evaluation survey links, and the like (i.e., /admin, /user, /users, /content, /survey, and /contact). Other pages are part of the test-taking and results reporting system (i.e., /node, /take, /test, /test-rpts, /test_rpts). The /about-locus branch provides general information about the LOCUS assessment and how to navigate the site, and the /professional-development branch provides specific information about statistical ideas and assessment items. We begin with these two branches.

³ Throughout this report, we refer to the professional development strand of the website as including the Question Browser components, one focused on grade level, and the other focused on GAISE framework categories.

Content structure of the LOCUS website

Section	Branch	Number of Pages	Total Page Views
Administration	/admin/	106	413
	/contact/	1	53
	/content/	11	113
	/survey/	2	23
	/user/	686	4210
	/users/	94	410
Information	/about-locus/	8	1679
Professional Development	/professional-development/	524	48538
Test taking and reporting	/node/	36273	40361
	/take/	165	1179
	/test/	477	7049
	/test-rpts/	242	6095
	/test_rpts/	685	4393

Use of About-LOCUS pages

There are nine pages within the “about-locus” branch of the website providing information about the project, the test development process and evidence model, the project’s staff including PIs, key personnel, test development committee and advisors, and the presentations and publications that serve as dissemination vehicles for LOCUS. The table below shows number of users who accessed each of these pages, and the total number of page views for each.

Usage within the About-Locus Section of the LOCUS Site

Page Path	N Users	Total Page Views
/about-locus	545	1531
/about-locus/test-development-process	118	325
/about-locus/presentations	104	261
/about-locus/publications	101	307
/about-locus/key-personnel	85	246
/about-locus/principal-investigators-and-project-staff	80	206
/about-locus/evidence-model	48	204
/about-locus/test-development-committees	41	98
/about-locus/advisory-board-members	32	78
TOTAL “about-locus” access:	1154 (677 unique users)	3256

Use of Professional Development pages

The “/professional-development” branch was the primary vehicle through which the LOCUS website educates its public about statistics and statistics education issues. There are a total of 526 separate pages within this branch, which had a total of 48,757 page views (average of 93 views per page, though distribution of page views was not at all uniform).

The root “/professional-development” page itself had 1416 separate users and 4915 page views. The page “/professional-development/questions/bia-supporting-content” provides access to the “Beginning Intermediate Advanced, GAISE Supporting Table” and had 268 page views by 95 different users, 19 of them with ID1 logins.

The “/professional-development/questions” branch of the site was divided two ways – by grade level, and by the four major statistics activities described by the GAISE framework

(formulate questions, collect data, analyze data, interpret results). Within each of these, there were separate pages for multiple choice questions and for constructed response questions. We describe activity in each of these sub-branches below.

By Grade Level

Within the “/professional-development/questions” branch, there were 297 pages with the root “/by-grade” with a total of 27,607 page views. These break down by grade level as in the table below. Total page views are more than the sum of multiple choice (MC) and constructed response (CR) page views because there are some pages for each grade band that are not tagged for MC/ CR item type. Notice that there are more total page views (and page views per page) at the high school level than for each middle school grade, though it’s important to remember that there are 4 possible grade levels (9-12) combined in the High School category.

Grade level professional development pages and page views, total and by item type.

Grade	Total Pages	Total page views (views per page)	MC Pages	MC page views (views per page)	CR Pages	CR page views (views per page)
Grade 6	72	6,232 (86.6)	49	3,622 (73.9)	20	1,707 (85.4)
Grade 7	85	3,759 (44.2)	43	2,246 (52.2)	40	1,053 (26.3)
Grade 8	40	2,037 (50.9)	21	955 (45.5)	17	681 (40.1)
High School	100	15,579 (155.8)	81	10,122 (125.0)	16	3,170 (198.1)
TOTAL	297	27,607 (93.0)	194	16,945 (87.3)	93	6,611 (71.1)

Examining how many of these grade level specific pages identified users interacted with, we find an average (mean) of 2.7 different pages (median 2, range of 1 to 12 IQR of 2 to 3). Those with ID1 identifiers access more page types (3.8) than those who only have ID2 identifiers (2.6) ($t=5.80$, $p \ll .0001$). Looking at the number of users and page views by user for each of the grade by item type identifiers, we get the following:

Distribution of page views by user, categorized by grade level and item type

Grade	Item Type	Users	Page views by User						
			Mean	SD	Min	Q1	Median	Q3	Max
Grade 6	MC	164	22.09	39.23	2	2	6	18.50	306
Grade 6	CR	136	12.55	21.77	1	2	4	10.50	125
Grade 7	MC	94	23.89	39.91	2	2	6	30.00	186
Grade 7	CR	78	13.50	23.23	1	2	4	10.75	98
Grade 8	MC	80	11.94	13.77	2	2	6	18.50	72
Grade 8	CR	73	9.33	16.10	2	2	4	8.00	92
High School	MC	487	20.78	40.26	1	2	6	18.00	528
High School	CR	323	9.81	21.45	1	2	4	8.50	288

More users view the high school level pages than any of the other three grades (though if we assume these users are distributed across the 4 high school grades, there is no difference (mean MC users = 122; mean CR users = 81). Users checking grade 6, 7, and high school content view pages associated with multiple choice content more frequently than pages associated with constructed response content; and they also view this content more than those checking grade 8 multiple choice content. The unusual value seems to be the Grade 8 multiple choice content which is viewed less than expected.

By GAISE Component

Doing a similar analysis for the PD pages organized by GAISE components, there are 221 pages in the “/professional-development/questions” branch that focus on the four GAISE

components – Formulate questions, Collect data, Analyze data, and Interpret results. The break down by GAISE component and item type is in the table below.

Examining which of these GAISE component-specific pages identified users interacted with, we find an average (mean) of 3.0 different pages (median 2, range of 1 to 12, IQR of 2 to 4). Those with ID1 identifiers access more page types (5.02) than those who only have ID2 identifiers (2.87) ($t=6.57$, $p \ll .0001$). Looking at the number of users and page views by user for each of the GAISE component by item type identifiers, we get the following:

GAISE component professional development pages and page views, total and by item type.

Component	Total Pages	Total Page views (views per page)	MC Pages	MC page views (views per page)	CR Pages	CR page views (views per page)
Formulate questions	20	3327 (166.4)	13	1977 (152.1)	4	542 (135.5)
Collect data	55	2123 (38.6)	35	1085 (31.0)	17	595 (35.0)
Analyze data	90	5687 (63.2)	57	2922 (51.3)	29	2017 (69.6)
Interpret results	56	4664 (83.3)	23	2614 (113.7)	31	1430 (46.1)
TOTAL	221	15801 (71.5)	128	8598 (67.2)	81	4584 (56.6)

Fewer users go to the Collect data pages than pages about the other GAISE components and, as before, somewhat fewer go to constructed response pages than multiple choice pages. There are some differences in number of page views per user, with Formulate questions pages of both item types, and Collect data constructed response pages visited less frequently than Analyze data or Interpret results pages.

Distribution of page views by user, categorized by GAISE component and item type

Component	Item Type	Users	Page views per user						
			Mean	SD	Min	Q1	Median	Q3	Max
Formulate questions	MC	181	10.92	12.40	2	6	8	12.0	102
Formulate questions	CR	107	5.07	5.35	1	2	2	6.0	36
Collect data	MC	73	14.86	24.75	2	2	6	16.0	148
Collect data	CR	71	8.38	12.14	1	2	4	9.5	71
Analyze data	MC	174	16.79	28.38	1	2	4	16.0	169
Analyze data	CR	140	14.41	27.69	1	2	6	10.0	204
Interpret results	MC	151	17.31	14.63	2	4	18	25.0	124
Interpret results	CR	102	14.02	32.88	1	2	4	10.0	289

For those who responded to the survey, there is a small but statistically significant increase in satisfaction with the LOCUS site for those who viewed more pages within the GAISE components section of the PD, whether measured by number of different pages ($\beta = 0.217$, $t=2.92$, $p=.0046$) or by number of page views ($\beta = 0.0059$, $t=2.55$, $p=.013$). There are no differences in satisfaction based on page views in the grade level professional development section of the site.

PDF downloads

Finally, though it was not used to a large extent, there are 27 different .pdfs available through the LOCUS site that were accessed a total of 97 times. Seven (7) of these are from the LOCUS site and represent documents describing the LOCUS evidence model or rubrics. The other 20 are from the www.amstat.org site and include the GAISE framework and a number of sample investigations. Number of downloads of each item are shown in the table below.

Documents downloaded from LOCUS site

Source	Document	Total Events
LOCUS/sites/default/files/pages/pdfs/	LOCUS_EvidenceModel_Finalby Component05012015.pdf	21
	LOCUS_EvidenceModel_Finalby Level05012015_0.pdf	17
LOCUS/sites/default/files/prodev/question/ constructed_response/	FinalRubric_BIForm2Q1.pdf	2
	FinalRubricBIEquater2.pdf	8
	FinalRubricBIForm1Q1.pdf	1
	FinalRubricBIForm2Q5.pdf	2
	FinalRubricEquater.pdf	8
www.amstat.org/education/gaise/	GAISEPreK-12_Full.pdf	8
www.amstat.org/education/btg/pdfs/	BDG_SampleInvestigation.pdf	3
www.amstat.org/asa/files/pdfs/stew/	AreFemaleHurricanesDeadlierthan MaleHurricanes.pdf	1
	Armspans.pdf	1
	ASweetTask.pdf	3
	BubbleTrouble.pdf	3
	DidITrapTheMedian.pdf	1
	DontSpilltheBeans!.pdf	2
	HowLongis30Seconds.pdf	1
	IAlwaysFeelLikeSomebodys WatchingMe.pdf	2
	TheCaseoftheCarelessZookeeper.pdf	3
	ASweetTask.pdf	1
	BubbleTrouble.pdf	1
	HowLongis30Seconds.pdf	2
	PercentWithinMileofRoad.pdf	1
	PopulationParameterswithMMs.pdf	2
	StepIntoStatistics.pdf	1
	UsingDicetoIntroduceSampling Distributions.pdf	2
	TOTAL	

Test Administration

The other large component of the LOCUS website were related to test administration and reporting. In this section, we provide an overview of the types of pages used within this branch, though don't provide a lot of detail. From what we can tell via analytics data, there are 208 identifiable people who accessed the "/node/add/quiz-instance" page which is used to create a test instance, and they did so 642 times (mean 3.1, median 2, range 1 to 38). To support creation of new test instances, the LOCUS site included a help screen "/test-giver-operational-help" which was accessed by 62 identified users a total of 198 times (mean 3.2, median 2, range 2 to 14).

Not all of those who went to the page that made it possible to add a new test instance actually did so. It seems 164 identifiable users created 380 distinct test instances. Interestingly, 67 of these test instances were made by 42 users who don't have ID1 login identifiers – we're not sure how this is possible given our understanding of the structure of the site.

There were 10 different tests that users could choose from. The most popular assessment was the short form AB assessment. More people used the AB form (729 users) than the BC form (564

users) with the ABC combined form having the fewest users (51). The short form (45 minutes) was also used more (911 users) than the longer (60 minute) form (382 users). Finally, 894 users selected Form 1 in any of its versions, while only 450 selected form 2.

Users could get five different kinds of reports for any of the assessments:⁴

- The Question Summary Report provides a listing of each question number, a link to the question text, the percentage of test takers who correctly answered the question, and the GAISE process component category associated with the question.
- The Detailed Question Summary Report (not described on the test-giver-operational-help support page) provides, for each question, the percentage of students who answered correctly, as well as the percentage of students who selected each distractor.
- The Test-Taker (Student) Summary Report provides the overall percent correct for each student, as well as the percent correct by GAISE process component and GAISE level.
- The Test-Taker (Student) Raw Detailed Report lists each student alongside the response option selected for each test question, along with the total score and responses to demographic questions.
- The Quiz Answer Key lists the name of each question for a quiz, the correct answer, and the GAISE process component and level.

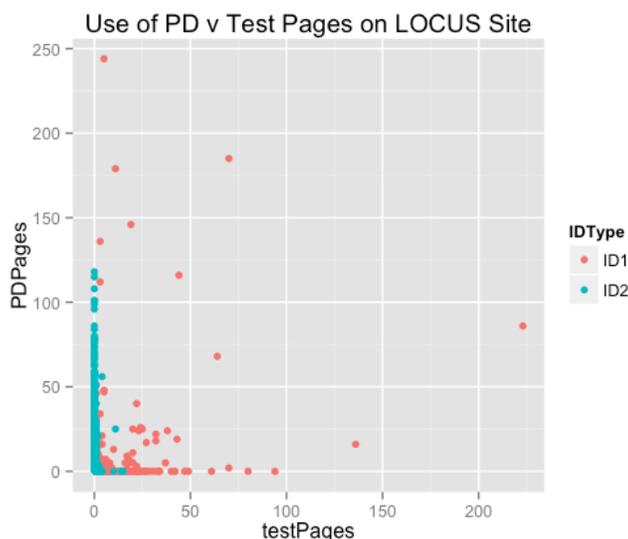
The Question Summary Report had 153 pages associated with it, the Detailed Question Summary Report had 109 pages, the Test-Taker Summary Report had 252 pages, the Test-Taker Raw Detailed Report had 151 different pages keyed to specific tests, and the Quiz Answer Key had 8 pages associated with it. The Detailed Question Summary Report had a total of 119 users (a few with multiple ID2 identifiers, for those who didn't have ID1 logins) and 848 page views, and was keyed to a specific administration whose type was not coded in the associated page path, so we can't provide separate summaries for test types. Details about the number of users and page views for each of the other report types for each test type are in the table below.

Test and report usage (number of users and page views) by test level, length and form

Level	Length	Form	Tests		Answers		Detailed Report		Question Summary		Student Summary	
			Users	PVs	Users	PVs	Users	PVs	Users	PVs	Users	PVs
AB	Short	1	361	832	15	54	33	121	48	384	86	271
AB	Short	2	199	435	10	30	46	145	39	253	63	265
AB	Medium	1	65	175	7	20	12	57	14	50	37	171
AB	Medium	2	104	238	0	0	3	5	1	1	8	42
BC	Short	1	245	544	13	42	22	74	19	176	45	198
BC	Short	2	106	215	3	6	7	18	10	32	14	42
BC	Medium	1	176	370	14	34	33	106	30	192	70	341
BC	Medium	2	37	82	4	10	4	14	3	6	13	154
ABC	Long	1	47	108	9	17	11	23	15	44	20	69
ABC	Long	2	4	8	0	0	6	22	1	2	5	26
TOTAL			1344	3007	75	213	177	585	180	1140	361	1579

⁴ The number of reports actually available on the user Dashboard, as well as the report names and descriptions, differed from the descriptions of reports on the LOCUS test-giver-operational-help support page.

We were curious about the balance between use of the professional development and test administration sides of the website. We identified users who had followed both the “/test” and the “/professional-development” branches. These are graphed below, distinguishing between those with ID1 identifiers those with only ID2 identifiers. There are many users who use only or predominantly one or the other of these branches of the LOCUS site – those plotted near one or the other axis. In fact, just 3.6% of users have more than 10% of their page hits on both “/test” and “/professional-development” branches suggesting that for the most part, these are orthogonal uses of the site. There were only 15 ID1 identified users who had more than 50 test or 50 PD page hits. Eight (8) of these had fewer than 10 page hits of the other type, and only four (4) had more than 20 page hits of each type. This rough split is also reflected in the interviews (see below)



We now turn to the findings from the interviews we conducted with site users.

Interview Analysis

All visitors to the website between December 2015 and November 2016 who provided an email address on the online survey were invited to participate in a telephone interview. A total of 44 invitations were sent successfully⁵. Ultimately, 18 LOCUS visitors participated in a telephone interview conducted between November 2016 and January 2017. Interviews used a structured protocol (see Appendix C) developed by SEEC researchers, and were audio-recorded and transcribed. Transcripts were analyzed using NVivo 11 software (QSR International, 2012).

The 18-user interview sample reflected a range of professional roles. Ten interview participants reported that they were primarily K-12 teachers, although some of these had instructional coaching or staff development roles. Five participants were college or university faculty members; of these, two work in education departments, and three work in other departments. The remaining participants identified themselves as a graduate student, a K-12 regional math instructional coach, and a professional development provider who is also a state-level mathematics consultant.

⁵ One email address provided through the online survey was invalid.

Uses of the LOCUS Website

Interviews with LOCUS users highlight several ways of using the materials available on the website, including both the website's assessment functions and the resources it provides. Users described using LOCUS as:

- an assessment tool – for both formative and summative purposes, and administered to students as well as teachers;
- a source for practice exercises for students;
- a tool for planning, instruction, and curriculum development; and
- a source of materials for professional development.

Below, we provide examples of these use categories.

LOCUS as an Assessment Tool

Interview participants described using the LOCUS website for a range of assessment purposes. For instance, one high school teacher described using LOCUS as a diagnostic tool, saying, *“I haven't really worked with [the assessment results] with the students. I get the results, and then I kind of go in and I particularly look at questions that a lot of them have missed, just to see if they're, what kinds of things do I need to focus on for the year, and what kinds of things do they already seem to know.”* Similarly, another high school teacher explained, *“I've gotten into the habit of using [LOCUS] just in August and April for the tests.”*

Teachers appreciated different aspects of the information gained from administering LOCUS during the academic year as a formative assessment. One high school teacher said, *“It kind of gives me that idea of which students to further assist.”* Multiple AP Statistics teachers described using LOCUS assessments prior to the AP exam in the spring to assist with targeting review efforts. An AP teacher explained, *“I try to do it after the course content's completed, usually end of March, beginning of April, but before the AP exam. So I can see if there are weaknesses in a particular area, then I can address those.”*

Another teacher, who also administers LOCUS assessments early in the school year to enable measurement of growth in students' conceptual understanding, described a more summative function of the LOCUS assessments, saying:

So then they take the same, or like a similar version of that same test in April, which is kind of, number one, it gives me an idea of how much they've learned over the year, and a lot of times, it encourages them that they've learned quite a bit. And then number two, it is nice to review, for the AP exam, like multiple choice review.

Some teachers used items available in the Question Browser to support development of their own assessments for use with students. For instance, an AP Statistics teacher said:

It's always a challenge to find good questions, and you know how kids are. They're very adept at finding things on the internet, so you have to be careful, using things that are already out there. So you have to be able to take a question, like reword it. So when you're giving tests and quizzes. So it's nice to have another source for that, and this is probably a source they're not going to find on their own.

High school teachers were not the only interview participants who used LOCUS assessment functions. For instance, a university professor appreciated the opportunity to use LOCUS

assessment functions to address students' misconceptions about statistics and gaps in their understanding, saying:

Doing the pre-test, I have found very, very helpful, cause it did reinforce for me that we needed to really like start with level A for a lot of our students. And I think, you know, everybody agrees that, it's not something unique to us, that a lot of students don't have— Even if they know how to calculate, they don't really understand what they're doing. So it did really reinforce, I think for us, that we have to, we do have to do that early conceptual work. And I think it made, at least for me, like I said— It's like, slow down, slow down, slow down, right? Try to cover fewer topics. Cover them better.

LOCUS assessments were also used to measure change in test-takers' statistics understanding before and after a teacher professional development course, in a research study comparing different approaches to statistics instruction, and as one measure in a high school teacher's evaluation plan.

Review Materials for the AP Exam

Two high school AP Statistics teachers described how they have used resources from the LOCUS Question Browser as practice exercises to support students' preparation for the AP Statistics examination. For instance, one teacher, reflecting on how she originally began referring to the LOCUS website, explained, “*I was looking at it originally for good quality test questions for the students to practice getting ready for the AP test.*” Another teacher explained:

Especially as we move toward the AP test, in that third trimester, I like to offer up some additional practice. I'm not a fan of students purchasing books to study and prepare for the AP test. I feel like we do a pretty good job of that in class. It's just a waste of their money. So to have the site like this as additional practice for them, I think is a nice bonus.

A Reference for Planning and Instruction

Several interview participants, working across a range of contexts and with learners at levels ranging from elementary to undergraduate, described using the LOCUS website to support planning and instruction. Planning and instruction uses included referring mainly to the LOCUS Question Browser for guidance with broad curriculum planning as well as for material to use as the focus of specific instructional activities.

For instance, a state-level math professional development specialist described referring to LOCUS as a source of information for her state's standards development process, explaining:

We went through a standards revision, and we actually implemented our new standards in August of 2016. So in the prep to do that, we would reference some of the LOCUS stuff in terms of, when we were writing our standards. So I would just look at some of the items so that we could look at the intent of how we wanted our standards written.

Similarly, math coaches at both the school and district levels referred to LOCUS as part of an effort to infuse statistics into curriculum at the elementary and middle levels. One coach explained, “*I have used [the LOCUS Question Browser] to I guess look at specific content standards throughout the grade level strands. So pulling up questions and seeing like what the*

question would look like at a 6th grade level versus an 8th grade level versus a high school statistics class.”

Participants also described using LOCUS for planning at a finer level. One math coach offered, “*This would be a great place for people to start when they’re thinking about planning what this unit would look like in terms of kind of these questions being the end result of where students need to be at.*” A university professor shared, “*I also teach a content course that I have just started, and that’s actually where I’ve turned toward LOCUS for some ideas and questions.*”

Aside from its use as a planning tool, interview participants also described using aspects of the Question Browser for focal in-class activities. One high school teacher described displaying a constructed response prompt on an overhead projector and engaging students in a discussion of that prompt. Similarly, a university professor working with preservice teachers explained:

I’ve had students be assigned to a problem, and had to come into class and present, and show the rest of the class how to work through that problem and think about it from a content perspective. So we’ve actually looked at how to teach it, too. We’ve gotten into that conversation with some of the different items as being like a launching point.

Similarly, an AP Statistics teacher, describing his use of the LOCUS Question Browser as a resource for statistics questions on which to focus in class, explained, “*I’m always looking for good multiple choice questions with good distractors, and the LOCUS test has like well thought out multiple choice and good like, you know, possible answer choices that students might select. So I was encouraged to use those questions in class.*”

Two university professors described using LOCUS to inform how they questioned their undergraduate students. One, teaching in a business program, explained using LOCUS to help move her instruction away from a procedural focus:

Most of the courses I taught were let’s say drill and practice, and I tried to include questions about understanding, but they were not the best. Like I asked students to explain the meaning, and asked them to compare, whatever, but not into the details I found in the LOCUS website, so I actually like the type of the questions posed.

Another professor described looking to LOCUS for ideas about how to push students in their thinking. She explained:

I’m trying to have students writing during class, or have students like talking to, in a group about data in the class. So it just gives me some ways to think about what kinds of questions to ask that can be— And what’s always nice about a test like this where, they show you how even you could do a multiple choice question that’s a really rich question, which is really hard. So I think that’s important, and it’s helped me just think about ways in my class that I can do that, that I can ask them short questions, but that get them to really look at the data, as opposed to just copy.

A Professional Development Resource

A final use for LOCUS that interview participants described is as a resource for professional development. For example, one regional math coach used items from the Question Browser as “*exemplars*” in a series of workshops with Algebra II teachers. Another participant, a high school

statistics teacher who also facilitates workshops for math teachers, explained, “*We’ve used the LOCUS test as a pre- and post-test for teachers in a statistics workshop. It was very eye-opening to a lot of teachers about the kinds of questions we should be working toward.*” An elementary- and middle-level math coach described a similar use, saying, “*I want our teachers to take it*” because the assessment would be an “*eye opener,*” encouraging them “*to realize that they don’t really know very much*” and to move toward new conceptual understandings. A different middle-level math coach described her use of a constructed response task as the focus of a discussion with teachers:

I kind of like that idea of being able to pull like a constructed response task type question for teachers to be able to take a look at... I printed out and highlighted a question maybe a 6th grade, 7th grade, etc. And we had conversations about those questions in smaller group breakouts.

Two high school teachers, both of whom also provide professional development support for other teachers, described LOCUS Question Browser content as a way of addressing teachers’ knowledge gaps and building pedagogical content knowledge for teaching statistics. One, who is the only statistics teacher in his school, explained, “*The teachers I work with don’t really know that much about statistics. So there’s a lot of those common misunderstandings. And that is very useful. I really like common misunderstandings, cause then you can kind of plan around that.*” Another teacher recognized the potential of the “Common misunderstandings” tab in Question Browser items to support teacher learning, saying “*The things like the common student mistakes, that’s very helpful. Especially, this is only my fourth year teaching AP, so, you know, it’s hard to know exactly where students are going to make mistakes when you’re first doing something.*”

Challenges with Using LOCUS

Although most interview participants generally spoke positively of their LOCUS use, they also mentioned some challenges they experienced. With one exception—namely, that one high school teacher and one university professor described comprehension difficulty among English Language Learners working with some of the wordier test items—these challenges fall into two categories: informational challenges, and technical challenges.

Informational Challenges

Several LOCUS users—primarily those who teach at the high school level or work with teachers who teach at that level—expressed frustration over what they sensed as a lack of information to guide their use of the website. Most of the information users felt they were missing involved test administration functions. For instance, one teacher explained:

There were so many tests to pick out from, and I wasn’t sure from the different choices what was best for my students, and what— Should I give them the same test for post as I did when I first gave them the test, or do I, you know— And I didn’t know how they vary, and if it applied to my students.

Some teachers also desired guidance about interpreting and acting upon results from LOCUS assessments they administered to their students. One high school teacher, relatively new to statistics teaching, explained:

I find reading the results a little bit difficult to kind of go through, maybe because I wasn’t trained to break down the information. But I [believe] that if you’re, if

we're supposed to give a test to students that are supposed to assess and for us to analyze, then there should be a more formal way of us going through the results and using that as feedback for our teaching. But it's just kind of like, it's there for us to use, and we just have to figure out how we're going to use it.

Another teacher expressed a similar desire for information on how to use information available in results reports, referring to a frustration with the limited information available from AP test results:

It is just kind of difficult to get a summary of, you know, how can I use these test results to inform my teaching, or how can I use these test results just to see what I should emphasize? Which is difficult, because even the College Board doesn't provide that much information about how my students do. They just say, you know, oh, on the first FRQ, your students got an average of a 1.1 out of 4. And like I can't really tell, what did they miss? What should I improve? Not just— They give kind of like common misperceptions that nationally and globally students do, but not really like particular, hey, your students really stink at doing mutually exclusive probabilities. [LOCUS] should really emphasize that.

For one teacher, the information lacking was limited to the mechanism through which reported scores are calculated:

I was trying to understand how they were grading the questions, because the raw score, I don't know if certain questions were weighted more or not, cause when I got back the raw score, I didn't know how to interpret it, actually, so no one was really there to interpret it for me, so I just kind of made a generalization of how they did out of 100 or a percent or something.

Unrelated to this perceived absence of information about results interpretation, an additional user who referred to LOCUS to help guide state-level curriculum redesign and related professional development efforts expressed frustration at the lack of explicit information about the range of permitted uses of information from the website. This user explained:

We don't put anything out without citing it or putting something out on our website. Cause a lot of times, what we do is, when we do a presentation, we provide our participants with copies of our presentation, or a website where they can go to and get that stuff. And I wanted to make sure that that was something that was shareable, and not something that I wasn't supposed to be sharing, or had that permission to share. So I don't do it unless I have permission to do it. And it's just not articulated really clearly to where I can tell.

During the course of conducting interviews, an additional barrier to use of the Question Browser portion of the website surfaced for some participants. Specifically, several participants (including 5 of the 9 teachers who were interviewed, all of whom have administered LOCUS assessments to students) said that they were unaware that this resource existed until they were prompted to review that portion of the website prior to the interview. One teacher conceded, “*I haven't used [the Question Browser] at all with my classes. I didn't even know that there was a question browser aspect of the website until this morning,*” when the teacher was prompted to log in to the website after recently clearing cookies. (This teacher also offered that he generally

remains logged in to the LOCUS website and links directly to test administration functions via a bookmarked link, which suggests a potential explanation for missing features added to the site after he began using LOCUS. He recommends providing a direct link to the Question Browser from the Dashboard.)

All participants who learned of the Question Browser through the process of being interviewed had favorable reactions to their brief explorations of it. For instance, one said, “*Now that I know that it’s there, I think it will actually become more valuable to me as a resource.*” Another teacher remarked while viewing the Question Browser for the first time during the interview, “*I’m just looking at it right now. This would probably be very helpful. I’m always looking for new questions.*”

Technical Challenges

A small handful of interview participants mentioned technical challenges impacting their use of LOCUS. One such challenge concerned website navigation, as explained by a university professor:

There is something odd about the workflow in the site, because I always go, and I go to the view where I can see like how the class did on specific questions, and then I want to go read the actual question, and then understand like the pattern of error in that question, or, you know, what did they get right on that question. And sometimes it’s weird how it sends you back to a place where it then requires many clicks to get back.

Two users expressed frustration over attempts to download test reports for use in Excel, saying they received “*error messages.*” Finally, some high school teachers felt that their use of LOCUS was limited by limitations on the number of computers available for in-class student use. As one AP Statistics teacher explained, “*[I] didn’t give it to kids from the website, cause we didn’t have, when I was using it, we didn’t have like one to one access. The kids didn’t have computers in the classroom.*”

Perceived Impacts of LOCUS

Although the evaluation design does not allow for causal inference, and—as one teacher explained—“*a website tends to have an indirect effect*” on teachers and teaching, interview participants described ways in which they perceived their use of LOCUS to have impacted knowledge of statistics content as well as approaches to statistics teaching. We describe these perceived impacts below. In some cases, interview participants felt more comfortable sharing their expectations of LOCUS’s *future* impact, and we include these cases as well, with indication that they are future-oriented.

Teacher Knowledge of Statistics

Some participants clearly regarded LOCUS as a resource for improving teachers’ own statistics content knowledge. A regional math coach who has used the Question Browser content in particular in professional development workshops described the LOCUS website as “*the single most valuable online resource for statistics education*” and for “*adult learning of statistics.*” A state-level math coach appreciated that LOCUS website content had “*cleared up some misunderstandings that I had.*” A high school teacher who also facilitates professional development sessions for AP Statistics teachers provided a specific example of a LOCUS assessment item that brought teachers’ misconceptions to light:

One question that a lot of the AP stat teachers even had difficulty with, and I think I even answered it wrong immediately was one about, comparing, this was like a yes or no question for 6th, 7th, 8th, and 9th grade students, or something like that. And the question, you know, which [?] has more variability? And in the data. And everybody picked the one that had a big difference between the yeses or nos, and the correct answer was one where the yes and nos were about the same. And I think that really struck home as, oh, that's what we mean when we talk about variability.

One interview participant did not sense substantial impact on teacher knowledge yet, but felt it would follow from broad dissemination of LOCUS assessments and resources:

I think that the more teachers that get to see this and use it, they would, I think they would start to have a better understanding of it, especially if they get to, like you said, if you register and you can take a test, it might really help in the understanding. It's kind of like, and I know I keep mentioning College Board, but them giving you access to past tests really, really helped in the understanding of the statistics and what you were teaching. I think this could do the same thing.

Statistics Teaching and Learning

Several interview participants also described perceived impacts on statistics teaching and knowledge of statistics pedagogy. One AP Statistics teacher described a change in his conception of statistics teaching, saying “*I think it's changing from 'doing the math' to interpreting and analyzing.*” A university professor made a similar remark, saying that s/he found using LOCUS with students “*very useful in kind of focusing on student interpretation of data, as opposed to student calculation.*” A math coach who works mainly with middle school students offered, “*When I look at this website, it helps me like formulate questions to ask students, and it helps me to kind of think about what a lesson leading up to something like this would look like.*”

Multiple teachers also remarked that their use of LOCUS assessments was influencing the kinds of tasks they gave and the nature of the questions they asked students. The following are two such remarks, both coming from AP Statistics teachers who mainly used the website's test administration functions:

Formulating questions, I think I've never really considered that as like questions that I should ask my students. But those are really good questions, especially thinking about what type of test to use, or what type of graph to display the data. So I think that's influenced or informed the way that I think about statistics, that I really should begin, like all the way at the beginning, like what's the question that we want to answer? Which of these four options is the best way to like formulate your question, and then like where to go from there. What should you actually, like what survey questions should be actually asked to get that kind of data? I think that's probably neglected in AP statistics. It's very infrequent to be asked those kind of questions from my experience on like multiple choice, and your response. It's usually just assumed, and you're just given in the stem. These students wanted to answer this question. They asked this question. Here's the data. Here's the graph. And then interpret.

LOCUS is doing a really good job, again, making the students understand conceptual ideas instead of just, like I said, finding means, finding standard

deviation, finding lines of best fit, but more using it and interpreting, which I believe is kind of the direction we should be going. Like especially as we read statistics and papers and articles and things, we should be questioning, where's the data come from? And that's part of it. And I think LOCUS does a good job of kind of pushing the boundaries a little more.

Using LOCUS, both as an assessment and as a resource, appears to have facilitated some interview participants' awareness and use of the GAISE framework. One math coach who leads professional development workshops about middle school statistics explained, "LOCUS inspired me to encourage teachers to use the formulate, gather, analyze." An AP Statistics teacher offered that LOCUS has "pushed me a little bit to kind of think of [statistics teaching] more in terms of the GAISE framework."

Similarly, a teacher who had previously had little or no exposure to the GAISE framework, accessed the GAISE report through the LOCUS website. She explained:

The GAISE report was really interesting to me, and I sat down, I downloaded it and read through the whole thing. To me, if I'm teaching, I want to know way more about a subject than I'm ever going to tell the students. So for me, it gives me that background, or some more in-depth knowledge so that I'm coming from a position of knowing that topic well.

One math coach talked in terms of potential for future impact on statistics teaching at the elementary and middle school levels:

I think if we had more people knowing about it, and more people on board with being gung ho about statistics, I think it would be very influential. Unfortunately, I think, and I hope I'm dead wrong on this, by the way, but I have a feeling that there's a few of us out there promoting this, and wanting our kids to be strong in statistics, and I think the vast majority are still on the traditional lane where you get statistics only if you have a teacher that really cruises through the curriculum and got to chapter 13, which is really sad.

Perceptions of Quality and Value

Interview participants described a range of aspects of the LOCUS website that they found to be valuable. One aspect that was particularly salient for many participants is "just the quality of questions" available on the LOCUS website, many of which users felt incorporated sophisticated visual components. The following two comments, the first from an AP Statistics teacher and the second from a university professor, elaborate on the value users found in the LOCUS assessment items:

A lot of the questions are like real world data, which either, you know, they either fabricated or made it look like it's real world data. And then the types of graphs that students are asked to create are to interpret the different like formulaic questions. How would you actually obtain data? I think those are valuable 21st century skills that students— You know, they'll see things like that in the newspaper. They might come across situations in their lives when they want to answer questions with data. And I think LOCUS provides a lot of real world contexts that I think would be valuable for students to be able to engage with and to interpret correctly.

I really like the type of questions posed. Like before, most of the courses I taught were let's say drill and practice, and I tried to include questions about understanding, but they were not the best. Like I asked students to explain the meaning, and asked them to compare, whatever, but not into the details I found in the LOCUS website, so I actually like the type of the questions posed.

Other users highlighted that the content and organization of the Question Browser materials in particular supported them in their professional roles and rendered LOCUS a particularly useful resource. For instance, a state-level math coach described the affordances LOCUS provides for supporting her own understanding of statistics for the large grade level range she supports:

I like the fact that it supports conceptual understanding in stats. I like that there's a, it aligns to a lot of the resources we already use, like the GAISE report, and the fact that it, there's a rubric for all, it also aligns to the four components of the statistical problem solving process, and it levels those out. So I like the fact that it shows, this is what it looks like at the beginning level, at the intermediate level, and at the advanced level. And then I also found when I was looking through it the past week that beginning intermediate is kind of your 6-12 range, but the intermediate advanced is your 10-12 range. So kind of breaking out the grade bands, so to speak, so that if I'm a middle school teacher, I'm looking towards the lower end. And because I support both, it really helps me to look at that, the big picture.

Similarly, a high school teacher appreciated the organization of Question Browser resources by grade level, saying “*I like the grade level tabs a lot. I don't think I would use [the Question Browser] if it didn't have grade level tables.*”

A math coach who works mainly with middle school teachers appreciated that the approach to statistics education that LOCUS reflects dovetails well with general mathematics standards:

I think it gets at exactly what students need to understand, and it stays true, for me, anyway, it stays true to the math standards of not looking at statistics as this [real] process thing, but that it's a thinking thing. It's very mathematical thinking. It's problem solving.

Another middle school math coach shared her impressions of the value of LOCUS for use in teacher professional development activities:

I find it to be invaluable. I think there's so much here, and that this tends to be a content area, like I said, especially at the 6th grade level. But even at the high school level, I've heard people say, I don't really, you know, understand it, or I don't really teach it, or I don't know how to teach that. And so because I think there are so many great resources here, that this would be a great place for people to start when they're thinking about planning what this unit would look like in terms of kind of these questions being the end result of where students need to be at. So how would you scaffold that lesson? And so I know there's links to like the illustrative math task, and the resources. And we use that a lot in our district. They're actually included in some of our curriculum guides already. But like [examples], that's a big thing too. So when we look at student work, what is it that we're actually looking for? What should it look like in terms of a student

response? I think there's a lot that is very helpful for teachers, especially teachers at the 6th grade who may not have a statistical, mathematical background.

Finally, although not all AP Statistics teachers felt that LOCUS is well aligned to the AP curriculum, some AP teachers regarded LOCUS as especially valuable as a practice resource for students prior to the AP examination. One teacher explains:

It seems to be pretty streamlined to the information that I'm presenting in class, and I always like an additional resource for students to get a gauge of where they are, especially as we move toward the AP test. In that third trimester, I like to offer up some additional practice. I'm not a fan of students purchasing books to study and prepare for the AP test. I feel like we do a pretty good job of that in class. It's just a waste of their money. So to have the site like this as additional practice for them, I think is a nice bonus.

Suggestions for Improvement

Throughout our interviews, participants offered several suggestions for improving the LOCUS website. Many of these suggestions concern ways in which the website, especially the Question Browser portion, would be used, although some comments echo feedback obtained from test administration users and reported in the LOCUS Formative Evaluation Report (Hochberg & Hammerman, 2015). Because several suggestions offered in response to the open-ended item in the website survey relate to the suggestions that interview participants gave, we discuss these suggestions together in this section. (Additional comments from the online survey are provided in Appendix D.)

Provide Additional Guidance for Using LOCUS

LOCUS users described needing a range of information that, if presented in a way that is both noticeable and clearly relevant to the range of professional roles users have, could support their own or others' use of LOCUS assessments and resources. An interview participant, concerned that teachers are only able to spend short periods of time exploring new resources in order to assess relevance to their needs, suggested that the "Learn About LOCUS" page was insufficient, especially for teachers, and could be improved by adding "*a little blurb about the kind of objective that's trying to be accomplished through the website, perhaps a short video of what's all available, and how it can be used.*" Survey respondents indicated a need for examples of how people in different role categories could use LOCUS appropriately as well as specific information to support their own use, as in these examples, provided along with the primary professional role of the respondent:

- (A math coach) *Who is the site designed for? How can individuals who serve as district and state leaders use the information here? Are the questions for open use with proper citation?*
- (A teacher) *Having a page that identifies the different strategies for use for different types of users so I know whether or not I want to register. For example, I'm an AP Stat teacher. What can I do with your website that will help my class? Can I tailor the tests to my needs of having them go along with the chapters in my textbook? Are these problems similar to problems I will specifically see on the AP exam? Are Null and Alternative Hypotheses names going to be H_0 and H_a or H_0 and H_1 ? AP Statistics is so particular that some sites won't work because they cover either more, less, or different topics than what I need. So how helpful is your site to me?*

- (A PD provider) *Create a subset of items that have Creative Commons licensing so that they can be used in PD and in support materials for teachers.*
- (A teacher) *It would be helpful to have more information about how teachers can use the tests in their classrooms prior to getting approval to open an account.*
- (A college/university faculty member and PD provider) *As someone who will be providing professional development and using the LOCUS I would like to have a sample test or collection of sample items. For now, it looks like I have to peruse sample items one by one. I'd like to see a sample test to know if I should use beginner/intermediate or intermediate/advanced concepts and assessment.*
- (A homeschool parent) *I would like to see the information on the website. [Note that we interpret this to be a desire for general information about the website.]*
- (A researcher) *If I can download the test, it will be great. I need to show the test to the IRB board in my university.*
- (A researcher) *Please provide an official APA citation.*

Consider Ways to Support Interpretation of Test Results

Some survey respondents and interview participants expressed a desire for additional information to support their interpretation of LOCUS assessment results and their decision-making about actions to help address misconceptions evident in these results. For instance, two teachers who were interviewed offered the following suggestions:

I think it would be cool if, and I don't know if it's possible, but I think it would be cool if LOCUS provided kind of like an executive summary, that like overall, your students did poorly in formulating questions. And like here's an example question that they missed, or here's an example question that you could use to help them understand this content, and how to teach this content.

LOCUS has the GAISE standards, but I think it would be cool if it was somehow correlated to the AP standards. So if a student misses a question, I can not only see like what GAISE standard they're lacking on, or which of those four categories, like analyzing data, formulating questions, and the other one, if those actually correlated with AP stats standards.

Comments from the online survey include similar suggestions, including one from a teacher who said, *"It would be great if the students could go back to the test taken to view correct answers and link to explanation of why."* Additionally, both a teacher who was interviewed and a researcher who responded to the online survey expressed confusion about how to interpret scores on the assessments. For instance, the researcher wrote in response to the open-ended survey question:

How do you calculate test-taker's score please? I add one test-taker's performance for each question, but the sum is different from the score that is shown in the Excel downloaded. For example, I have a student whose sum-up-score is 82, but the score that is shown in Excel is 62.

Provide Additional Connections to Support Statistics Pedagogy

Interview respondents in particular described a desire for additional resources to support their own or others' approaches to statistics pedagogy. As these comments suggest, the LOCUS website could be improved (such as through additional links to the Question Browser) by adding

suggested lessons or activities to support addressing both particular concepts and broad approaches to statistics teaching more generally (or making the resources that are available, but were rarely downloaded, more prominent and accessible):

I think it would be nice to be able to see, since we're talking about pedagogy, what a statistics lesson might look like. Like how do you have these discussions maybe around a question or around a task? And so I guess video of what it actually looks and sounds like, because it has its own unique language and way of thinking that's I guess less computation heavy and driven, and more kind of like, you know, data driven and talking about math. I kind of think of it as the, you know, let's talk about math, and, you know, see what stories the numbers tell us. And so I think for people to be able to see that might be helpful.

One thing that would be helpful on your website are more, are some like hands-on type activities, or like lab activities for [some] topics. That's the only suggestion I could make, would be, cause I go to that [CauseWeb] website to find things like that, like lab type activities, either computer or oriented or not, that help to reinforce. I find the kids really learn from doing hands-on activities.

My interpretation of the way that the entire site is designed is that any teacher coming out of college who has been given the opportunity to have meaningful lessons modeled for them is going to understand the depth of the website. But I'm not sure that an established teacher is going to change their skill drill method without like video lessons, or some sort of example.

Consider Adding Additional Features to the Question Browser

We received additional suggestions specifically related to features of the question browser. For instance, one teacher described a desire for a search feature to support quick reference to items of particular relevance:

I'd really like it if it was sorted out by standard, or there was like a search that I could kind of search by key words, would be really nice. Cause again, like I'm always looking for more probability stuff, but this is more data. And I don't really see any probability.

Similarly, a teacher who responded to the online survey offered that “*It would be nice if we could search the resources by standard within each of the domains (analyze data, collect data, etc.)*.” One teacher expressed a desire for “*printable questions, not just one at a time*” to enable herself and other teachers to refer to multiple Question Browser items at a time without having to click around or rely on an unstable internet connection.

Explore Ways to Improve User-Friendliness of Test Administration Functions

Online survey respondents suggested several ways that the experience of using LOCUS test administration functions could be improved. On the registration side, university professors made the following comments:

- *Decrease the delay between applying for a LOCUS account and getting approval.*
- *Questions on my background during registration seem a bit much. Why is this information important at that point?*

Additional comments on the online survey refer to potential improvements to the process of creating and submitting test requests. For instance, a teacher suggested, *“It would be nice for instructors to be able to see the tests before assignment so that I can choose the best ones.”* Another teacher requested *“the ability to print tests.”* A different teacher appeared to want suggestions for naming conventions to use when creating a test request and administering a test to students, saying, *“Have a more specific way to label the test taker identifier. Have a standard way of labeling each test.”* Other suggestions include:

- *Make it possible to modify the starting date of exams.*
- *Having students be able to create their own accounts so you can track their improvements.*

Attend to User Navigation Challenges

One piece of feedback we received from a researcher who responded to the online survey is that the LOCUS website is *“a little difficult to navigate at first but it’s most likely due to the wealth of information.”* Other LOCUS users offered additional observations and suggestions pertaining to navigation from the home page, including the following, both from university professors:

- *I would make the Looking to create a test, looking to take a test bigger.*
- *I think a lot of instructors would be interested in looking at sample questions. At first glance, those are not easy to find.*

Another university professor noted challenges with navigation through test administration pages: *“If you are logged in as an instructor I don’t think you can navigate to the “take” page, which is kind of a pain since I need to paste that link into the instructions to students.”* Finally, another university professor notes that it is *“hard to get back to the main menu page.”* Although it is not clear whether this comment refers to the test administration Dashboard, the LOCUS homepage, the main Question Browser page, or something else, it seems appropriate to attend to ease of navigation throughout the site.

Summary

Overall, the LOCUS website was able to attract a modest amount of traffic from the range of users it was hoping to target — primarily K-12 teachers (60% of survey respondents), with the rest mostly a variety of other K-12 district personnel and higher education educators and researchers. While many users only visited the site once or spent just a few minutes on the site, others stayed longer and/ or came back several times to create and then access results of LOCUS assessments, to learn more about statistics and statistics education, or to get support for their own classroom planning.

The site’s resources for test administration are highly regarded, although survey and interview respondents suggest a number of improvements for navigating the site and interpreting test results, as described above. The site provided resources both for test administration and for learning and professional development about statistics, although few users accessed both primary “branches” of the site, and interviews suggest that many of those who came to create and administer tests didn’t realize the Question Browser information was available to support them.

Within the Professional Development/ Question Browser branch, site visitors found both the grade level view and the view by GAISE component useful, though the grade level pages got about 30% more views per page than did the GAISE component pages, and pages related to multiple choice items got 23% more views per page than did those related to constructed response items. Pages about the GAISE component Collect data received less attention than did

pages focusing on Formulate questions, Analyze data, or Interpret results. That said, survey respondents who visited more GAISE component pages expressed increased satisfaction with the LOCUS site overall than did those who visited fewer GAISE pages. There was no such difference based on grade level pages visited. Though interview respondents suggested that additional resources to support teaching statistics would be very useful, very few site visitors downloaded the .pdfs provided.

All in all, the content presented on the LOCUS site is of high quality. However, the tools available for navigating the site were insufficient for many users to find all of the resources, or get an overview of the site that would help them know what tools are available to help them achieve desired goals. For example, the addition of some way to navigate between major components of the site – test administration and professional development, or grade level and GAISE component sections of the Question Browser – would remind users about other resources available. A succinct overview of the site that’s accessible to a range of audiences would help people envision a way to use LOCUS to support whatever purposes they have as statistics educators and researchers. Resources that might support the teaching of statistics, when available, are buried deep within the Question Browser – finding a way to make them more visible and accessible would increase their use. Finally, existing registered users may not be aware of all of the resources that are available on the site – some kind of notification of updates and changes would likely draw attention to the site and increase interest and collegial referrals. Still, for those who explore it, LOCUS has exposed users to the GAISE framework for the first time, which has supported new ways of thinking about statistics and statistics teaching that move the focus of instruction towards broad concepts and processes rather than procedures and algorithms.

References

Hochberg, E. D., & Hammerman, J. K. L. (2015). *Levels of Conceptual Understanding in Statistics (LOCUS) formative evaluation report*. Cambridge, MA: TERC.

QSR International. (2012). NVivo 11 [Computer software]. Available from <http://www.qsrinternational.com>

Appendix A — LOCUS users by Metro Region

Google Analytics identified “metro regions” for ID1 identified LOCUS site users

metro	N ID1s	metro	N ID1s	metro	N ID1s
Los Angeles CA	25	Spokane WA	3	Ft. Myers-Naples FL	1
New York NY	20	Cincinnati OH	2	Grand Junction-Montrose CO	1
Atlanta GA	16	Cleveland-Akron (Canton) OH	2	Grand Rapids-Kalamazoo-Battle Creek MI	1
Chicago IL	15	Kansas City MO	2	Green Bay-Appleton WI	1
(not set)	12	Las Vegas NV	2	Greensboro-High Point-Winston Salem NC	1
Jacksonville FL	10	Lexington KY	2	Greenville-New Bern-Washington NC	1
Seattle-Tacoma WA	10	Little Rock-Pine Bluff AR	2	Harrisburg-Lancaster-Lebanon-York PA	1
Boston MA-Manchester NH	9	Louisville KY	2	Idaho Falls-Pocatello ID	1
Orlando-Daytona Beach-Melbourne FL	9	Montgomery (Selma) AL	2	Jackson MS	1
San Francisco-Oakland-San Jose CA	8	New Orleans LA	2	Johnstown-Altoona PA	1
Gainesville FL	7	Phoenix AZ	2	Knoxville TN	1
Raleigh-Durham (Fayetteville) NC	7	Pittsburgh PA	2	La Crosse-Eau Claire WI	1
San Diego CA	7	Providence RI-New Bedford MA	2	Lafayette IN	1
Washington DC (Hagerstown MD)	7	Salt Lake City UT	2	Lansing MI	1
Milwaukee WI	6	Springfield MO	2	Miami-Ft. Lauderdale FL	1
Charlotte NC	4	St. Louis MO	2	Missoula MT	1
Dallas-Ft. Worth TX	4	Tallahassee FL-Thomasville GA	2	Monterey-Salinas CA	1
Denver CO	4	Albany-Schenectady-Troy NY	1	Odessa-Midland TX	1
Indianapolis IN	4	Augusta GA	1	Palm Springs CA	1
Portland OR	4	Austin TX	1	Reno NV	1
Rochester NY	4	Bangor ME	1	San Antonio TX	1
Baltimore MD	3	Biloxi-Gulfport MS	1	South Bend-Elkhart IN	1
Columbia SC	3	Birmingham AL	1	Syracuse NY	1
Detroit MI	3	Boise ID	1	Tampa-St. Petersburg (Sarasota) FL	1
Hartford & New Haven CT	3	Charleston SC	1	Toledo OH	1
Madison WI	3	Charleston-Huntington WV	1	Tulsa OK	1
Minneapolis-St. Paul MN	3	Colorado Springs-Pueblo CO	1	Twin Falls ID	1
Nashville TN	3	Columbus GA	1	Wausau-Rhineland WI	1
Norfolk-Portsmouth-Newport News VA	3	Columbus OH	1	West Palm Beach-Ft. Pierce FL	1
Philadelphia PA	3	Columbus-Tupelo-West Point MS	1	Wilkes Barre-Scranton PA	1
Sacramento-Stockton-Modesto CA	3	Davenport IA-Rock Island-Moline IL	1	Yuma AZ-El Centro CA	1
		Dothan AL	1		

Appendix B – Survey Consent Text

Information about LOCUS Website Survey

Thank you for using the Levels of Conceptual Understanding in Statistics (LOCUS) project website. As you may know, the LOCUS project is funded by the National Science Foundation. The LOCUS project is based at the University of Florida, Gainesville, and led by Dr. Tim Jacobbe. It is being evaluated by the STEM Education Evaluation Center (SEEC) at TERC, a non-profit STEM education research and development organization located in Cambridge, MA.

1. Purpose: This survey is part of the external evaluation of LOCUS. SEEC staff are collecting feedback from LOCUS website users. The LOCUS project will use this feedback to improve the website and materials.

2. Procedures: You will complete an online survey. The survey is anonymous, although if you choose to provide your email address to participate in an optional follow-up phone interview, your responses will be associated with your email address.

3. Risks and benefits: The survey asks about your profession, your reasons for visiting the website, and your level of satisfaction, so the risks to you are minimal. Responses are anonymous, except if you choose to provide your email address. The survey will take about 2 minutes of your time. There are no direct benefits to you, but your responses may help improve the LOCUS website and materials, and you may benefit from that.

4. What we do with the results: Survey responses will be summarized and described in a report for the LOCUS project team. This report will also be shared with the National Science Foundation. SEEC researchers may present about the study at conferences or in publications for researchers or educators. Your identity will remain entirely confidential whether or not you choose to provide your email address with your survey responses.

Participation in the survey is voluntary. You may decide to withdraw at any time. Withdrawal or refusal to participate will not impact your access to the LOCUS website.

If you have questions about the survey or the research, please contact the lead evaluator at SEEC, Jim Hammerman, at 617-873-9600, jim_hammerman (at) terc (dot) edu. You can also contact Teon Edwards on TERC's oversight board for human subjects research (IRB) at 617-873-9600, teon_edwards (at) terc (dot) edu.

Appendix C – Interview Questions

SECTION 1: USER BACKGROUND AND PROFESSIONAL ROLE(S)

To help contextualize your comments, I would like to know more about your connection to statistics education.

1. On the online survey, you indicated that you are a [K-12 TEACHER, K-12 ADMINISTRATOR, FACULTY MEMBER OR INSTRUCTOR IN HIGHER ED, PD PROVIDER, RESEARCHER, GRADUATE STUDENT, OR OTHER]. Tell me more about what you do professionally.
 - a. If TEACHER OR OTHER K-12 SCHOOL OR DISTRICT PERSONNEL:
 - i. What grade level(s) and content area(s) do you teach? (Or What grade level(s) and content area(s) do you supervise?)
 - ii. For how long have you taught/supervised this/these grade level(s) and content area(s)?
 - b. If TEACHER EDUCATOR:
 - i. What grade level(s) and content area(s) are teachers with whom you work being prepared to teach?
 - ii. Do you work primarily with pre-service teachers, with in-service teachers, or with both?
 - c. If OTHER FACULTY:
 - i. In which college or university department do you work?
 - ii. On what topics are the courses you teach and/or your research?
 - d. If RESEARCHER, probe for general type and content of research
 - e. If OTHER, probe for clarity
 - f. If MULTIPLE PROFESSIONAL ROLES: Which would you consider to be your primary professional role (i.e., the one that occupies the greatest proportion of your time or effort)?
2. [If not already answered above]: To what extent is teaching statistics, or teaching others to teach statistics, part of your job?
3. Tell me about your background in statistics. (Prompt: For instance, what formal preparation (e.g., college-level courses) have you had in statistics or statistics education? To what extent have you conducted statistical analyses as part of your work or other activities?)

SECTION 2: USER ENGAGEMENT WITH THE LOCUS WEBSITE

Now, I would like to get a sense of how you have used the LOCUS website.

4. When did you start using the LOCUS website?
 - a. How did you initially find out about LOCUS?

5. For what purposes have you used or referred to the LOCUS website?
6. Have you created a LOCUS test administration account on the website?
 - a. If NO:
 - i. What about the website, your reasons for being on the website, or your own personal situation have kept you from creating an account?
 - ii. What improvements could be made to the website that would make it more likely for you to create an account?
7. Have you administered a LOCUS assessment?
 - a. If YES:
 - i. Which test(s) did you administer? To whom did you administer the test(s)?
 - ii. For what purposes? (e.g., research, formative assessment, summative assessment, etc.)
 - b. If NO:
 - i. What about the website, your reasons for being on the website, or your own personal situation have kept you from administering a LOCUS assessment? [Probe on factors that may have constrained use (e.g., issues of timing, technological capacity, lack of administrator support).]
 - ii. What improvements could be made to the website that would make it more likely for you to administer a LOCUS assessment?

In addition to the LOCUS test administration functions that are accessible only to users who have registered for a LOCUS account, the website includes a large quantity of questions and associated commentary and resources under the “View Items & Resources” tab on the website. We refer to this section of the website as the Question Browser.

8. To what extent have you viewed the Question Browser portion of the website?
 - a. If FREQUENTLY/OCCASIONALLY viewed:
 - i. For what purposes have you viewed content in the Question Browser?
 - ii. What features of the Question Browser have you found to be most helpful to you for achieving these purposes?
 - b. If NEVER/RARELY viewed:
 - i. What about the website, your reasons for being on the website, or your own personal situation have kept you from viewing the Question Browser?
 - ii. What improvements could be made to the website that would make it more likely for you to use the Question Browser?
9. [IF RESPONDENT HAS USED BOTH ASSESSMENT ADMINISTRATION AND QUESTION BROWSER PORTIONS OF THE WEBSITE]:

- a. Did you visit the Question Browser portion of the site before administering a LOCUS assessment, or did you give an assessment before visiting the Question Browser?
 - b. Which do you tend to use more frequently – the Question Browser or the test administration functions?
 - i. Is there a reason you use one more than the other?
 - c. To what extent do the test administration and Question Browser portions of the website complement one another?
10. Thinking about the website as a whole, how often do you use or refer to materials or resources on the LOCUS website?
- a. [IF RESPONDENT TEACHES STUDENTS OR TEACHERS OF STATISTICS]:
 - i. In what ways have you used LOCUS materials as resources for your work with [students]/[teachers]?
 - ii. In what ways have [your students]/[the teachers with whom you work] used LOCUS materials?

SECTION 3: QUALITY OF THE LOCUS WEBSITE

Now, I'd like to hear your thoughts on the quality of the LOCUS website.

11. What is your overall impression of the value of the LOCUS website?
12. What would you say are the most valuable aspects of the LOCUS website for you?
- a. How have these aspects been valuable? (If multiple, ask about each one.)
 - b. [IF GENERALLY NEGATIVE ABOUT LOCUS, probe for details about what limits the LOCUS website's (and/or materials') value.]

SECTION 4: IMPACT OF LOCUS

Now, I'd like to ask you to think about the impact LOCUS has had. First, I'll ask you to consider the Question Browser portion of the website.

13. How has the Question Browser portion of the website influenced your understanding about statistics content? (Probe for details about impact on statistics content learning.)
14. How has the Question Browser portion of the website influenced your understanding about statistics teaching? (Probe for details about impact on statistics pedagogy.)
15. How have you used the LOCUS website to inform how you [teach statistics]/[teach pre-service teachers of statistics]/[work with in-service teachers of statistics]/[approach research in statistics or mathematics education]? (Probe for details/descriptions of impact on practice.)

Now, I'd like you to consider the impact of LOCUS more broadly.

16. What do you think of the LOCUS website and assessments as an image of what ought to be the content and focus of statistics education for students in grades 6-12?
17. How do you think the LOCUS website is influencing the content or pedagogy of statistics education for grades 6-12?
 - a. IF LIMITED PRESENT INFLUENCE: How could the LOCUS website influence the content or pedagogy of statistics education for grades 6-12 in the future?

SECTION 5: FINAL QUESTIONS

I have a few remaining questions for you.

18. What suggestions do you have for how to make LOCUS assessments and resources as useful as possible for [statistics educators/statistics teacher educators/researchers/etc.] like you?
19. Is there anything that I haven't asked you about your experiences with LOCUS that you would like to add?
20. Is there anything about what you have said that you wouldn't want to have quoted or shared with the LOCUS project team?

Thank you for taking the time to talk with me today. Before we hang up, would you please confirm the email address where you would like your \$25 Amazon.com electronic gift card sent?

You should expect to receive this within the next several weeks. If you do not, please contact me at eric_hochberg@terc.edu or (617) 873-9600.

Appendix D – Selection of Comments from Online Survey

This table includes a selection of 50 respondents’ comments, organized by category, from among the 118 who did not leave the open-ended response blank. We exclude comments that were not substantive (e.g., that said only “none” or “NA”), as well as any that referred only to the timing of the website survey or were not relevant to the question about website improvement.

General Praise

Role	Quote
Regional math coach	<i>“This is a phenomenal resource!”</i>
Teacher	<i>“keep it going...I love it”</i>
Teacher	<i>“The questions are great to get learners thinking about Statistics.”</i>
Statistics software developer	<i>“I just started to take a look. It looks nice question which really test understanding.”</i>
Teacher	<i>“It’s already a very well organized website.”</i>
University professor	<i>“Site looks great.”</i>
University professor	<i>“It is quite thorough. Thank you.”</i>
Teacher	<i>“What I see is impressive.”</i>

General Use of Website

Role	Quote
Math coach	<i>“Who is the site designed for? How can individuals who serve as district and state leaders use the information here? Are the questions for open use with proper citation?”</i>
Teacher	<i>“It would be helpful to have more information about how teachers can use the tests in their classrooms prior to getting approval to open an account.”</i>
PD provider	<i>“Create a subset of items that have creative commons licensing so that they can be used in PD and in support materials for teachers.”</i>
Teacher	<i>“Have a general overview of purpose available on front page.”</i>
Teacher	<i>“More specific on the topics the tests measures.”</i>
University professor	<i>“I want to know if there is a way to use the test in a pre- and post-test version. Still trying to figure that out!”</i>
Researcher	<i>“I think the full question bank isn’t available on the site without a full account - I would highlight that info (that there are more questions than what’s initially available.)”</i>
PD provider and University professor	<i>“As someone who will be providing professional development and using the LOCUS I would like to have a sample test or collection of sample items. For now, it looks like I have to peruse sample items one by one. I’d like to see a sample test to know if I should use beginner/intermediate or intermediate/advanced concepts and assessment.”</i>

Homeschool parent	<i>"I would like to see the information on the website."</i>
Teacher	<i>"It would help to have a general idea of what this website does? I'm assuming I can have my students take tests, then get a summary of results afterwards. It would also be nice if I could preview the test beforehand in order to get an idea of the appropriateness for my students."</i>
Teacher	<i>"Having a page that identifies the different strategies for use for different types of users so I know whether or not I want to register. For example, I'm an AP Stat teacher. What can I do with your website that will help my class? Can I tailor the tests to my needs of having them go along with the chapters in my textbook? Are these problems similar to problems I will specifically see on the AP exam? Are Null and Alternative Hypotheses names going to be Ho and Ha or Ho and H1? AP Statistics is so particular that some sites won't work because they cover either more, less, or different topics than what I need. So how helpful is your site to me?"</i>

Test Administration

Role	Quote
University professor	<i>"Make it possible to modify the starting date of exams."</i>
Teacher	<i>"You should be able to change start date to test."</i>
Teacher	<i>"It would be nice for instructors to be able to see the tests before assignment so that I can choose the best one."</i>
Teacher	<i>Having student be able to create their own accounts so you can track their improvements</i>
Teacher	<i>Have a more specific way to label the test taker identifier. Have a standard way of labeling each test.</i>
University professor	<i>"I would make the looking to create a test, looking to take a test bigger. Also if you are logged in as an instructor I don't think you can navigate to the "take" page which is kind of a pain since I need to paste that link into the instructions to students."</i>
Researcher	<i>"It would be helpful to explain how one can administer a test - whether there are special testing features.</i>
Teacher	<i>"Is it possible to create several versions of a test?"</i>
Teacher	<i>"The ability to print tests."</i>
University professor	<i>"Decrease the delay between applying for a LOCUS account and getting approval."</i>
University professor	<i>"Make the test available for download to registered users."</i>
University professor	<i>"Questions on my background during registration seem a bit much. Why is this information important at that point?"</i>

Results interpretation

Role	Quote
Teacher	<i>“more information about what the test results show”</i>
Teacher	<i>“It would be great if the students could go back to the test taken to view correct answers and link to explanation of why.”</i>
Teacher	<i>“The reports for the tests are hard to read and the export option is not working. I wonder why there is not labels for the answer choices like A and B, etc. It makes it harder to check results.”</i>
Teacher	<i>“I'd love to see more detail on the questions my students miss. Just showing their incorrect/correct answer with no topic/objective connected is not helpful.”</i>
Researcher	<i>“How do you calculate test-taker's score please?I add one test-taker's performance for each question, but the sum is different from the score that is shown in the Excel downloaded. For example, I have a student whose sum-up-score is 82, but the score that is shown in Excel is 62.”</i>
Researcher	<i>“Teachers in a related program are using LOCUS with their students...I find that they aren't necessarily using dashboard to view students results. Wondering whether there is some way to support their interpreting of results?”</i>
University professor	<i>“it would be helpful if emailed reports gave them all information of scores in the subscales as shown in the Test Taker Summary report. My students find that summary most helpful. It is the next best thing to an item report for them.”</i>
University professor	<i>“If I can download the test, it will be great. I need to show the test to the IRB board in my university;”</i>

Question Browser Features

Role	Quote
Teacher	<i>“It would be nice if we could search the resources by standard within each of the domains (analyze data, collect data, etc.)”</i>
Teacher	<i>“I would like to be able to search by standard for the sample items.”</i>
Teacher	<i>“sample lessons aligned to the standards or concepts”</i>
Teacher	<i>“Maybe printable questions, not just one at a time.”</i>

Research Needs

Role	Quote
University professor	<i>“Please provide an official APA citation.”</i>
Researcher	<i>“More links to presentations listed.”</i>
University professor	<i>“Increase the availability of documents for download.”</i>

Navigation and Technical Issues

Role	Quote
Teacher	<i>“The result generation is very slow.”</i>
University professor	<i>“I think a lot of instructors would be interested in looking at sample questions. At first glance, those are not easy to find.”</i>
Researcher	<i>“A little difficult to navigate at first but it's most likely due to the wealth of information.”</i>
Teacher	<i>“Sometimes this site doesn't load properly”</i>

University professor	<i>“Devise a means for moving more smoothly from item to time without having to scroll down to the beginning of each item. Clicking "next" should take the reader to the beginning of each item as opposed to the top of the window.”</i>
University professor	<i>“The dashboard options do not work when trying to view students responses. I took the test myself several times and no data was recorded or available for use.”</i>
University professor	<i>“Hard to get back to the main menu page.”</i>
