Empowering Educators

Supporting Student Progress in the Classroom with Digital Games

TECHNICAL APPENDIX

A REPORT OF THE **A-GAMES PROJECT:** ANALYZING GAMES FOR ASSESSMENT IN MATH, ELA/SOCIAL STUDIES, AND SCIENCE

SCHOOL OF INFORMATION
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NYU | **STEINHARDT**

INSIDE

INTRODUCTION

The A-GAMES project (Analyzing Games for Assessment in Math, ELA/Social Studies, and Science), a collaboration between the University of Michigan and New York University, studied how teachers use digital games in their teaching to support formative assessment. Formative assessment is a set of practices to gauge student progress toward learning goals, and to adjust instruction on the basis of that information to meet students where they are.

Formative assessment is arguably one of the most important parts of a teacher's instructional tool kit. When used well, it has been found to be among the most powerful ways to improve student learning outcomes, and it may be particularly important to the success of low-ability students. But as with any "best practice," in order to be effective, formative assessment approaches must be both useful and used. And that's where games — potentially — come into play.

This study was conducted in two parts: part one was a nationwide survey of K-12 teachers to investigate common formative assessment practices, common game use practices, and the intersection of the two. Part two consisted of case studies of various game features and how they are perceived and used by teachers. These case studies were based on observations and interviews with 30 middle grades (5-8) teachers in the New York City area who volunteered to use one of eleven games as part of their teaching in Spring 2014. The survey offers a "mile high" picture of what teachers are doing with games related to formative assessment. The observations and interviews focused on how teachers used (or did not use) various features within each game that had the potential to be used for formative assessment. The A-GAMES study is exploratory in nature, and is not intended to compare or gauge the effectiveness of games, game features, or approaches to formative assessment.

This Technical Appendix provides details from the survey that informed part one of the A-Games study, for those who are curious about the details underlying the survey report (which can be downloaded here). The survey itself is included as Appendix 1, and response breakdowns for each item and details of all analyses follow in subsequent appendices.

We hope that this Technical Appendix, along with the original survey and case study reports, provides a complete picture of the data and findings from the A-GAMES project.

The utility of games as instructional tools will continue to expand. Our hope is that our work with the A-GAMES project provides useful information to teachers about the ways games can inform and support their practice, and to the game development community about ways to continue to strengthen the support for learning and teaching provided by their games.

Appendix 1 – The A-GAMES Survey

Items from A-GAMES National Teacher Survey, Fall 2013

Teacher Background Items

This section asks some basic questions about you, your teaching background, and the students you teach.

(1) What is your gender?
- ○ Male
- ○ Female
- ○ Prefer not to respond

(2) In what year were you born?
(Range of Years from 1935-1996 presented, including "Prefer not to respond.")

(3) What is the highest degree you have earned?
- ○ Completed some college, but no degree
- ○ Associate's degree
- ○ Bachelor's degree (e.g., B.A., A.B., B.S.)
- ○ Completed some graduate school, but no degree
- ○ Master's degree
- ○ Doctorate
- ○ Prefer not to respond

(4) Which of the following BEST describes your CURRENT position? [The survey targeted K-12 classroom teachers and Specialist teachers. All others choices end the survey.]
- ○ K-12 classroom teacher
- ○ Specialist teacher
- ○ Out-of-school educator
- ○ Administrator
- ○ Student or pre-service teacher
- ○ None of the above
- ○ Prefer not to respond

(5) [If "Specialist teacher" was selected in item 4]
Do you teach a course that meets regularly in a classroom or computer lab?
- ○ Yes
- ○ No

(6) [If "Specialist teacher" was selected in item 4]
What is your specialty?
- ❍ Health/PE
- ❍ Computer or Technology
- ❍ Special Education
- ❍ School-based Staff Developer or Coach
- ❍ Librarian or Media Specialist
- ❍ Other (please specify): _____

(7) [If "K-12 classroom teacher" was selected in item 4]
Which of the following BEST describes your classroom teaching position?
- ❍ Subject matter teacher, e.g., I teach stand-alone classes in math, science, history, etc.
- ❍ Self-contained classroom teacher, I teach all subjects
- ❍ Self-contained classroom teacher, but I switch classes with another teacher for some subjects (including team teaching)

(8) INCLUDING THIS YEAR, how many years have you been a classroom teacher?
[Range of 1-65 presented, including "Prefer not to respond."]

(9) Which grade level(s) do you CURRENTLY teach? Please check ALL that apply.
- ❑ K
- ❑ 1
- ❑ 2
- ❑ 3
- ❑ 4
- ❑ 5
- ❑ 6
- ❑ 7
- ❑ 8
- ❑ 9
- ❑ 10
- ❑ 11
- ❑ 12

(10) Which subject(s) do you CURRENTLY teach? Please select ALL that apply.
[Not asked if "Specialist Teacher" was selected in question 4.]
- ❑ English/Language Arts/ELA
- ❑ Mathematics
- ❑ Science
- ❑ History/Social Studies
- ❑ Other (please specify): _____
- ❑ None of the above

(11) How would you describe the GENERAL performance level of the students for all the classes YOU currently teach?
- ❍ Below grade level
- ❍ At grade level
- ❍ Above grade level
- ❍ Mixed ability
- ❍ Prefer not to respond

(12) What is your SCHOOL's zip code?

(13) Please choose the options that MOST CLOSELY describe the school where you currently work.

Type	❍ Public	❍ Charter	❍ Private/Religious
Setting	❍ Urban	❍ Suburban	❍ Rural
Socioeconomic	❍ Affluent	❍ Middle Income	❍ Low Income
Title 1?	❍ Yes	❍ No	❍ Not sure

(14) About what percentage of students at your school are eligible for free- or reduced-price lunch?
- ❍ 0-9%
- ❍ 10-19%
- ❍ 20-29%
- ❍ 30-39%
- ❍ 40-49%
- ❍ 50-59%
- ❍ 60-69%
- ❍ 70-79%
- ❍ 80-89%
- ❍ 90-100%

Formative Assessment Items

This next set of questions focuses on formative assessment in your classroom. By "formative assessment" we mean the various ways that teachers check for student progress or understanding during instruction. The overall goal of formative assessment is to shape instruction or measure progress through instruction. This makes it different from summative assessment, which is used to measure student outcomes, often at the end of a unit. We are interested in learning more about your formative assessment practices, and the ways you go about formative assessment during your lessons and units of instruction.

(15) Generally speaking, WHEN do you use formative assessment?

	Rarely/Never	Sometimes	Regularly	Most/All of the time
Before a unit/ lesson				
At planned check points during a unit/lesson				
Spontaneously during teaching				
At the end of a unit/ lesson				

(16) Generally speaking, when you use formative assessment, WHAT do you check for? (Check all that apply.)
❏   Facts and knowledge
❏   Procedures and processes
❏   Concepts and big ideas
❏   Misconceptions
❏   Prior knowledge related to the lesson
❏   Metacognitive knowledge
❏   Motivation and engagement
❏   Progress on standards
❏   Mastery of specific skills
❏   Other things not listed here.

(17) [Items selected in the previous item are re-presented in a matrix]. Now please indicate how OFTEN you use formative assessment to check for these things by dragging each one to the appropriate box: Regularly (THROUGHOUT each lesson), Often (at some point during EACH lesson), Sometimes (in MOST lessons), or Occasionally (in SOME lessons).

(18) How often do you use each of the following formative assessment techniques?

	This isn't something I typically do.	Occasionally. In SOME lessons	Sometimes. In MOST lessons	Often. At some point during EACH lesson	Regularly. THROUGHOUT each lesson
I ask for a show of hands					
I have students write down a short answer					
I have students solve a problem during class					
I have students complete exit tickets					
I asking probing questions					
I look over students' shoulders					
I observe students in class					

(19) What do you DO with the information from formative assessment?
[Respondents are asked to drag the items presented below in boxes labeled "About daily," "About weekly," "About monthly", or "I don't typically do this"]

Convey/clarify lesson objectives to students
Track student progress
Give feedback to students
Change the lesson in real-time
Plan or modify future lessons
Continue as planned, but come back to important ideas in the future
Assign additional work
Group students/pair students
Find/create alternative instructional strategies for teaching a topic.

(20) Do you share or discuss formative assessment information with others?

	About daily	About weekly	About monthly	I don't typically do this.
Give feedback to parents				
Share the information with my teacher colleagues.				
Share the information with my administrator(s).				
Discuss the information with my teaching colleagues.				
Discuss the information with my administrator(s).				

(21) What barriers do you face in conducting formative assessment of student understanding?
❑ Curriculum materials are too inflexible
❑ Curriculum doesn't provide materials/resources for formative assessment
❑ There is not enough time to administer formative assessments
❑ There's not enough time to use the formative assessment results to modify instruction
❑ Insufficient training/preparation for doing formative assessment
❑ Insufficient training/preparation for making use of formative assessment results
❑ It's too hard to make sense of the information I get from formative assessments
❑ I don't know what to do with the information I get from formative assessments
❑ Formative assessments don't give me the information I need for instructional modification
❑ Formative assessment results conflict with other information/data (e.g., summative test results).
❑ Other barriers not listed here.
❑ I do not face any barriers in conducting formative assessment in my classroom.

(22) [Barriers selected in the previous item are re-presented in a list, and respondents are asked to sort them by "dragging them into [a] box and ordering them from MOST challenging (#1, top of the list) to LEAST challenging (bottom of the list)"].

Video Game Use Items

These questions are about how you use and think about games in your instruction. With these questions, we are hoping to learn more about your perspective and practices related to digital games for teaching and assessing. There are about 10 questions in this section. Depending on your responses, some questions include optional follow-up prompts.

(23) How often do YOU play video/digital games for entertainment or other NON work-related reasons? Examples: game consoles, computer games, smart phone game apps, social media games, etc.
- ○ Rarely/never
- ○ About monthly
- ○ About weekly
- ○ About daily

(24) How often do you use digital games (e.g., video games, simulations, educational online games, etc.) as a TEACHING tool?
- ○ Rarely/never
- ○ About monthly
- ○ About weekly
- ○ About daily

(25) How comfortable are you using digital games as a teaching tool?
- ○ Not comfortable
- ○ Slightly comfortable
- ○ Moderately comfortable
- ○ Very comfortable

(26) To what extent do you feel digital games can be effective at:

	Unsure	Not at all effective	Somewhat effective	Effective	Very effective
Teaching students new content					
Helping students reinforce or master previously taught content					
Motivating students to learn content					
Providing useful information about student learning					

(27) Do you use any of the following online sites for educational games? Please check ALL that apply.
[Respondents were only shown this item if they selected "About monthly" or more often in item 24.]

❏   GameUp, by BrainPOP
❏   Educade
❏   Filament Games
❏   Learning Games Network
❏   Mangahigh.com
❏   PBS Kids
❏   Playful Learning
❏   Poptropica
❏   PowerMyLearning
❏   Thinkfinity
❏   Other(s) (please specify): _____
❏   None - I do not use or belong to any educational game sites.

(28) At your school, which of these barriers do TEACHERS face in using digital games in the classroom? NOTE: Please drag ONLY the options that you feel are barriers for teachers.

[Respondents were asked to select from the list of barriers below, and then sort them by "dragging them into [a] box and ordering them from MOST challenging (#1, top of the list) to LEAST challenging (bottom of the list)"].

Hard to find games that fit our school's curriculum
Lack of technology resources (computers, devices, Internet connection)
Emphasis on standardized test scores
Insufficient time in curriculum
Not sure where to find quality games
Not sure how to integrate games into instruction
Lack of administrative support
Lack of parental support
Cost of game software
Unfamiliarity with technology
There are no barriers

(29) About how often do your students use each of these kinds of digital games in your classroom?
[Respondents were only shown this item if they selected "About monthly" or more often in item 24.]

	Rarely/Never	About Monthly	About Weekly	About Daily
Educational games, e.g., literacy, math, or other content-specific games, such as MangaHigh or MissionUS				
Student-designed games				
Simulation games, e.g., SimCity, SimLife, Civilization series				
Role-playing games, e.g., MUDs, MMORPGs, DragonQuest, Revolution				
Puzzle or manipulative games, e.g., Tetris, Angry Birds				
Trivia games, e.g., Free Rice, Triviaplaying.com				
Active/Physical games, e.g., Dance Dance Revolution, sports simulations				
Action/Adventure games, e.g., LEGO Harry Potter, Super Mario Brothers				

(30) About how often do you use digital games for each of the following purposes?
[Respondents were only shown this item if they selected "About monthly" or more often in item 24.]

	Rarely/Never	About monthly	About weekly	About daily
To cover content mandated by local/ district curriculum standards.				
To cover content mandated by state/ national standards such as the Common Core State Standards, National Curriculum Standards for Social Studies, Next Generation Science Standards, etc.				
To conduct formative assessment of students' standards-based curriculum knowledge and/or skills				
To conduct summative (end-of-unit, end-of-year) assessment of students' standards-based curriculum knowledge and/or skills				
To teach supplemental content (not mandated by curriculum standards)				
To assess students on supplemental knowledge and/or skills.				

(31) WHEN you assess student learning with digital games, how often do you do each of the following?
[Respondents were only shown this item if they selected "About monthly" or more often in item 24.]

	Rarely/Never	Occasionally	Sometimes	Almost always
I use the built-in assessments or assessment systems that come with certain games.				
I look at students' scores on certain games to assess their knowledge/ skills on topics we cover in other formats (e.g., textbook, lectures, discussions, other media).				
I create my own tests/quizzes (paper, online tools, essays, etc.) to assess what students have learned by playing a digital game(s).				
I use whole-class discussions to assess what students have learned through their digital game play.				

(32) How often do you use digital games to:
[Respondents were only shown this item if they selected "About monthly" or more often in item 24.]

	Rarely/Never	About monthly	About weekly	About daily
Understand student mastery of concepts/content at the START of a unit.				
Understand student mastery of concepts/content at the END of a unit.				
Make instructional decisions.				
Group students.				
Document students' overall performance and/or as part of my grading system.				
Monitor student time-on-task.				
Gauge student engagement with material.				
Prepare students for mandatory district/state tests.				

Appendix 2 – Demographics

Note: In some instances, percentages may not total 100% due to rounding. The total "n" for each item varies due to either missing responses, or because some items were presented only to a subset of respondents (e.g., only math teachers). Numbers in parentheses refer to survey question numbers in Appendix 1.

Figure 2.1: What is your gender (1)?
Data from all teacher respondents (n=486).

Male 29.0% (141)

Prefer not to respond 0.4% (2)

Female 70.6% (343)
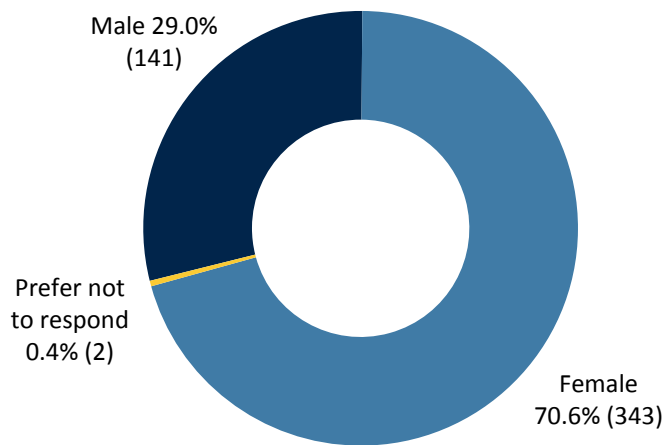
Figure 2.2: Including this year, how many years have you been a classroom teacher (8)?
Data from all teacher respondents (n=484).

<4   9.3% (45)

4 to 9   26.9% (130)

10 to 14   21.3% (103)

15+   42.6% (206)
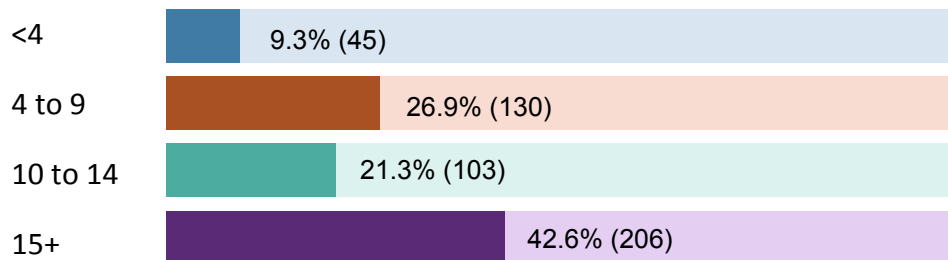
Figure 2.3: What is your age (2)?*
Data from all teacher respondents (n=481).

<30	15.0% (72)
30-39	27.4% (132)
40-49	31.0% (149)
50+	26.6% (128)
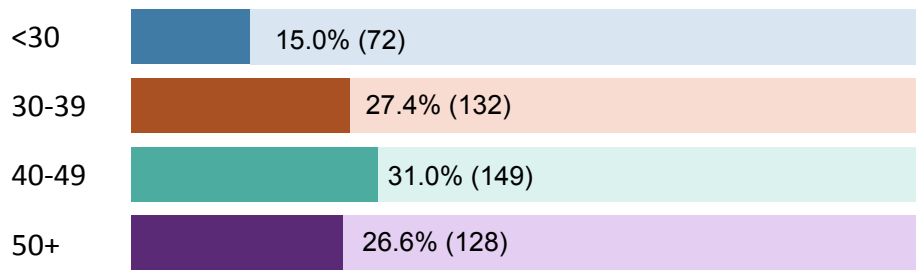
*Age was calculated from birth year.

Figure 2.4: What is the highest degree you have earned (3)?
Data from all teacher respondents (n=488).

Some college, but no degree	0.2% (1)
Associate's degree	0.4% (2)
Bachelor's degree	14.8% (72)
Some graduate school, but no degree	15.6% (76)
Master's degree	66.6% (325)
Doctorate	1.8% (9)
Prefer not to respond	0.6% (3)
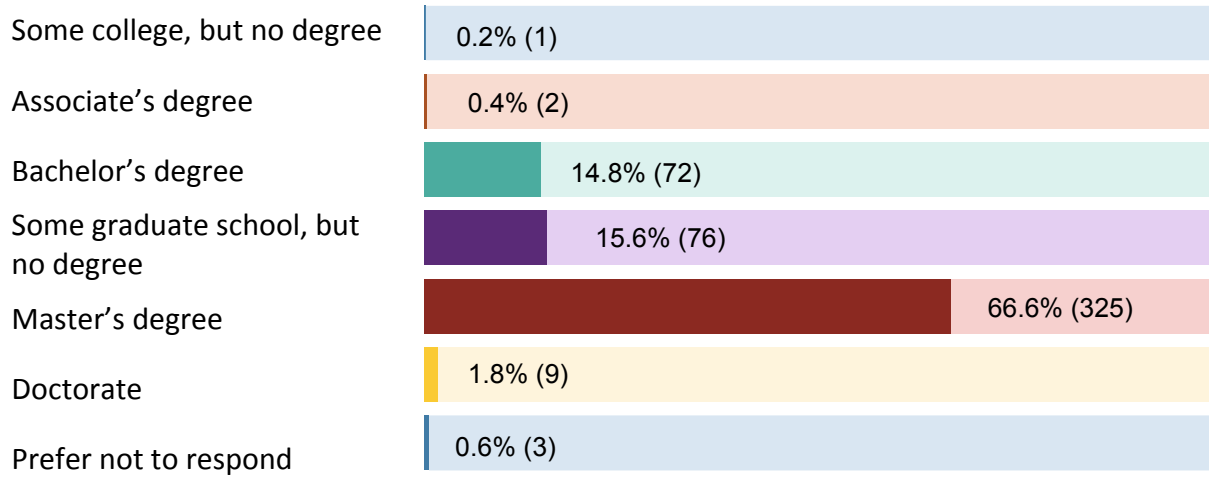
Figure 2.5: Which of the following BEST describes your classroom teaching position (4,5,7)?
Data from all teacher respondents (n=488).

Specialist
teacher 13.1%
(64)

Self-contained
classroom
teacher 30.9%
(151)

Subject
matter only
teacher 55.9%
(273)
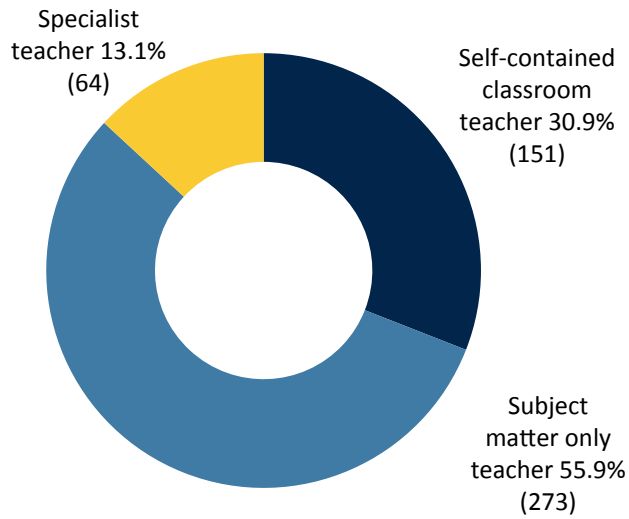
Figure 2.6: What grades do you currently teach (9)?
Data from all teacher respondents (n=487). Teachers were asked to select all grades they teach.

Grade	Percentage (count)
Kindergarten	9.7% (47)
Grade 1	10.3% (50)
Grade 2	10.1% (49)
Grade 3	13.8% (67)
Grade 4	17.2% (84)
Grade 5	23.4% (114)
Grade 6	30.4% (148)
Grade 7	29.8% (145)
Grade 8	28.5% (139)
Grade 9	17.5% (85)
Grade 10	18.3% (89)
Grade 11	17.9% (87)
Grade 12	16.6% (81)
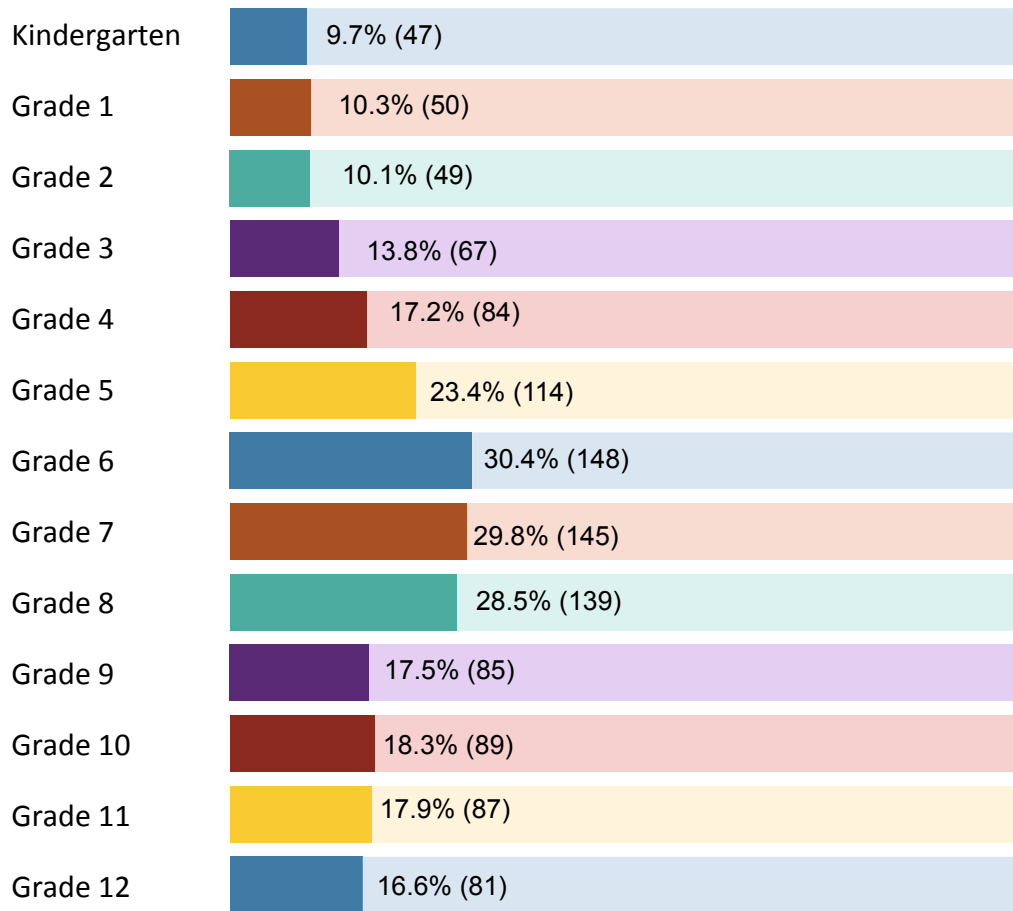
Figure 2.7: What grades do you currently teach (by gradeband) (9)?
Data from all teacher respondents (n=487). Teachers were asked to select all grades they teach.

Gradeband	Percentage (count)
K-2	14.2% (69)
3-5	34.9% (170)
6-8	49.3% (240)
9-12	24.4% (119)
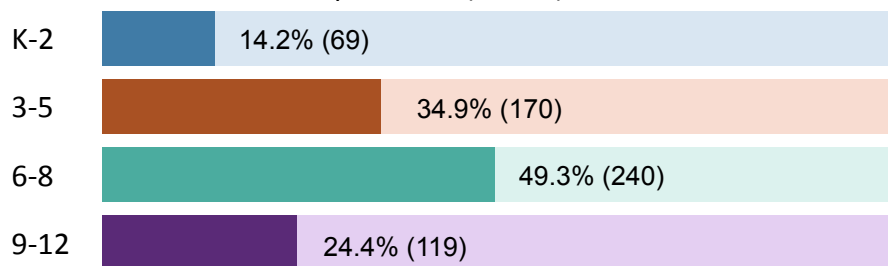
Figure 2.8: What subjects do you currently teach (10)?
Data from all teachers who selected subject matter only teacher (n=272)

Subject	Percentage
Math only	36.0% (98)
Science only	13.6% (37)
ELA/History only	20.6% (56)
Other subjects only	11.0% (30)
Multiple subjects	18.8% (51)
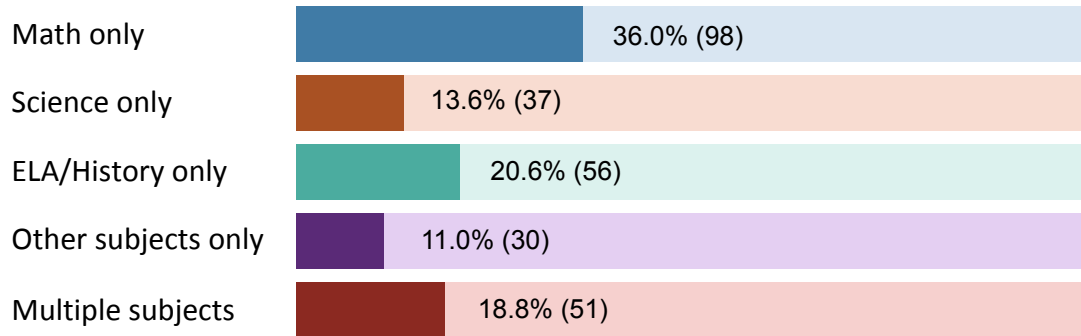
Figure 2.9: What type of school do you work in (13)?
Data from all teacher respondents (n=485).

Private/Religious 12.8% (62)
Charter 4.5% (22)
Public 82.7% (401)
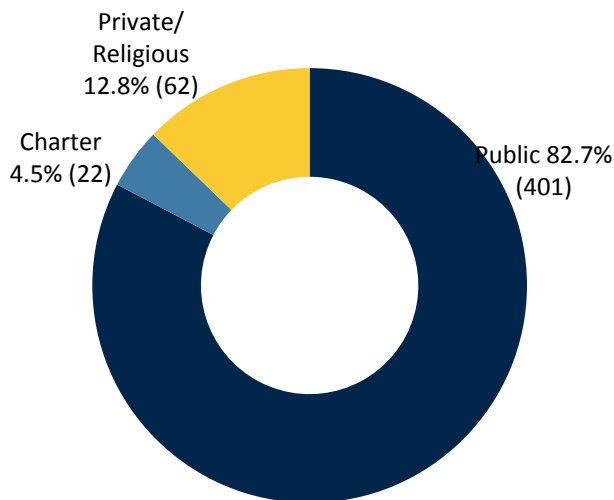
Figure 2.10: What setting is your school in (13)?
Data from all teacher respondents (n=486).

Urban 28.2% (137)
Suburban 46.9% (228)
Rural 24.9% (121)
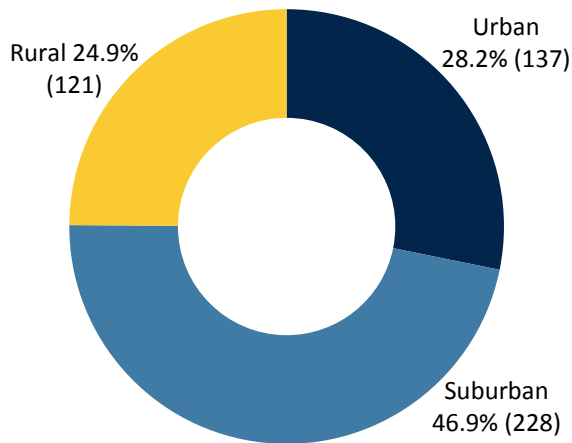
Figure 2.11: How would you describe the socioeconomic status of your school (13)?
Data from all teacher respondents (n=484).

Affluent 16.3% (79)
Middle Income 37.6% (182)
Low Income 46.1% (223)
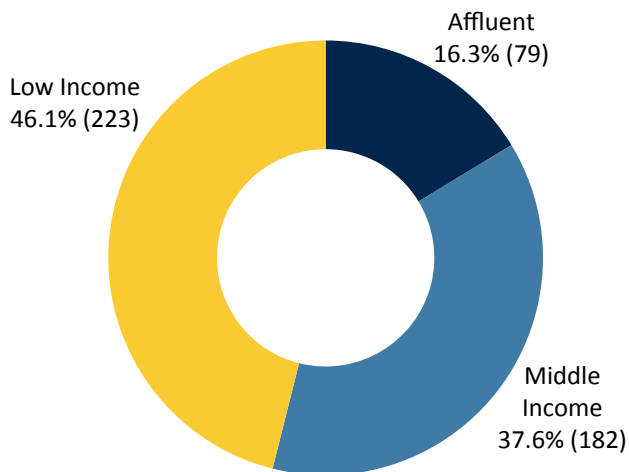
Figure 2.12: What is your school's Title 1 status (13)?
Data from all teacher respondents (n=483).
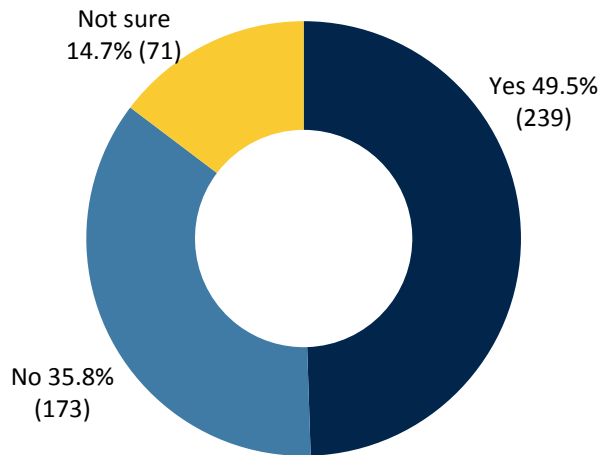
Figure 2.13: About what percentage of students at your school are eligible for free- or reduced-price lunch (14)?
Data from all teacher respondents (n=467).

0-9%	17.6% (82)
10-19%	13.5% (63)
20-29%	7.1% (33)
30-39%	8.1% (38)
40-49%	7.9% (37)
50-59%	7.7% (36)
60-69%	7.9% (37)
70-79%	12.4% (58)
80-89%	6.2% (29)
90-100%	11.6% (54)
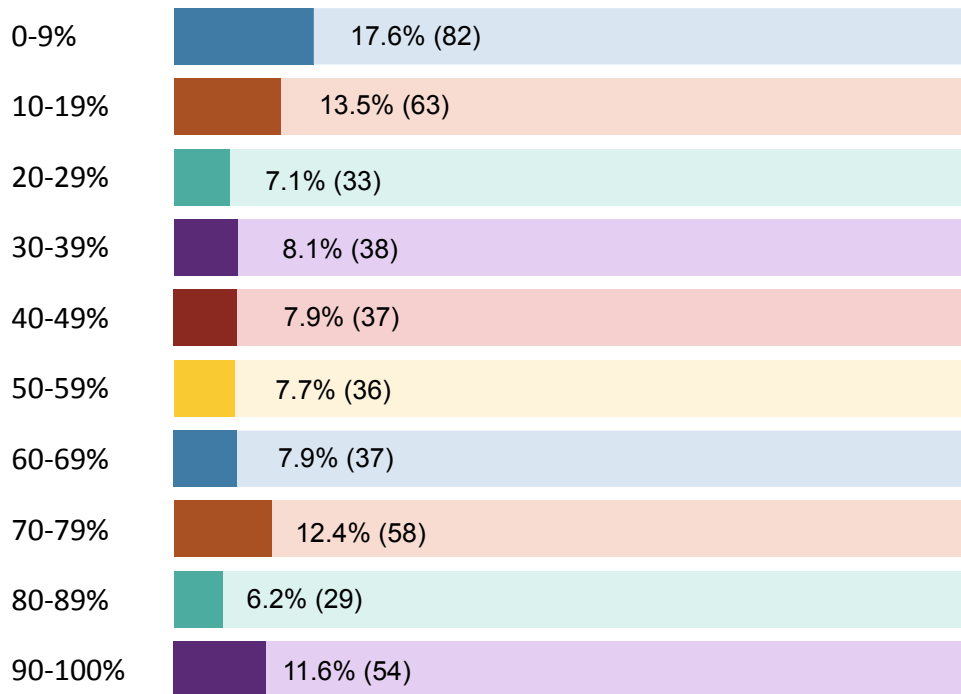
Figure 2.14: How would you describe the general performance level of the students for all the classes you currently teach (11)?
Data from all teacher respondents (n=485).

Below grade level	18.2% (88)
At grade level	28.6% (138)
Above grade level	12.6% (61)
Mixed	40.6% (196)
Prefer not to respond	0.4% (2)
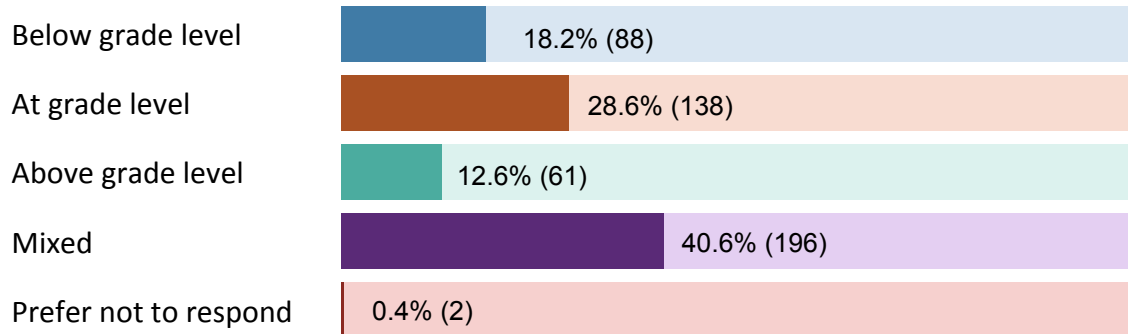
Appendix 3 – Teachers' Formative Assessment Practices

Note: In some instances, percentages may not total 100% due to rounding. The total "n" for each item varies due to either missing responses, or because some items were presented only to a subset of respondents (e.g., only math teachers). Numbers in parentheses refer to survey question numbers in Appendix 1.

Figure 3.1: When do you use formative assessment (15)?
Data from all teacher respondents.

Before a unit/ lesson (n=481)
- 14.6% (70)
- 26.6% (128)
- 44.9% (216)
- 13.9% (67)

At planned check points during a unit/lesson (n=480)
- 23.3% (112)
- 54.4% (261)
- 21.0% (101)
- 1.3% (6)

Spontaneously during teaching (n=482)
- 24.7% (119)
- 35.1% (169)
- 32.0% (154)
- 8.3% (40)

At the end of a unit/lesson (n=482)
- 47.1% (227)
- 33.0% (159)
- 16.4% (79)
- 3.5% (17)

Legend: Most/ All of the time | Regularly | Sometimes | Rarely/Never
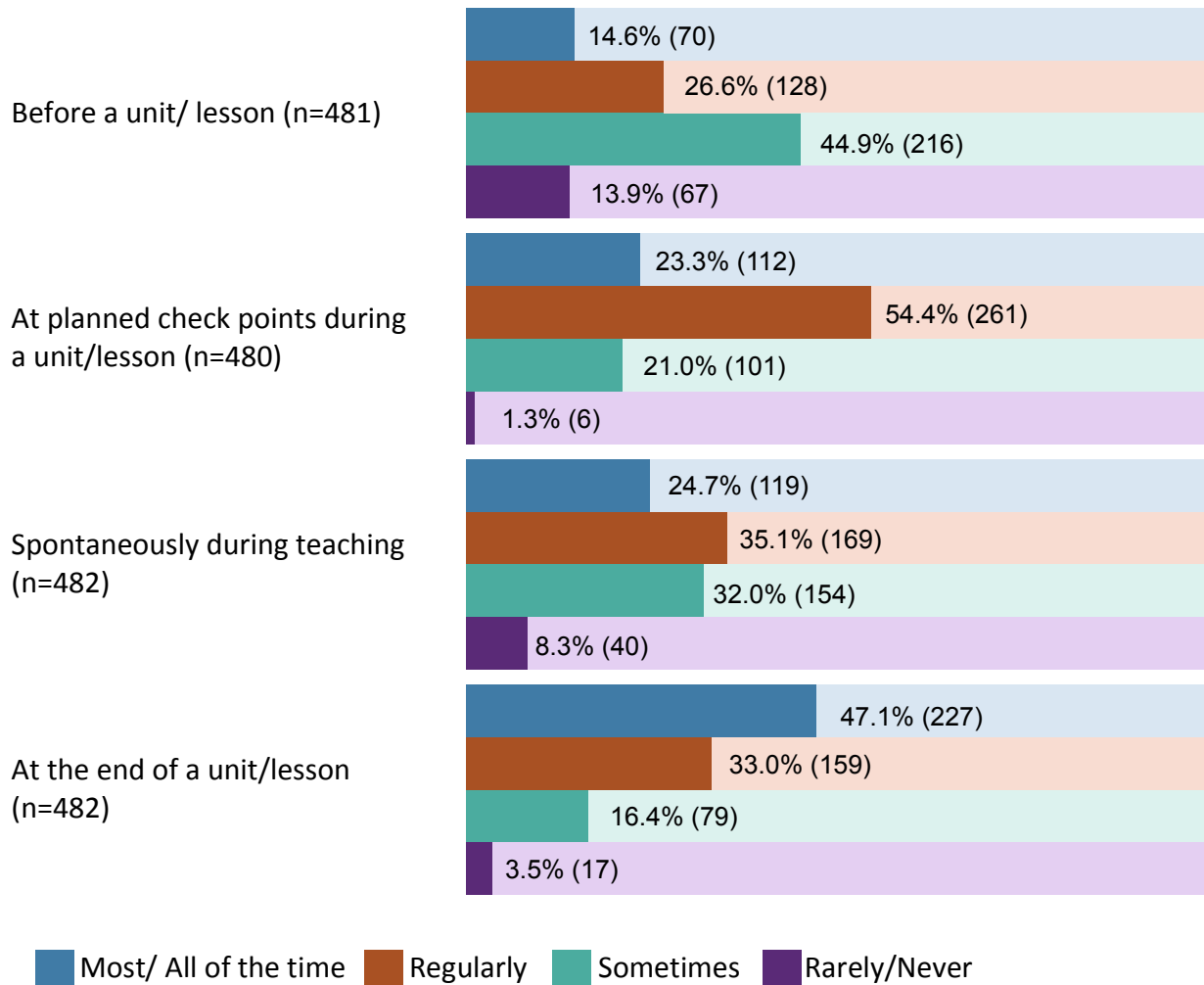
Figure 3.2: When you use formative assessment, what do you check for (16)?
Data from all teacher respondents (n=487). Teachers could select more than one option.

Category	% (N)
Mastery of specific skills	84.4% (288)
Concepts and big ideas	81.5% (312)
Facts and knowledge	80.1% (331)
Progress on standards	62.4% (162)
Prior knowledge related to the lesson	59.8% (147)
Misconceptions	58.7% (188)
Motivation and engagement	37.2% (132)
Metacognitive knowledge	34.9% (91)

Table 3.1: Percent of teachers who check for each of the following types of knowledge or skills during formative assessment by gradeband. For example, 76.7% of grades K-2 teachers check for progress on standards during formative assessment, compared to 54.3% of grades 9-12 teachers.

	Gradeband									χ^2		
	K-2		3-5		6-8		9-12					
	N	%	N	%	N	%	N	%	df	N	F	p
Check for progress on standards	23	76.7%	74	71.8%	106	63.1%	50	54.3%	3	393	8.636	0.035
Check for mastery of specific skills	21	70.0%	94	91.3%	139	82.7%	76	82.6%	3	393	8.735	0.033

Data from all teacher respondents, includes only teachers who teach in one gradeband [K-2 (n=30), 3-5 (n=103), 6-8 (n=168), 9-12 (n=92)]

Table 3.2: Percent of teachers who check for each of the following types of knowledge or skills during formative assessment by subject area. For example, 86.7% of math only subject teachers check for procedures and processes during formative assessment, compared to 30.4% of ELA/history only subject teachers.

| | Subject area | | | | | | | | | |
| | Math only subject teacher | | Science only subject teacher | | ELA/History only subject teacher | | | | χ^2 | |
	N	%	N	%	N	%	df	N	F	p
Check for procedures and processes	85	86.7%	26	72.2%	17	30.4%	2	190	52.000	<0.001
Check for misconceptions	71	72.4%	25	69.4%	23	41.1%	2	190	15.872	<0.001
Check for metacognitive knowledge	27	27.6%	10	27.8%	26	46.4%	2	190	6.310	0.043
Check for mastery of specific skills	88	89.8%	29	80.6%	41	73.2%	2	190	7.211	0.027

Data from all teacher respondents, includes subject matter teachers who teach in only one subject area: Math, Science, ELA/History. [Math only (n=98), Science only (n=36), ELA/History only (n=56)]

Table 3.3: Percent of teachers who check for progress on standards during formative assessment by classroom type. For example, 71.5% of self-contained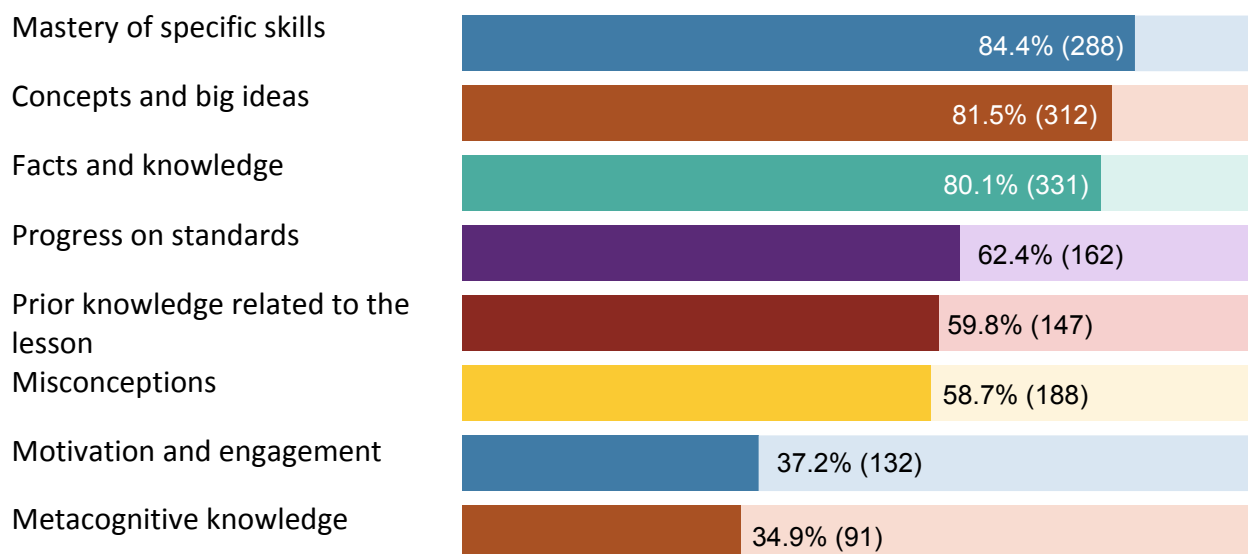 classroom teachers check for progress on standards during formative assessment, compared to 58.5% of subject matter only teachers.

| | Classroom type | | | | | | | |
| | Self-contained classroom teacher | | Subject matter only teacher | | | | χ^2 | |
	N	%	N	%	df	N	F	p
Check for progress on standards	108	71.5%	159	58.5%	1	423	7.122	0.008

Data from all teacher respondents, excludes specialist teachers [Self-contained (n=151), Subject matter only (n=272)]

Figure 3.3: How often do you check for each type of knowledge or skill (17)?
Data from all teacher respondents (n-487).

Facts and knowledge
- 51.1% (249)
- 16.8% (82)
- 6.2% (30)
- 1.0% (5)
- 4.9% (24)
- 19.9% (97)

Concepts and big ideas
- 39.2% (191)
- 24.8% (121)
- 10.5% (51)
- 2.1% (10)
- 4.9% (24)
- 18.5% (90)

Mastery of specific skills
- 30.2% (147)
- 29.0% (141)
- 12.7% (62)
- 6.2% (30)
- 6.4% (31)
- 15.6% (76)

Misconceptions
- 18.9% (92)
- 19.7% (96)
- 12.5% (61)
- 3.9% (19)
- 3.7% (18)
- 41.3% (201)

Motivation and engagement

- 17.5% (85)
- 9.7% (47)
- 3.5% (17)
- 2.7% (13)
- 3.9% (19)
- 62.8% (306)

Progress on standards

- 14.2% (69)
- 19.1% (93)
- 17.2% (84)
- 7.8% (38)
- 4.1% (20)
- 37.6% (183)

Prior knowledge related to the lesson

- 12.1% (59)
- 18.1% (88)
- 15.4% (75)
- 9.4% (46)
- 4.7% (23)
- 40.2% (196)

Metacognitive knowledge

- 8.4% (41)
- 10.3% (50)
- 9.2% (45)
- 3.9% (19)
- 3.1% (15)
- 65.1% (317)

Legend:
- Regularly: Throughout teach lesson
- Often: At some point during each lesson
- Sometimes: In most lessons
- Occasionally: In some lessons
- Indicated they check, but no frequency given
- Never

Table 3.4: Percent of teachers who use formative assessment to check for metacognitive knowledge at least once during each lesson by gradeband. For example, 29.3% of grades 3-5 teachers check for metacognitive knowledge at least once during each lesson, compared to 15.2% of grades 6-8 teachers.

| | Gradeband | | | | | | | | | χ^2 | |
| | K-2 | | 3-5 | | 6-8 | | 9-12 | | | | | |
	N	%	N	%	N	%	N	%	df	N	F	p
Check for metacognitive knowledge at least once during each lesson	5	16.7%	29	29.3%	25	15.2%	15	16.9%	3	383	8.639	0.035

Data from all teacher respondents, includes only teachers who teach in one gradeband [K-2 (n=30), 3-5 (n=99), 6-8 (n=165), 9-12 (n=89)]

Table 3.5: Percent of teachers who use formative assessment to check for each type of knowledge or skill at least once during each lesson by subject area. For example, 78.5% of math only subject teachers check for procedures and processes at least once during each lesson, compared to 21.8% of ELA/history only subject teachers.

| | Subject area | | | | | | | | | χ^2 | |
| | Math only subject teacher | | Science only subject teacher | | ELA/History only subject teacher | | | | | | |
	N	%	N	%	N	%	df	N	F	p
Check for procedures and processes at least once during each lesson	73	78.5%	17	51.5%	12	21.8%	2	181	45.520	<0.001
Check for concepts and big ideas at least once during each lesson	57	62.0%	25	75.8%	43	81.1%	2	178	6.507	0.039
Check for misconceptions at least once during each lesson	48	52.2%	11	31.4%	18	32.7%	2	182	7.434	0.024

Data from all teacher respondents, includes subject matter teachers who teach in only one subject area: Math, Science, ELA/History. [Check for procedures and processes at least once during each lesson: Math only (n=93), Science only (n=33), ELA/History only (n=55); Check for concepts and big ideas at least once during each lesson: Math only (n=92), Science only (n=33), ELA/History only (n=53); Check for misconceptions at least once during each lesson: Math only (n=92), Science only (n=35), ELA/History only (n=55)]

Table 3.6: Percent of teachers who use formative assessment to check for metacognitive knowledge at least once during each lesson by classroom type. For example, 25.7% of self-contained classroom teachers check for metacognitive knowledge at least once during each lesson, compared to 14.7% of subject matter only teachers.

	Classroom type							
	Self-contained classroom teacher		Subject matter only teacher				χ^2	
	N	%	N	%	df	N	F	p
Check for metacognitive knowledge at least once during each lesson	38	25.7%	39	14.7%	1	413	7.519	0.006

Data from all teacher respondents, excludes specialist teachers [Self-contained (n=148), Subject matter only (n=265)]

Figure 3.4: How often do you use each of these formative assessment techniques (18)?
Data from all teacher respondents.

Observe students in class (n=466)
- 78.3% (365)
- 14.6% (68)
- 5.6% (26)
- 1.1% (5)
- 0.4% (2)

Looking over students' shoulders (n=467)
- 45.2% (211)
- 25.3% (118)
- 17.6% (82)
- 7.9% (37)
- 4.1% (19)

Probing questions (n=469)
- 44.1% (207)
- 34.1% (160)
- 15.4% (72)
- 6.0% (28)
- 0.4% (2)

Solve a problem during class (n=469)
- 31.3% (147)
- 29.6% (139)
- 19.6% (92)
- 15.4% (72)
- 4.1% (19)

Show of hands (n=467)
- 14.6% (68)
- 18.4% (86)
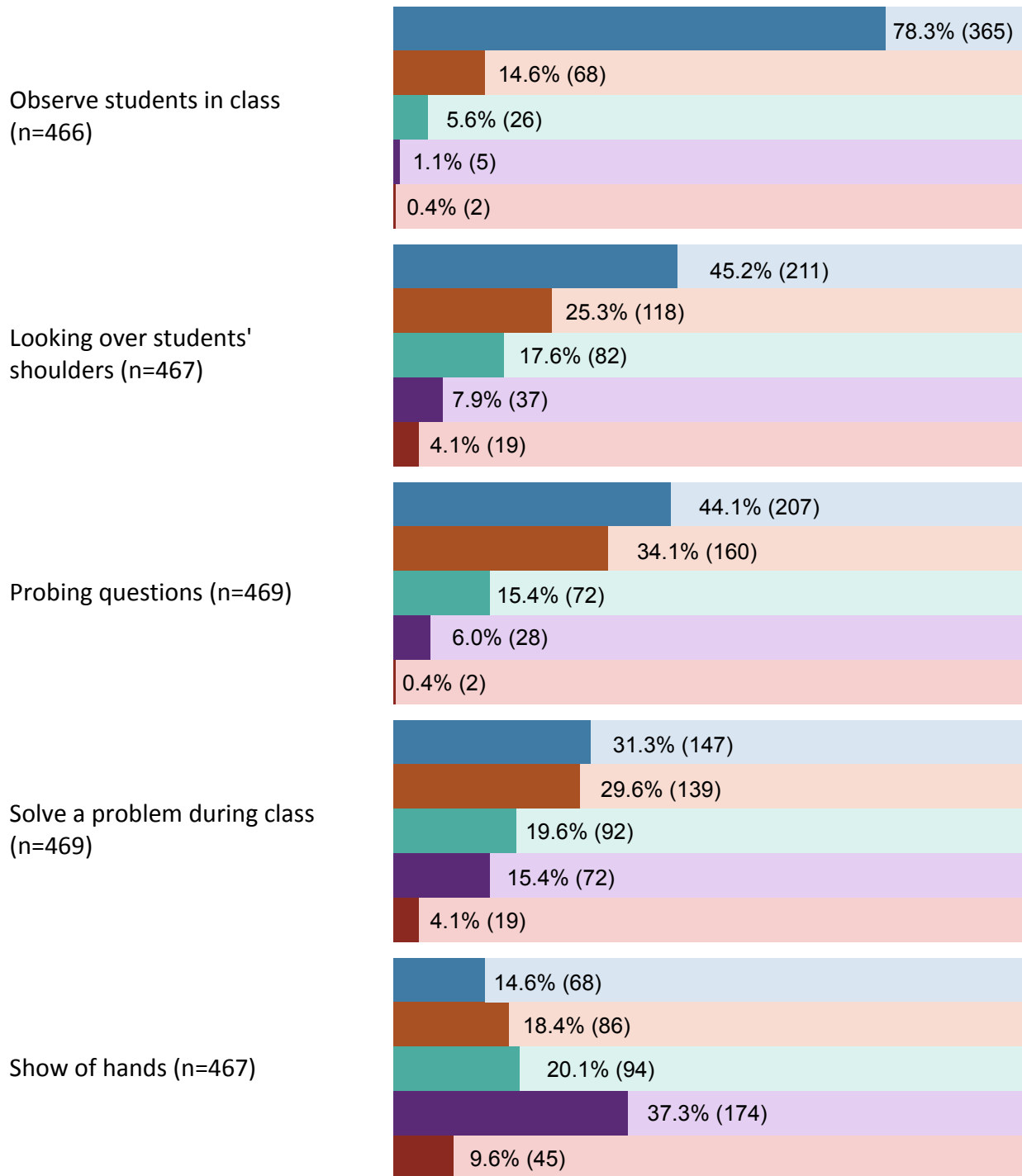- 20.1% (94)
- 37.3% (174)
- 9.6% (45)

Table 3.8: Percent of teachers who use each technique at least once during each lesson by subject area. For example, 87.1% of math only subject teachers conduct formative assessment by having students solve a problem at least once during each lesson, compared to 32.1% of ELA/history only subject teachers.

| | Subject area | | | | | | | χ^2 | | |
| | Math only subject teacher | | Science only subject teacher | | ELA/History only subject teacher | | | | | |
	N	%	N	%	N	%	df	N	F	p
Conduct formative assessment by having students solve a problem at least once during each lesson	81	87.1%	13	36.1%	17	32.1%	2	182	54.630	<0.001
Conduct formative assessment by asking probing questions at least once during each lesson	73	78.5%	26	72.2%	50	94.3%	2	182	8.523	0.014

Data from all teacher respondents, includes subject matter teachers who teach in only one subject area: Math, Science, ELA/History. [Math only (n=93), Science only (n=36), ELA/History only (n=53)]

Table 3.9: Percent of teachers who con each technique at least once during each lesson by having students solve a problem at least once during each lesson by classroom type. For example, 69.6% of self-contained classroom teachers conduct formative assessment by having students solve a problem at least once during each lesson, compared to 59.5% of subject matter only teachers.

| | Classroom type | | | | | | χ^2 | | |
| | Self-contained classroom teacher | | Subject matter only teacher | | | | | | |
	N	%	N	%	df	N	F	p
Conduct formative assessment by having students solve a problem at least once during each lesson	103	69.6%	156	59.5%	1	410	4.108	0.043

Data from all teacher respondents, excludes specialist teachers [Self-contained (n=148), Subject matter only (n=262)]

Figure 3.5: What do you do with the information from formative assessment (19)?
(Data from all teacher respondents).

Convey/clarify lesson objectives to students (n=435)
- 77.2% (336)
- 19.5% (85)
- 2.3% (10)
- 0.9% (4)

Change the lesson in real-time (n=431)
- 69.4% (299)
- 26.9% (116)
- 1.9% (8)
- 1.9% (8)

Give feedback to students (n=434)
- 68.7% (298)
- 26.5% (115)
- 4.4% (19)
- 0.5% (2)

Group students/pair students (n=435)
- 43.2% (188)
- 35.2% (153)
- 16.1% (70)
- 5.5% (24)

Plan or modify future lessons (n=438)
- 38.1% (167)
- 53.0% (232)
- 8.7% (38)
- 0.2% (1)

Track student progress (n=436)
- 32.8% (143)
- 56.4% (246)
- 9.6% (42)
- 1.1% (5)

Find/create alternative instructional strategies for teaching a topic (n=435)

- 25.7% (112)
- 52.2% (227)
- 21.1% (92)
- 0.9% (4)

Continue as planned, but come back to important ideas in the future (n=427)

- 16.6% (71)
- 41.2% (176)
- 25.8% (110)
- 16.4% (70)

Assign additional work (n=427)

- 10.8% (46)
- 40.0% (171)
- 24.6% (105)
- 24.6% (105)

■ About daily   ■ About weekly   ■ About monthly   ■ I don't typically do this

Table 3.10: Percent of teachers who use information from formative assessment to group or pair students on a daily basis by gradeband. For example, 59.3% of grades 3-5 teachers use information from formative assessment to group or pair students on a daily basis, compared to 40.3% of grades 6-8 teachers.

	Gradeband								χ^2		
	K-2		3-5		6-8		9-12					
	N	%	N	%	N	%	N	%	df	N	F	p
Use information from formative assessment to group or pair students on a daily basis	14	48.3%	54	59.3%	62	40.3%	32	40.5%	3	353	9.585	0.022

Data from all teacher respondents, includes only teachers who teach in one gradeband [K-2 (n=29), 3-5 (n=91), 6-8 (n=154), 9-12 (n=79)]

Table 3.11: Percent of teachers who use information from formative assessment to do each of the following on a daily basis by subject area. For example, 48.5% of science only subject teachers use information from formative assessment to track student progress on a daily basis, compared to 22.4% of ELA/history only subject teachers.

| | Subject area | | | | | | | | | |
| | Math only subject teacher | | Science only subject teacher | | ELA/History only subject teacher | | | | χ^2 | |
	N	%	N	%	N	%	df	N	F	p
Use information from formative assessment to track student progress on a daily basis	35	39.3%	16	48.5%	11	22.4%	2	171	6.540	0.038
Use information from formative assessment to find or create alternative instructional strategies for teaching a topic on a daily basis	16	18.2%	10	30.3%	19	38.0%	2	171	6.793	0.033

Data from all teacher respondents, includes subject matter teachers who teach in only one subject area: Math, Science, ELA/History. [Use information from formative assessment to track student progress: Math only (n=89), Science only (n=33), ELA/History only (n=49); Use information from formative assessment to find/create alternative instructional strategies for teaching a topic: Math only (n=88), Science only (n=33), ELA/History only (n=50)]

Table 3.12: Percent of teachers who use information from formative assessment to do each of the following on a daily basis by classroom type. For example, 26.8% of self-contained classroom teachers use information from formative assessment to track student progress on a daily basis, compared to 36.8% of subject matter only teachers.

| | Classroom type | | | | | | | | |
| | Self-contained classroom teacher | | Subject matter only teacher | | | | χ^2 | |
	N	%	N	%	df	N	F	p
Use information from formative assessment to track student progress on a daily basis	37	26.8%	91	36.8%	1	385	4.014	0.045
Use information from formative assessment to group or pair students on a daily basis	74	54.0%	96	39.0%	1	383	8.010	0.005

Data from all teacher respondents, excludes specialist teachers [Track student progress: Self-contained (n=138), Subject matter only (n=247); Group or pair students: Self-contained (n=137), Subject matter only (n=246)]

Table 3.13: Logistic regression analysis predicting teachers' use of information from formative assessment to give feedback to students weekly or more often. The odds of a teacher using information from formative assessment to give feedback to students weekly or more often increases by a factor of 1.140 for each one year increase in teaching experience, controlling for status as a subject matter or self-contained classroom teacher, gradebands taught, and school setting,

Variable	β	Standard error	Odds ratio	p
Constant	1.683	1.037	5.382	0.105
Years of teaching experience	0.131	0.045	1.140	0.003
Subject matter teacher (as compared to self-contained classroom teachers)	0.206	0.797	1.228	0.796
Teaches one or more of grades K-2	0.429	1.178	1.536	0.716
Teaches one or more of grades 3-5	0.690	0.807	1.993	0.393
Teaches one or more of grades 6-8	-0.677	0.725	0.508	0.351
Teaches one or more of grades 9-12	-0.548	0.759	0.578	0.470
School setting: Suburban (as compared to Urban)	-0.042	0.558	0.959	0.941
School setting: Rural (as compared to Urban)	0.754	0.736	2.125	0.306
-2 log likelihood	132.095			
Cox & Snell R Square	0.048			
Nagelkerke R Square	0.145			
Chi-square	18.364			0.019
N	376			

Figure 3.6: Do you share or discuss formative assessment information with others (20)?
Data from all teacher respondents.

	Discuss the information with my teaching colleagues (n=452)	Share the information with my teacher colleagues (n=454)	Give feedback to parents (n=451)	Share the information with my administrator(s) (n=453)	Discuss the information with my administrator(s) (n=452)
About daily	23.0% (104)	19.6% (89)	4.9% (22)	2.4% (11)	2.0% (9)
About weekly	48.5% (219)	45.6% (207)	33.7% (152)	19.4% (88)	17.7% (80)
About monthly	21.2% (96)	23.3% (106)	42.1% (190)	46.6% (211)	48.9% (221)
I don't typically do this	7.3% (33)	11.5% (52)	19.3% (87)	31.6% (143)	31.4% (142)

Legend: About daily · About weekly · About monthly · I don't typically do this
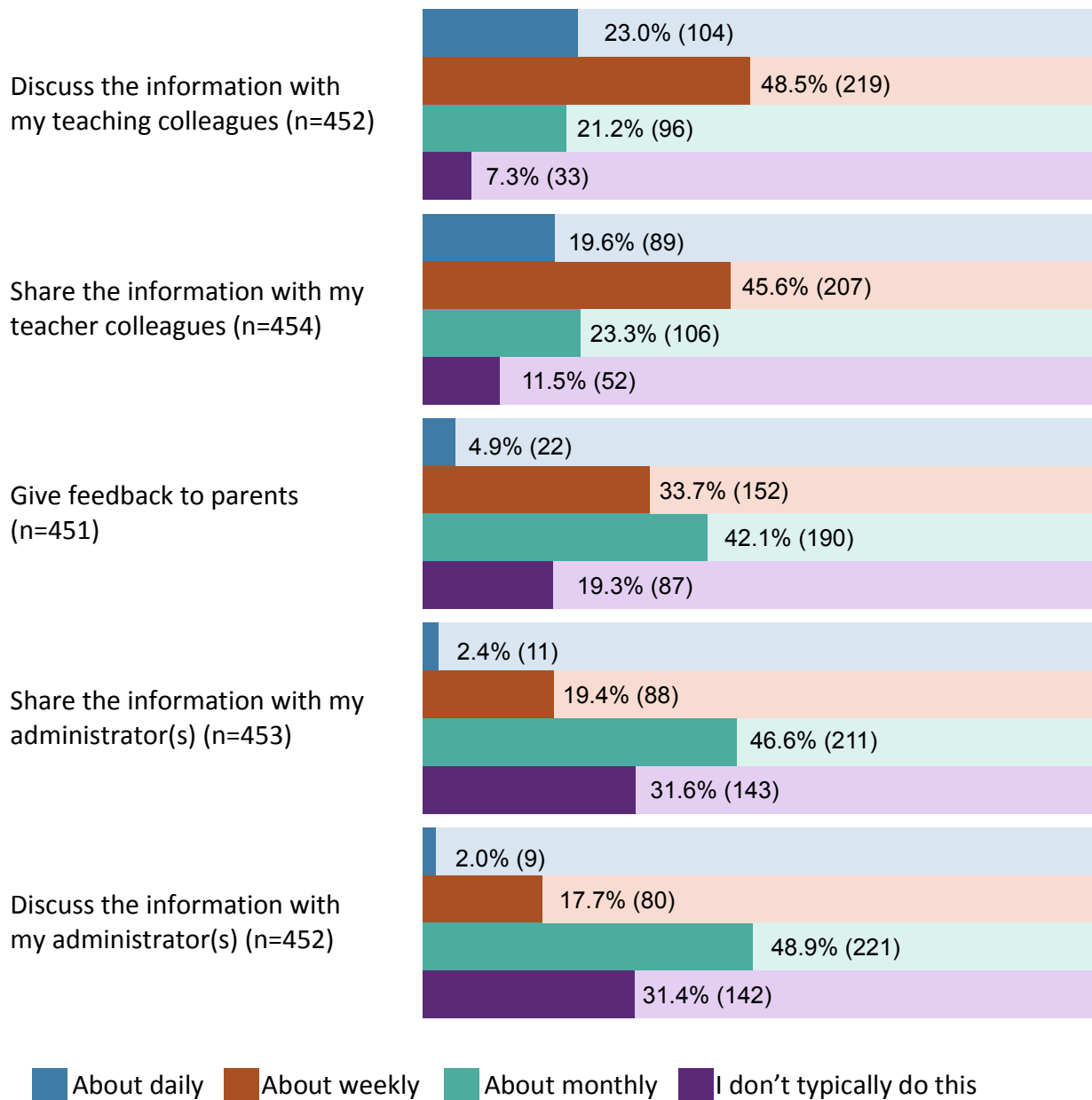
Table 3.14: Percent of teachers who use information from formative assessment to give parents feedback weekly or more often by gradeband. For example, 50.0% of grades 3-5 teachers use information from formative assessment to give parents feedback weekly or more often, compared to 29.8% of grades 9-12 teachers.

| | Gradeband | | | | | | | | | χ^2 | |
| | K-2 | | 3-5 | | 6-8 | | 9-12 | | | | | |
	N	%	N	%	N	%	N	%	df	N	F	p
Use information from formative assessment to give parents feedback weekly or more often	14	48.3%	48	50.0%	70	44.6%	25	29.8%	3	366	8.631	0.038

Data from all teacher respondents, includes only teachers who teach in one gradeband [K-2 (n=29), 3-5 (n=96), 6-8 (n=157), 9-12 (n=84)]

Table 3.15: Percent of teachers who use information from formative assessment to give parents feedback weekly or more often by subject area. For example, 43.3% of math only subject teachers use information from formative assessment to give parents feedback weekly or more often, compared to 22.0% of ELA/history only subject teachers.

| | Subject area | | | | | | | | | χ^2 | |
| | Math only subject teacher | | Science only subject teacher | | ELA/History only subject teacher | | | | | | |
	N	%	N	%	N	%	df	N	F	p
Use information from formative assessment to give parents feedback weekly or more often	39	43.3%	12	33.3%	11	22.0%	2	176	6.482	0.039

Data from all teacher respondents, includes subject matter teachers who teach in only one subject area: Math, Science, ELA/History. [Use information from formative assessment to give parents feedback: Math only (n=90), Science only (n=36), ELA/History only (n=50)]

Table 3.16: Percent of teachers who use information from formative assessment for each of the following purposes weekly or more often by classroom type. For example, 50.3% of self-contained classroom teachers use information from formative assessment to give parents feedback weekly or more often, compared to 35.1% of subject matter only teachers.

| | Classroom type | | | | | | | |
| | Self-contained classroom teacher | | Subject matter only teacher | | | | χ^2 | |
	N	%	N	%	df	N	F	p
Use information from formative assessment to give parents feedback weekly or more often	72	50.3%	88	35.1%	1	394	8.830	0.003
Share information from formative assessment with teaching colleagues weekly or more often	105	73.4%	160	63.5%	1	395	4.078	0.043
Share information from formative assessment with administrators weekly or more often	23	16.1%	62	24.7%	1	394	3.998	0.046
Discuss information from formative assessment with administrators weekly or more often	19	13.4%	58	23.1%	1	393	5.447	0.020

Data from all teacher respondents, excludes specialist teachers [Give parents feedback: Self-contained (n=143), Subject matter (n=251); Share information with teaching colleagues: Self-contained (n=143), Subject matter (n=252); Share information with administrators: Self-contained (n=143), Subject matter (n=251); Discuss information with administrator(s): Self-contained (n=142), Subject matter (n=251)]

Table 3.17: Logistic regression analysis predicting teachers' use of information from formative assessment to give parents feedback weekly or more often. The odds of a teacher using information from formative assessment to give parents feedback weekly or more often increases by a factor of 1.032 for each one year increase in teaching experience, controlling for status as a subject matter or self-contained classroom teacher, gradebands taught, and school setting,

Variable	β	Standard error	Odds ratio	p
Constant	-0.147	0.486	0.864	0.763
Years of teaching experience	0.032	0.013	1.032	0.014
Subject matter teacher (as compared to self-contained classroom teachers)	-0.233	0.352	0.792	0.508
Teaches one or more of grades K-2	-0.725	0.444	0.484	0.102
Teaches one or more of grades 3-5	-0.607	0.368	0.545	0.099
Teaches one or more of grades 6-8	-0.719	0.408	0.487	0.078
Teaches one or more of grades 9-12	-1.48	0.453	0.228	0.001
School setting: Suburban (as compared to Urban)	0.601	0.278	1.823	0.031
School setting: Rural (as compared to Urban)	0.504	0.317	1.655	0.112
-2 log likelihood	487.639			
Cox & Snell R Square	0.093			
Nagelkerke R Square	0.125			
Chi-square	37.849			<0.001
N	389			

Figure 3.7: What barriers do you face in conducting formative assessment of student understanding (21)?
Data from all teacher respondents (n=447). Teachers could select more than one option.

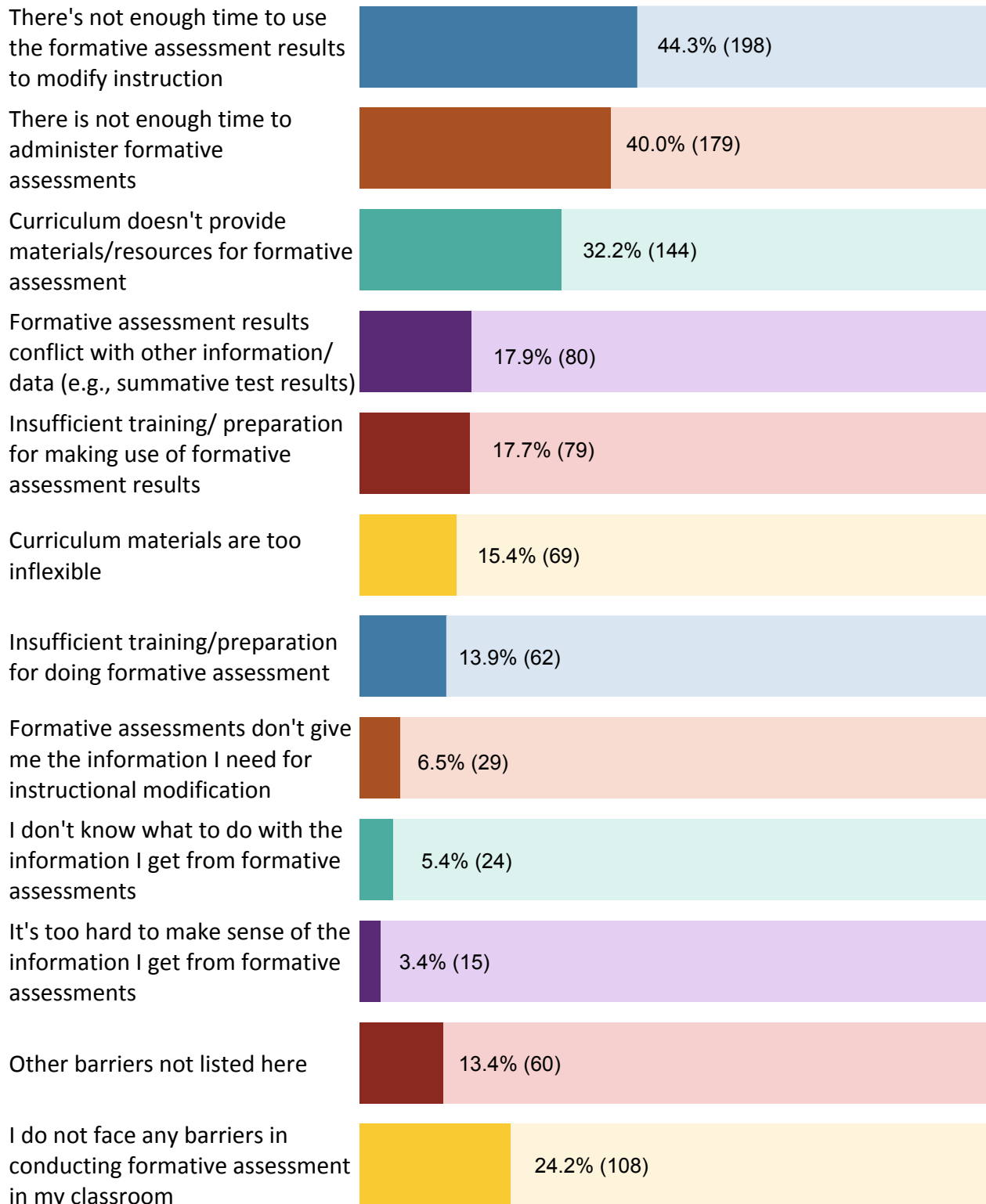| Barrier	Percent (count)
There's not enough time to use the formative assessment results to modify instruction	44.3% (198)
There is not enough time to administer formative assessments	40.0% (179)
Curriculum doesn't provide materials/resources for formative assessment	32.2% (144)
Formative assessment results conflict with other information/data (e.g., summative test results)	17.9% (80)
Insufficient training/ preparation for making use of formative assessment results	17.7% (79)
Curriculum materials are too inflexible	15.4% (69)
Insufficient training/preparation for doing formative assessment	13.9% (62)
Formative assessments don't give me the information I need for instructional modification	6.5% (29)
I don't know what to do with the information I get from formative assessments	5.4% (24)
It's too hard to make sense of the information I get from formative assessments	3.4% (15)
Other barriers not listed here	13.4% (60)
I do not face any barriers in conducting formative assessment in my classroom	24.2% (108)

Table 3.18: Percent of teachers who face the barrier of insufficient training or preparation for making use of formative assessment results by gradeband. For example, 8.6% of grades 3-5 teachers report facing the barrier of insufficient training or preparation for making use of formative assessment results, compared to 24.7% of grades 9-12 teachers.

	Gradeband									χ^2	
	K-2		3-5		6-8		9-12					
	N	%	N	%	N	%	N	%	df	N	F	p
Insufficient training or preparation for making use of formative assessment results	6	20.7%	8	8.6%	30	19.5%	21	24.7%	3	361	8.523	0.036

Data from all teacher respondents, includes only teachers who teach in one gradeband [K-2 (n=29), 3-5 (n=93), 6-8 (n=154), 9-12 (n=85)]

Table 3.19: Logistic regression analysis predicting reporting the barrier of insufficient training or preparation for making use of formative assessment results. The odds of a teacher reporting the barrier of insufficient training or preparation for making use of formative assessment results decreases by a factor of 0.950 for each one year increase in teaching experience, controlling for status as a subject matter or self-contained classroom teacher, gradebands taught, and school setting,

Variable	β	Standard error	Odds ratio	p
Constant	-1.250	0.660	0.286	0.058
Years of teaching experience	-0.052	0.022	0.950	0.017
Subject matter teacher (as compared to self-contained classroom teachers)	0.359	0.542	1.431	0.508
Teaches one or more of grades K-2	0.915	0.535	2.496	0.087
Teaches one or more of grades 3-5	-0.632	0.471	0.532	0.180
Teaches one or more of grades 6-8	-0.432	0.549	0.650	0.432
Teaches one or more of grades 9-12	-0.295	0.602	0.745	0.624
School setting: Suburban (as compared to Urban)	0.258	0.386	1.294	0.504
School setting: Rural (as compared to Urban)	-0.230	0.463	0.794	0.618
-2 log likelihood	281.338			
Cox & Snell R Square	0.040			
Nagelkerke R Square	0.074			
Chi-square	15.711			0.047
N	384			

Table 3.20: Logistic regression analysis predicting facing no barriers to conducting formative assessment. The odds of a teacher facing no barriers to conducting formative assessment increases by a factor of 1.039 for each one year increase in teaching experience, controlling for status as a subject matter or self-contained classroom teacher, gradebands taught, and school setting,

Variable	β	Standard error	Odds ratio	p
Constant	-2.427	0.499	0.088	<0.001
Years of teaching experience	0.038	0.014	1.039	0.006
Subject matter teacher (as compared to self-contained classroom teachers)	0.123	0.385	1.130	0.750
Teaches one or more of grades K-2	0.845	0.435	2.328	0.052
Teaches one or more of grades 3-5	0.919	0.357	2.507	0.010
Teaches one or more of grades 6-8	0.680	0.379	1.974	0.073
Teaches one or more of grades 9-12	1.001	0.426	2.721	0.019
School setting: Suburban (as compared to Urban)	-0.294	0.299	0.745	0.326
School setting: Rural (as compared to Urban)	-0.527	0.346	0.591	0.128
-2 log likelihood	412.985			
Cox & Snell R Square	0.042			
Nagelkerke R Square	0.063			
Chi-square	16.677			0.034
N	384			

Appendix 4 – Teachers' Game Use Practices

Note: In some instances, percentages may not total 100% due to rounding. The total "n" for each item varies due to either missing responses, or because some items were presented only to a subset of respondents (e.g., only math teachers). Numbers in parentheses refer to survey question numbers in Appendix 1.

Figure 4.1: How often do you play video/digital games for entertainment or other non work-related reasons (23)?
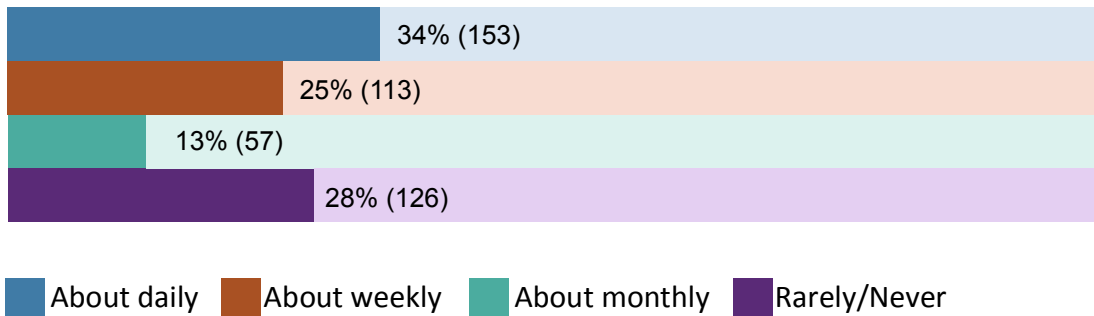Data from all teacher respondents (n=449).

About daily	34% (153)
About weekly	25% (113)
About monthly	13% (57)
Rarely/Never	28% (126)

■ About daily   ■ About weekly   ■ About monthly   ■ Rarely/Never

Figure 4.2: How often do you use digital games as a teaching tool (24)?
Data from all teacher respondents (n=450).

About daily	18% (83)
About weekly	38% (172)
About monthly	27% (121)
Rarely/Never	16% (74)

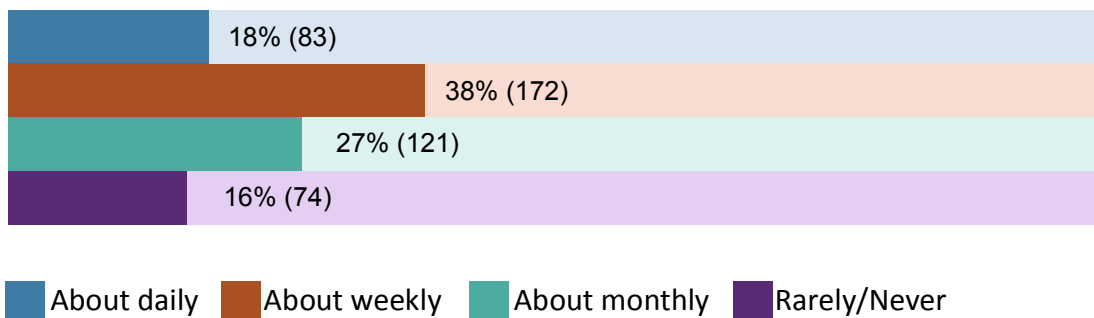■ About daily   ■ About weekly   ■ About monthly   ■ Rarely/Never

Table 4.1: Percent of teachers who use digital games as a teaching tool weekly or more often by gradeband. For example, 78.9% of grades 3-5 teachers use digital games as a teaching tool weekly or more often, compared to 40.5% of grades 9-12 teachers.

| | Gradeband | | | | | | | | | χ^2 | |
| | K-2 | | 3-5 | | 6-8 | | 9-12 | | | | | |
	N	%	N	%	N	%	N	%	df	N	F	p
Use digital games as a teaching tool weekly or more often	19	65.5%	75	78.9%	73	47.4%	34	40.5%	3	362	34.095	<0.001

Data from all teacher respondents, includes only teachers who teach in one gradeband [K-2 (n=29), 3-5 (n=95), 6-8 (n=154), 9-12 (n=84)]

Table 4.2: Percent of teachers who use digital games as a teaching tool weekly or more often by subject area. For example, 50.6% of math only subject teachers use digital games as a teaching tool weekly or more often, compared to 30.6% of science only subject teachers, and 20.8% of ELA/history only subject teachers.

| | Subject area | | | | | | | | | χ^2 | |
| | Math only subject teacher | | Science only subject teacher | | ELA/History only subject teacher | | | | | | | |
	N	%	N	%	N	%	df	N	F	p		
Use digital games as a teaching tool weekly or more often	45	50.6%	11	30.6%	10	20.8%	2	173	12.791	0.002		

Data from all teacher respondents, includes subject matter teachers who teach in only one subject area: Math, Science, ELA/History [Math only (n=89), Science only (n=36), ELA/History only (n=48)]

Table 4.3: Percent of teachers who use digital games as a teaching tool weekly or more often by classroom type. For example, 74.6% of self-contained classroom teachers use digital games as a teaching tool weekly or more often, compared to 45.0% of subject matter only teachers.

| | Classroom type | | | | | | | | | |
| | Self-contained classroom teacher | | Subject matter only teacher | | | | χ^2 | | | |
	N	%	N	%	df	N	F	p		
Use digital games as a teaching tool weekly or more often	106	74.6%	112	45.0%	1	391	32.265	<0.001		

Data from all teacher respondents, excludes specialist teachers [Self-contained (n=142), Subject matter only (n=249)]

Figure 4.3: How comfortable are you using digital games as a teaching tool (25)?
Data from all teacher respondents (n=450).

- Very comfortable
- Moderately comfortable
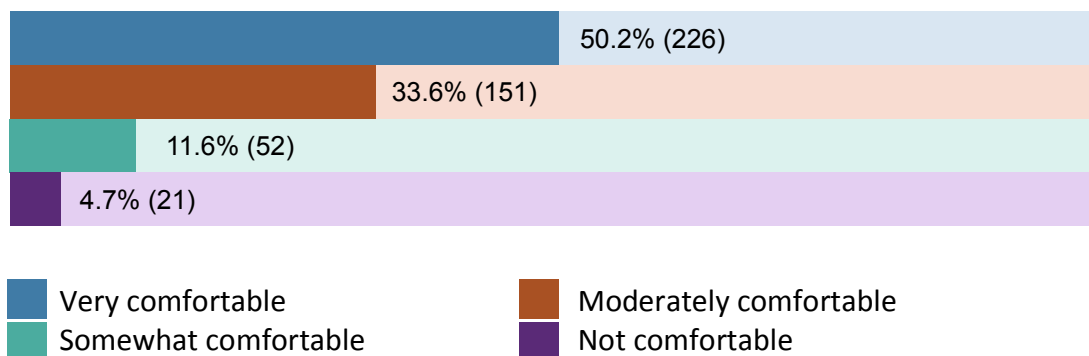- Somewhat comfortable
- Not comfortable

Table 4.4: Teachers' frequency using digital games as a teaching tool by their comfort level using digital games as a teaching tool. For example, of the 226 teachers who are very comfortable using digital games as a teaching tool, 32.3% use digital games in their teaching daily and 47.3% do so weekly.

	Comfort level using digital games as a teaching tool											
	Very Comfortable		Moderately Comfortable		Slightly Comfortable		Not Comfortable				χ^2	
	N	%	N	%	N	%	N	%	df	N	F	p
Frequency using digital games as a teaching tool									9	450	171.021	<0.001
Daily	73	32.3%	9	6.0%	1	1.9%	0	0.0%				
Weekly	107	47.3%	58	38.4%	7	13.5%	0	0.0%				
Monthly	36	15.9%	54	35.8%	26	50.0%	5	23.8%				
Rarely/ Never	10	4.4%	30	19.9%	18	34.6%	16	76.2%				

Data from all teacher respondents: Very Comfortable (n=226), Moderately Comfortable (n=151), Slightly Comfortable (n=52), Not Comfortable (n=21).

Figure 4.4: To what extent do you feel digital games can be effective at (26):
Data from all teacher respondents.

Motivating students to learn content (n=444)
- 65.1% (289)
- 24.5% (109)
- 9.2% (41)
- 0.0% (0)
- 1.1% (5)

Helping students reinforce or master previously taught content (n=444)
- 56.8% (252)
- 32.7% (145)
- 8.6% (38)
- 0.2% (1)
- 1.8% (8)

Providing useful information about student learning (n=442)
- 33.0% (146)
- 33.0% (146)
- 25.6% (113)
- 4.1% (18)
- 4.3% (19)

Teaching students new content (n=446)
- 24.9% (111)
- 33.6% (150)
- 32.1% (143)
- 3.4% (15)
- 6.1% (27)

Legend:
- Very effective
- Effective
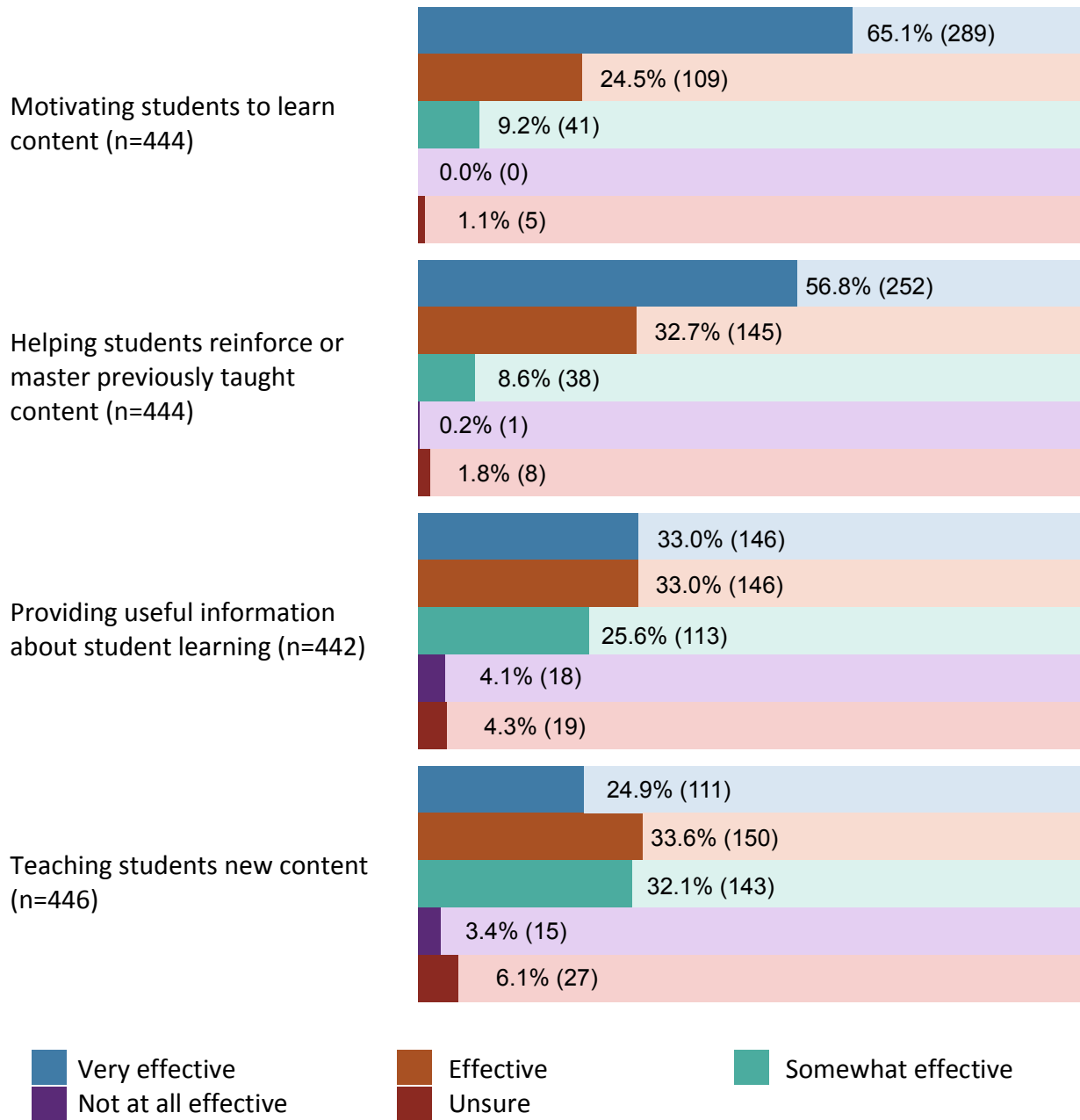- Somewhat effective
- Not at all effective
- Unsure

Table 4.5: Percent of teachers who feel digital games are effective or very effective for each purpose by gradeband. For example, 41.4% of grades K-2 teachers feel digital games are effective or very effective for teaching students new content, compared to 62.8% of grades 3-5 teachers.

| | Gradeband | | | | | | | | | χ^2 | |
| | K-2 | | 3-5 | | 6-8 | | 9-12 | | | | | |
	N	%	N	%	N	%	N	%	df	N	F	p
Teaching students new content	12	41.4%	59	62.8%	93	61.6%	40	47.6%	3	358	8.475	0.037
Motivating students to learn content	26	89.7%	86	93.5%	141	93.4%	67	79.8%	3	356	12.805	0.005
Helping students reinforce or master previously taught content	26	89.7%	89	95.7%	135	90.0%	69	82.1%	3	356	8.756	0.033

Data from all teacher respondents, includes only teachers who teach in one gradeband [Teaching students new content: K-2 (n=29), 3-5 (n=92), 6-8 (n=151), 9-12 (n=84); Motivating students to learn content: K-2 (n=29), 3-5 (n=92), 6-8 (n=151), 9-12 (n=84); Helping students reinforce or master previously taught content: K-2 (n=29), 3-5 (n=93), 6-8 (n=150), 9-12 (n=84)]

Table 4.6: Percent of teachers who feel digital games are effective or very effective for motivating students to learn content by classroom type. For example, 94.2% of self-contained classroom teachers feel digital games are effective or very effective for motivating students to learn content, compared to 87.0% of subject matter only teachers.

| | Classroom type | | | | | | | |
| | Self-contained classroom teacher | | Subject matter only teacher | | | | χ^2 | |
	N	%	N	%	df	N	F	p
Motivating students to learn content	131	94.2%	214	87.0%	1	385	5.018	0.025

Data from all teacher respondents, excludes specialist teachers [Self-contained (n=139), Subject matter only (n=246)]

Figure 4.5: Do you use any of the following online sites for educational games (27)?
Data from all teacher respondents who reported using digital games for teaching monthly or more often (n=371). Teachers could select more than one option.
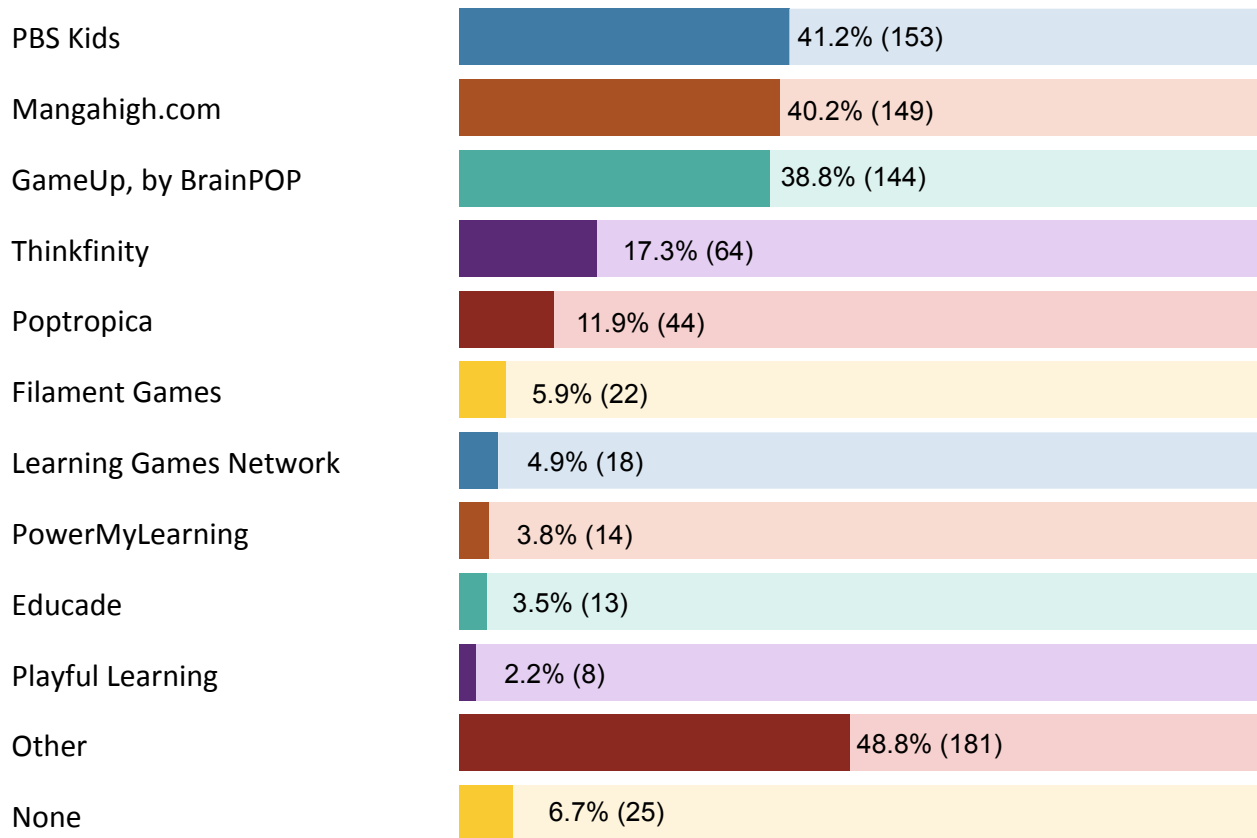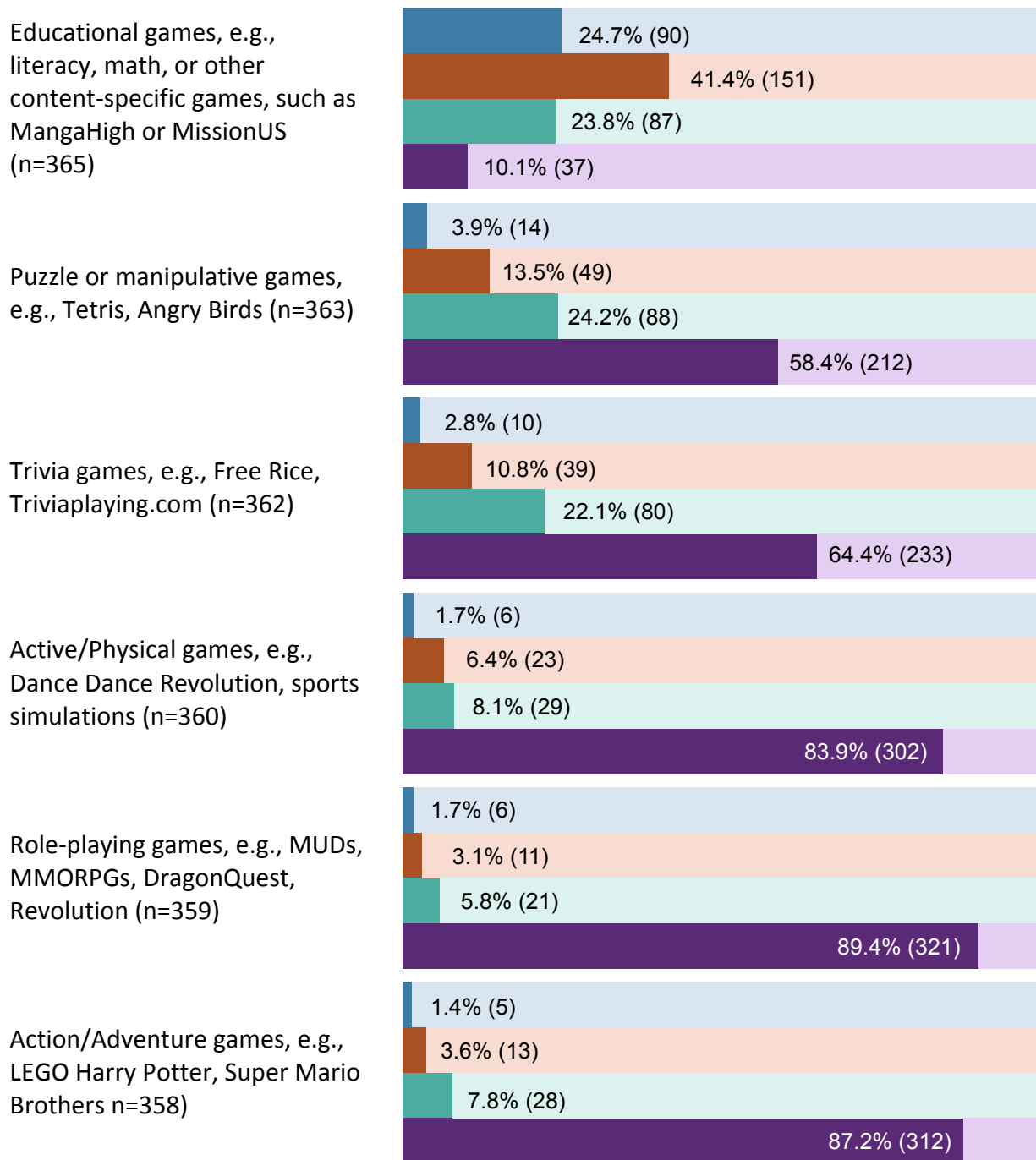
Site	Percentage (Count)
PBS Kids	41.2% (153)
Mangahigh.com	40.2% (149)
GameUp, by BrainPOP	38.8% (144)
Thinkfinity	17.3% (64)
Poptropica	11.9% (44)
Filament Games	5.9% (22)
Learning Games Network	4.9% (18)
PowerMyLearning	3.8% (14)
Educade	3.5% (13)
Playful Learning	2.2% (8)
Other	48.8% (181)
None	6.7% (25)

Figure 4.6: About how often do your students use each of these kinds of digital games in your classroom (29)?
Data from all teacher respondents who reported using digital games for teaching monthly or more often.
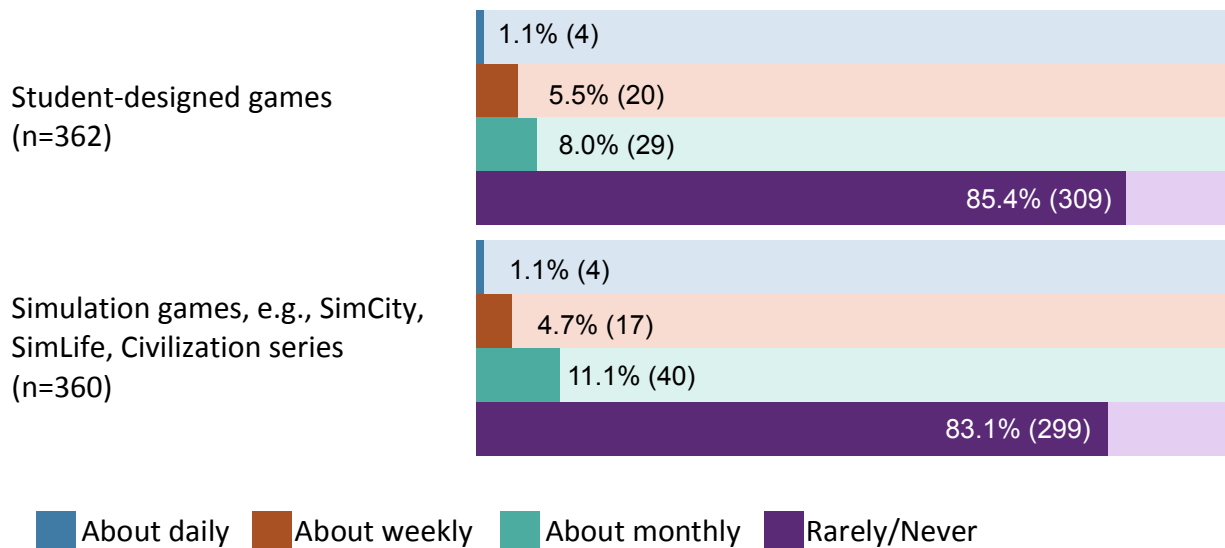
Educational games, e.g., literacy, math, or other content-specific games, such as MangaHigh or MissionUS (n=365)
- 24.7% (90)
- 41.4% (151)
- 23.8% (87)
- 10.1% (37)

Puzzle or manipulative games, e.g., Tetris, Angry Birds (n=363)
- 3.9% (14)
- 13.5% (49)
- 24.2% (88)
- 58.4% (212)

Trivia games, e.g., Free Rice, Triviaplaying.com (n=362)
- 2.8% (10)
- 10.8% (39)
- 22.1% (80)
- 64.4% (233)

Active/Physical games, e.g., Dance Dance Revolution, sports simulations (n=360)
- 1.7% (6)
- 6.4% (23)
- 8.1% (29)
- 83.9% (302)

Role-playing games, e.g., MUDs, MMORPGs, DragonQuest, Revolution (n=359)
- 1.7% (6)
- 3.1% (11)
- 5.8% (21)
- 89.4% (321)

Action/Adventure games, e.g., LEGO Harry Potter, Super Mario Brothers n=358)
- 1.4% (5)
- 3.6% (13)
- 7.8% (28)
- 87.2% (312)

Table 4.7: Percent of teachers who report students use educational games weekly or more often in their classroom by gradeband. For example, 80.5% of grades 3-5 teachers report that students use educational games weekly or more often in their classroom, compared to 47.4% of grades 9-12 teachers.

| | Gradeband | | | | | | | | χ^2 | | |
| | K-2 | | 3-5 | | 6-8 | | 9-12 | | | | | |
	N	%	N	%	N	%	N	%	df	N	F	p
Educational games	20	74.1%	70	80.5%	67	54.9%	27	47.4%	3	293	22.137	<0.001

Data from all teacher respondents who reported using digital games for teaching monthly or more often, includes only teachers who teach in one gradeband [K-2 (n=27), 3-5 (n=87), 6-8 (n=122), 9-12 (n=57)]

Table 4.8: Percent of teachers who report students use educational games weekly or more often in their classroom by subject area. For example, 58.6% of math only subject teachers report that students use educational games weekly or more often in their classroom, compared to 33.3% of science only subject teachers.

| | Subject area | | | | | | | | χ^2 | | |
| | Math only subject teacher | | Science only subject teacher | | ELA/History only subject teacher | | | | | | | |
	N	%	N	%	N	%	df	N	F	p
Educational games	41	58.6%	8	33.3%	9	34.6%	2	120	7.06	0.029

Data from all teacher respondents who reported using digital games for teaching monthly or more often, includes subject matter teachers who teach in only one subject area: Math, Science, ELA/History [Math only (n=70), Science only (n=24), ELA/History only (n=26)]

Table 4.9: Percent of teachers who report students use educational games weekly or more often in their classroom by classroom type. For example, 82.2% of self-contained classroom teachers report that students use educational games weekly or more often in their classroom, compared to 53.5% of subject matter only teachers.

	Classroom type							
	Self-contained classroom teacher		Subject matter only teacher				χ^2	
	N	%	N	%	df	N	F	p
Educational games	106	82.2%	99	53.5%	1	314	27.541	<0.001

Data from all teacher respondents who reported using digital games for teaching monthly or more often, excludes specialist teachers [Self-contained (n=129), Subject matter only (n=185)]

Figure 4.7: About how often do you use digital games for each of the following purposes (30)?
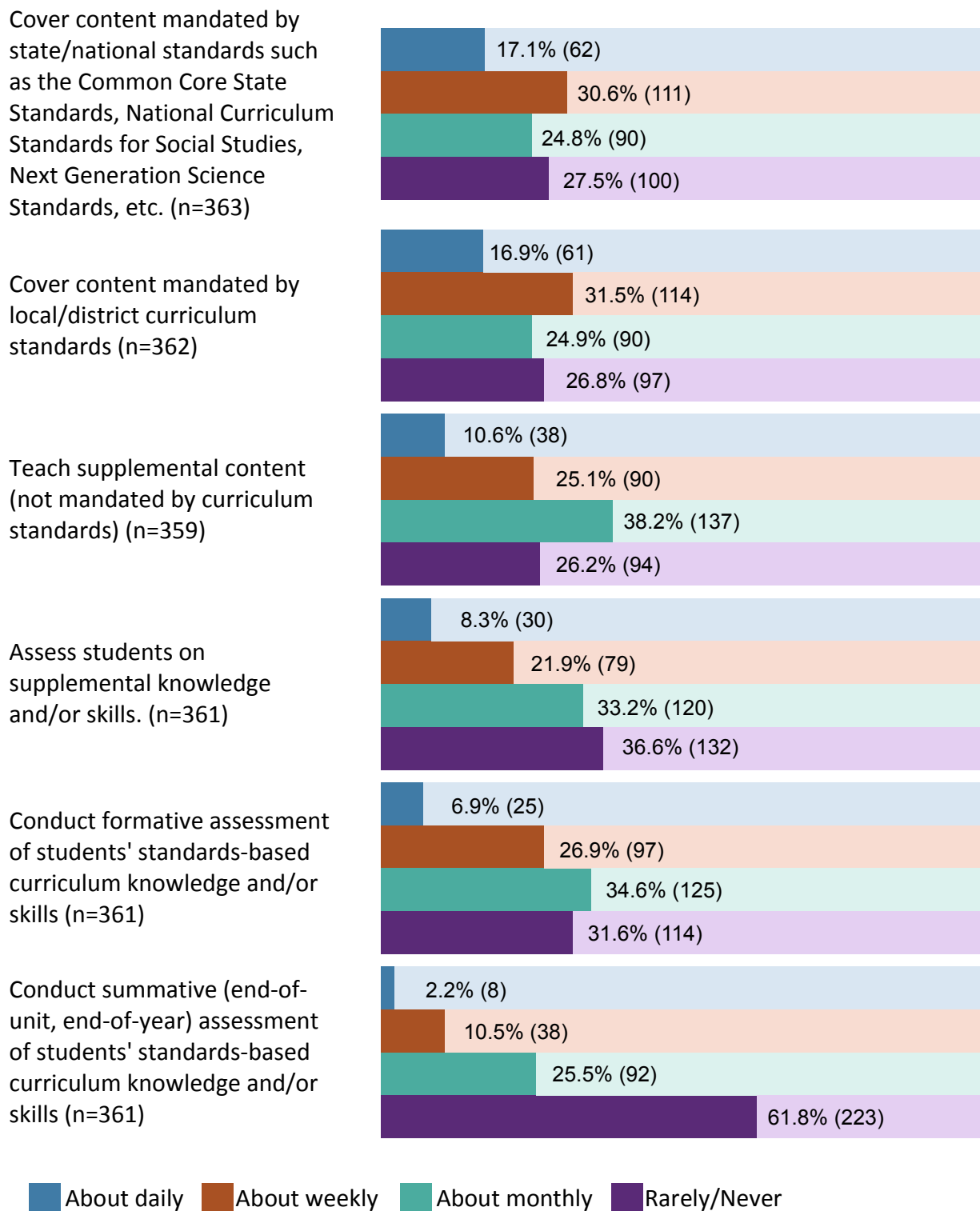Data from all teacher respondents who reported using digital games for teaching monthly or more often.

Cover content mandated by state/national standards such as the Common Core State Standards, National Curriculum Standards for Social Studies, Next Generation Science Standards, etc. (n=363)	17.1% (62)	30.6% (111)	24.8% (90) 27.5% (100)
Cover content mandated by local/district curriculum standards (n=362)	16.9% (61)	31.5% (114)	24.9% (90) 26.8% (97)
Teach supplemental content (not mandated by curriculum standards) (n=359)	10.6% (38)	25.1% (90)	38.2% (137) 26.2% (94)
Assess students on supplemental knowledge and/or skills. (n=361)	8.3% (30)	21.9% (79)	33.2% (120) 36.6% (132)
Conduct formative assessment of students' standards-based curriculum knowledge and/or skills (n=361)	6.9% (25)	26.9% (97)	34.6% (125) 31.6% (114)
Conduct summative (end-of-unit, end-of-year) assessment of students' standards-based curriculum knowledge and/or skills (n=361)	2.2% (8)	10.5% (38)	25.5% (92) 61.8% (223)

■ About daily ■ About weekly ■ About monthly ■ Rarely/Never

Table 4.10: Percent of teachers who use digital games for each purpose weekly or more often by gradeband. For example, 65.1% of grades 3-5 teachers report that they use digital games weekly or more often to cover content mandated by local/district curriculum standards, compared to 35.5% of grades 6-8 teachers.

| | Gradeband | | | | | | | | χ^2 | |
| | K-2 | | 3-5 | | 6-8 | | 9-12 | | | | | |
	N	%	N	%	N	%	N	%	df	N	F	p
Cover content mandated by local/district curriculum standards	14	53.8%	56	65.1%	43	35.5%	22	39.3%	3	289	19.545	<0.001
Cover content mandated by state/national standards	14	51.9%	58	67.4%	38	31.4%	20	35.7%	3	290	29.397	<0.001

Data from all teacher respondents who reported using digital games for teaching monthly or more often, includes only teachers who teach in one gradeband [Cover content mandated by local/district standards: K-2 (n=26), 3-5 (n=86), 6-8 (n=121), 9-12 (n=56); Cover content mandated by state/national standards: K-2 (n=27), 3-5 (n=86), 6-8 (n=121), 9-12 (n=56)]

Table 4.11: Percent of teachers who use digital games for each purpose weekly or more often by subject area. For example, 48.6% of math only subject matter teachers report that they use digital games weekly or more often to cover content mandated by local/district curriculum standards, compared to 13.0% of science only subject teachers.

| | Subject area | | | | | | | | χ^2 | |
| | Math only subject teacher | | Science only subject teacher | | ELA/History only subject teacher | | | | | | |
	N	%	N	%	N	%	df	N	F	p
Cover content mandated by local/district curriculum standards	34	48.6%	3	13.0%	5	19.2%	2	119	13.327	0.001
Cover content mandated by state/national standards	34	48.6%	1	4.3%	4	15.4%	2	119	19.933	<0.001

Data from all teacher respondents who reported using digital games for teaching monthly or more often, includes subject matter teachers who teach in only one subject area: Math, Science, ELA/History [Math only (n=70), Science only (n=23), ELA/History only (n=26)]

Table 4.12: Percent of teachers who use digital games for each purpose weekly or more often by classroom type. For example, 59.1% of self-contained classroom teachers report that they use digital games weekly or more often to cover content mandated by local/ district curriculum standards, compared to 38.6% of subject matter only teachers.

| | Classroom type | | | | | | | |
| | Self-contained classroom teacher | | Subject matter only teacher | | | | χ^2 | |
	N	%	N	%	df	N	F	p
Cover content mandated by local/district curriculum standards	75	59.1%	71	38.6%	1	311	12.639	<0.001
Cover content mandated by state/national standards	75	58.6%	69	37.5%	1	312	13.515	<0.001
Conduct formative assessment of students' standards-based curriculum knowledge and/or skills	54	42.2%	51	28.0%	1	310	6.732	0.009
Teach supplemental content (not mandated by curriculum standards)	52	40.9%	53	29.1%	1	309	4.662	0.031

Data from all teacher respondents who reported using digital games for teaching monthly or more often, excludes specialist teachers [Cover content mandated by local/district standards: Self-contained (n=127), Subject matter (n=184); Cover content mandated by state/national standards: Self-contained (n=128), Subject matter (n=184); Conduct formative assessment of students' standard-based curriculum knowledge and/or other skills: Self-contained (n=128), Subject matter (n=182); Teach supplemental content: Self-contained (n=127), Subject matter (n=182)]

Figure 4.8: When you assess student learning with digital games, how often do you do each of the following (31)?
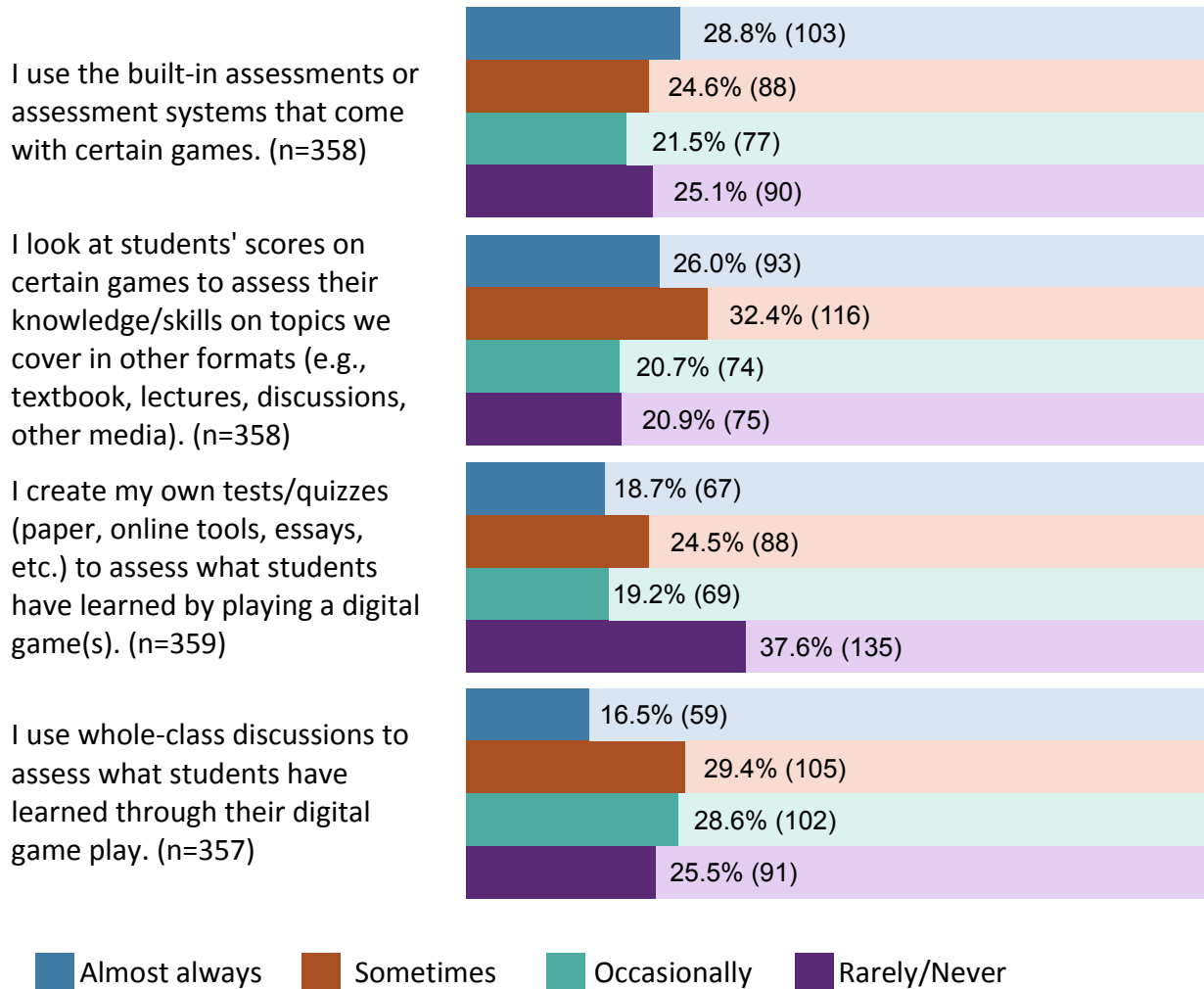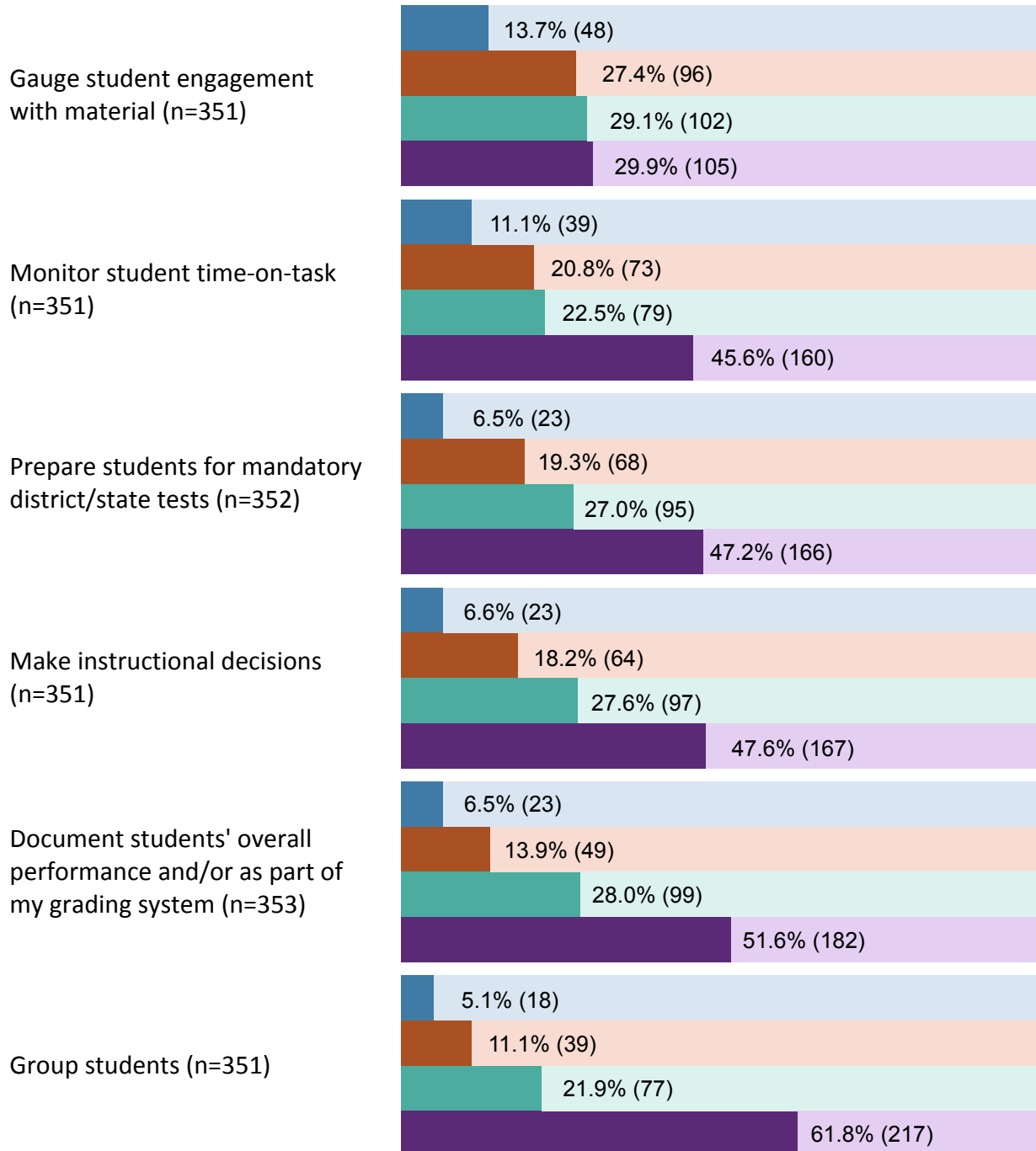Data from all teacher respondents who reported using digital games for teaching monthly or more often.

I use the built-in assessments or assessment systems that come with certain games. (n=358)	28.8% (103) 24.6% (88) 21.5% (77) 25.1% (90)
I look at students' scores on certain games to assess their knowledge/skills on topics we cover in other formats (e.g., textbook, lectures, discussions, other media). (n=358)	26.0% (93) 32.4% (116) 20.7% (74) 20.9% (75)
I create my own tests/quizzes (paper, online tools, essays, etc.) to assess what students have learned by playing a digital game(s). (n=359)	18.7% (67) 24.5% (88) 19.2% (69) 37.6% (135)
I use whole-class discussions to assess what students have learned through their digital game play. (n=357)	16.5% (59) 29.4% (105) 28.6% (102) 25.5% (91)

■ Almost always ■ Sometimes ■ Occasionally ■ Rarely/Never

Table 4.13: Percent of teachers who sometimes or always look at students' scores to assess knowledge/ skills on topics covered in other formats when they assess student learning with digital games by subject area. For example, 70.0% of math only subject teachers report that whey they assess student learning with digital games, they sometimes or always use students' scores on certain games to assess their knowledge/skills on topics covered in other formats, compared to 39.1% of science only subject teachers.

	Subject area									
	Math only subject teacher		Science only subject teacher		ELA/History only subject teacher				χ^2	
	N	%	N	%	N	%	df	N	F	p
Look at students' scores on certain games to assess their knowledge/skills on topics covered in other formats	49	70.0%	9	39.1%	13	50.0%	2	119	8.146	0.017

Data from all teacher respondents who reported using digital games for teaching monthly or more often, includes subject matter teachers who teach in only one subject area: Math, Science, ELA/History [Math only (n=70), Science only (n=23), ELA/History only (n=26)]

Table 4.14: Percent of teachers who sometimes or always use the built-in assessments or assessment systems that come with certain games when they assess student learning with digital games by classroom type. For example, 60.8% of self-contained classroom teachers report that when they assess student learning with digital games, they sometimes or always use the built in assessments or assessment systems that come with certain games, compared to 48.4% of subject matter only teachers.

	Classroom type							
	Self-contained classroom teacher		Subject matter only teacher				χ^2	
	N	%	N	%	df	N	F	p
Use the built-in assessments or assessment systems that come with certain games	76	60.8%	89	48.4%	1	309	4.622	0.032

Data from all teacher respondents who reported using digital games for teaching monthly or more often, excludes specialist teachers [Self-contained (n=125), Subject matter (n=184)]

Figure 4.9: How often do you use digital games for each purpose (32)?
Data from all teacher respondents who reported using digital games for teaching monthly or more often.
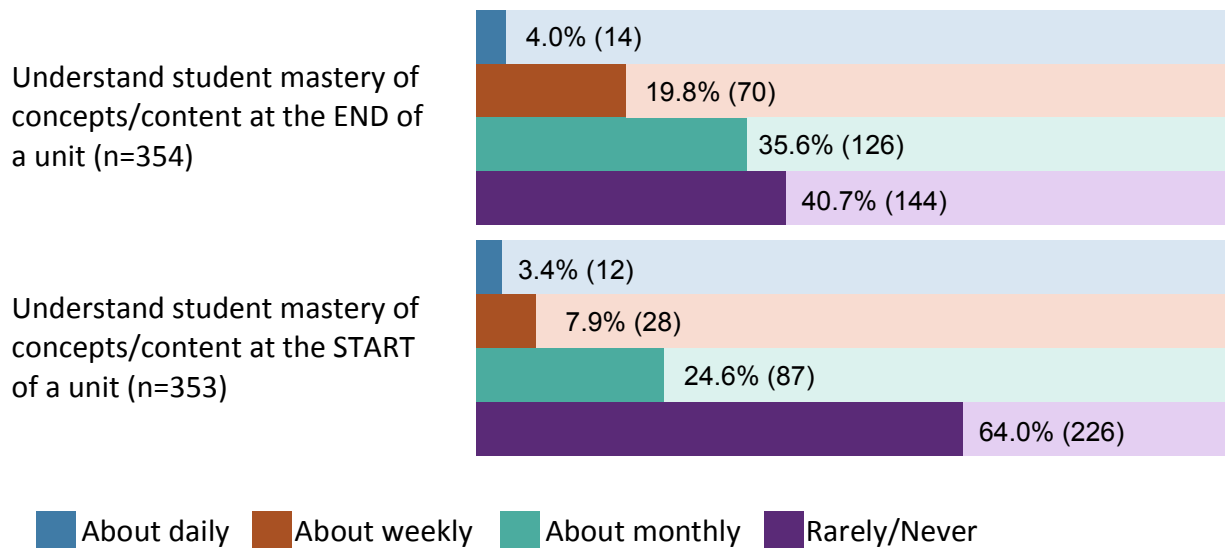

Gauge student engagement with material (n=351)
- 13.7% (48)
- 27.4% (96)
- 29.1% (102)
- 29.9% (105)

Monitor student time-on-task (n=351)
- 11.1% (39)
- 20.8% (73)
- 22.5% (79)
- 45.6% (160)

Prepare students for mandatory district/state tests (n=352)
- 6.5% (23)
- 19.3% (68)
- 27.0% (95)
- 47.2% (166)

Make instructional decisions (n=351)
- 6.6% (23)
- 18.2% (64)
- 27.6% (97)
- 47.6% (167)

Document students' overall performance and/or as part of my grading system (n=353)
- 6.5% (23)
- 13.9% (49)
- 28.0% (99)
- 51.6% (182)

Group students (n=351)
- 5.1% (18)
- 11.1% (39)
- 21.9% (77)
- 61.8% (217)

Understand student mastery of concepts/content at the END of a unit (n=354)
- 4.0% (14)
- 19.8% (70)
- 35.6% (126)
- 40.7% (144)

Understand student mastery of concepts/content at the START of a unit (n=353)
- 3.4% (12)
- 7.9% (28)
- 24.6% (87)
- 64.0% (226)

Legend: ■ About daily ■ About weekly ■ About monthly ■ Rarely/Never

Table 4.15: Percent of teachers who use digital games for each purpose weekly or more often by gradeband. For example, 11.1% of grades K-2 teachers report using digital games weekly or more often to make instructional decisions, compared to 30.1% of grades 3-5 teachers.

| | Gradeband | | | | | | | | | χ^2 | | |
| | K-2 | | 3-5 | | 6-8 | | 9-12 | | | | | |
	N	%	N	%	N	%	N	%	df	N	F	p
Make instructional decisions	3	11.1%	25	30.1%	19	16.0%	14	26.4%	3	282	8.259	0.041
Gauge student engagement with material	7	26.9%	42	50.0%	39	32.5%	23	43.4%	3	283	8.405	0.038
Prepare students for mandatory district/state tests	2	7.7%	37	44.0%	27	22.3%	7	13.2%	3	284	24.280	<0.001

Data from all teacher respondents who reported using digital games for teaching monthly or more often, includes only teachers who teach in one gradeband [Make instructional decisions: K-2 (n=27), 3-5 (n=83), 6-8 (n=119), 9-12 (n=53); Gauge student engagement with material: K-2 (n=26), 3-5 (n=84), 6-8 (n=120), 9-12 (n=53); Prepare students for mandatory district/state tests: K-2 (n=26), 3-5 (n=84), 6-8 (n=121), 9-12 (n=53)]

Table 4.16: Percent of teachers who use digital games for each purpose weekly or more often by subject area. For example, 44.8% of math only subject teachers report using digital games weekly or more often to monitor student time-on-task, compared to 7.7% of ELA/history only subject matter teachers.

| | Subject area | | | | | | | χ^2 | |
| | Math only subject teacher | | Science only subject teacher | | ELA/History only subject teacher | | | | |
	N	%	N	%	N	%	df	N	F	p
Monitor student time-on-task	30	44.8%	2	9.5%	2	7.7%	2	114	17.376	<0.001
Gauge student engagement with material	28	41.2%	3	14.3%	6	23.1%	2	115	6.591	0.037
Prepare students for mandatory district/state tests	22	32.4%	1	4.5%	1	3.8%	2	116	13.627	0.001

Data from all teacher respondents who reported using digital games for teaching monthly or more often, includes subject matter teachers who teach in only one subject area: Math, Science, ELA/History [Monitor student time-on-task: Math only (n=67), Science only (n=21), ELA/History only (n=26); Gauge student engagement with material: Math only (n=68), Science only (n=21), ELA/History only (n=26); Prepare students for mandatory district/state tests: Math only (n=68), Science only (n=22), ELA/History only (n=26)]

Table 4.17: Percent of teachers who use digital games for each purpose weekly or more often by classroom type. For example, 20.3% of self-contained classroom teachers report using digital games weekly or more often to group students, compared to 11.1% of subject matter teachers.

| | Classroom type | | | | | | χ^2 | |
| | Self-contained classroom teacher | | Subject matter only teacher | | | | | |
	N	%	N	%	df	N	F	p
Group students	25	20.3%	20	11.1%	1	303	4.906	0.027
Prepare students for mandatory district/state tests	41	33.1%	40	22.2%	1	304	4.416	0.036

Data from all teacher respondents who reported using digital games for teaching monthly or more often, excludes specialist teachers [Group students: Self-contained (n=123), Subject matter (n=180); Prepare students for mandatory district/state tests: Self-contained (n=124), Subject matter (n=180)]

Figure 4.10: At your school, which of these barriers do teachers face in using digital games in the classroom (28)?
Data from all teacher respondents (n=434). Teachers could select more than one option.

Barrier	Percentage (count)
Cost of game software	54.8% (238)
Insufficient time in curriculum	52.3% (227)
Lack of technology resources (computers, devices, Internet connection)	52.1% (226)
Not sure where to find quality games	47.7% (207)
Hard to find games that fit our school's curriculum	47.5% (206)
Emphasis on standardized test scores	40.1% (174)
Not sure how to integrate games into instruction	33.4% (145)
Unfamiliarity with technology	25.8% (112)
Lack of administrative support	13.6% (59)
Lack of parental support	9.0% (39)
There are no barriers	9.7% (42)

Table 4.18: Percent of teachers by gradeband who report teachers at their school face each barrier to classroom digital game use. For example, 31.9% of grades 3-5 teachers report that teachers at their school face the barrier that it is hard to find games that fit their school's curriculum, compared to 60.8% of grades 9-12 teachers.

| | Gradeband | | | | | | | | | χ^2 | |
| | K-2 | | 3-5 | | 6-8 | | 9-12 | | | | | |
	N	%	N	%	N	%	N	%	df	N	F	p
Hard to find games that fit our school's curriculum	13	44.8%	29	31.9%	75	50.3%	48	60.8%	3	348	15.052	0.002
Not sure where to find quality games	16	55.2%	30	33.0%	78	52.3%	47	59.5%	3	348	13.948	0.003
Cost of game software	17	58.6%	39	42.9%	93	62.4%	47	59.5%	3	348	9.341	0.025

Data from all teacher respondents, includes only teachers who teach in one gradeband [K-2 (n=29), 3-5 (n=91), 6-8 (n=149), 9-12 (n=79)]

Table 4.19: Percent of teachers by subject area who report teachers at their school face each barrier to classroom digital game use. For example, 43.4% of math only subject teachers report that teachers at their school face the barrier that they are not sure where to find quality games, compared to 80.4% of ELA/history only subject teachers.

| | Subject area | | | | | | | | χ^2 | |
| | Math only subject teacher | | Science only subject teacher | | ELA/History only subject teacher | | | | | |
	N	%	N	%	N	%	df	N	F	p
Not sure where to find quality games	36	43.4%	19	52.8%	37	80.4%	2	165	16.645	<0.001
Not sure how to integrate games into instruction	28	33.7%	7	19.4%	22	47.8%	2	165	7.243	0.027

Data from all teacher respondents, includes subject matter teachers who teach in only one subject area: Math, Science, ELA/History [Math only (n=83), Science only (n=36), ELA/History only (n=46)]

Table 4.20: Percent of teachers by classroom type who report teachers at their school face each barrier to classroom digital game use. For example, 35.5% of self-contained classroom teachers report that teachers at their school face the barrier that it is hard to find games to fit their school's curriculum, compared to 52.7% of subject matter only teachers.

| | Classroom type | | | | | | | |
| | Self-contained classroom teacher | | Subject matter only teacher | | | | χ^2 | |
	N	%	N	%	df	N	F	p
Hard to find games that fit our school's curriculum	49	35.5%	127	52.7%	1	379	10.425	0.001
Not sure where to find quality games	54	39.1%	129	53.5%	1	379	7.284	0.007
Lack of administrative support	11	8.0%	40	16.6%	1	379	5.607	0.018
Cost of game software	66	47.8%	141	58.5%	1	379	4.038	0.044

Data from all teacher respondents, excludes specialist teachers [Self-contained (n=138), Subject matter only (n=241)]

Table 4.21: Logistic regression analysis predicting reporting the barrier that it is hard to find games that fit their school's curriculum. The odds of a teacher reporting the barrier that it is hard to find games that fit their school's curriculum decreases by a factor of 0.971 for each one year increase in teaching experience, controlling for status as a subject matter or self-contained classroom teacher, gradebands taught, and school setting,

Variable	β	Standard error	Odds ratio	p
Constant	-0.066	0.443	0.936	0.881
Years of teaching experience	-0.030	0.013	0.971	0.019
Subject matter teacher (as compared to self-contained classroom teachers)	0.486	0.341	1.626	0.155
Teaches one or more of grades K-2	0.179	0.397	1.196	0.651
Teaches one or more of grades 3-5	-0.329	0.323	0.720	0.309
Teaches one or more of grades 6-8	-0.009	0.349	0.991	0.978
Teaches one or more of grades 9-12	0.371	0.384	1.449	0.333
School setting: Suburban (as compared to Urban)	0.037	0.270	1.037	0.892
School setting: Rural (as compared to Urban)	-0.048	0.304	0.954	0.876
-2 log likelihood	494.889			
Cox & Snell R Square	0.057			
Nagelkerke R Square	0.076			
Chi-square	21.776			0.005
N	374			

Table 4.22: Logistic regression analysis predicting reporting the barrier that they are unsure where to find quality games. The odds of a teacher reporting the barrier that they are unsure where to find quality games decreases by a factor of 0.967 for each one year increase in teaching experience, controlling for status as a subject matter or self-contained classroom teacher, gradebands taught, and school setting,

Variable	β	Standard error	Odds Ratio	p
Constant	1.092	0.461	2.979	0.018
Years of teaching experience	-0.034	0.013	0.967	0.008
Subject matter teacher (as compared to self-contained classroom teachers)	0.182	0.342	1.200	0.594
Teaches one or more of grades K-2	-0.483	0.416	0.617	0.245
Teaches one or more of grades 3-5	-0.902	0.336	0.406	0.007
Teaches one or more of grades 6-8	-0.304	0.354	0.738	0.391
Teaches one or more of grades 9-12	-0.166	0.389	0.847	0.671
School setting: Suburban (as compared to Urban)	-0.523	0.272	0.593	0.054
School setting: Rural (as compared to Urban)	-0.122	0.307	0.885	0.690
-2 log likelihood	489.758			
Cox & Snell R Square	0.073			
Nagelkerke R Square	0.098			
Chi-square	28.449			<0.001
N	374			

Appendix 5 – Intersection of Teachers' Digital Game Use and Formative Assessment Practices

Note: The total "n" for each item varies due to either missing responses, or because some items were presented only to a subset of respondents (e.g., only math teachers). Numbers in parentheses refer to survey question numbers in Appendix 1.

Table 5.1: Teachers' formative assessment practices by their frequency of using digital games for formative assessment (30). For example, 27.2% of teachers who rarely use games for formative assessment check for motivation and engagement during formative assessment (conducted with or without digital games), compared to 48.0% of teachers who use games daily for formative assessment.

	Teachers' frequency of game use for formative assessment									χ^2		
	Rarely		Monthly		Weekly		Daily					
	N	%	N	%	N	%	N	%	df	N	F	p
Check for motivation and engagement during formative assessment (16)	31	27.2%	49	39.5%	46	47.4%	12	48.0%	3	360	10.437	0.015
Use information from formative assessment to track student progress daily (19)	27	24.3%	43	36.1%	28	30.8%	13	54.2%	3	345	9.391	0.025
Use information from formative assessment to give feedback to students daily (19)	76	68.5%	70	59.8%	71	78.0%	22	91.7%	3	343	13.940	0.003

Data from teacher respondents who reported using digital games for teaching at least monthly [Check for motivation and engagement during formative assessment: Rarely (n=114), Monthly (n=124), Weekly (n=97), Daily (n=25); Use information from formative assessment to track student progress daily: Rarely (n=111), Monthly (n=119), Weekly (n=91), Daily (n=24); Use information from formative assessment to give feedback to students daily: Rarely (n=111), Monthly (n=117), Weekly (n=91), Daily (n=24)]

Table 5.2: Percent of teachers who share information from formative assessment with teaching colleagues weekly or more often by their frequency of using digital games for formative assessment (20, 30). For example, 58.1% of teachers who use games for formative assessment monthly share information from formative assessment (conducted with or without digital games) with teaching colleagues weekly or more often, compared to 75.3% of teachers who use games weekly for formative assessment.

| | Teachers' frequency of game use for formative assessment | | | | | | | | | | χ^2 | |
| | Rarely | | Monthly | | Weekly | | Daily | | | | | |
	N	%	N	%	N	%	N	%	df	N	F	p
Share information from formative assessment with teaching colleagues weekly or more often	71	62.3%	72	58.1%	73	75.3%	18	72.0%	3	360	8.017	0.046

Data from teacher respondents who reported using digital games for teaching at least monthly [Rarely (n=114), Monthly (n=124), Weekly (n=97), Daily (n=25)]

Table 5.3: Percent of teachers who report facing each barrier to formative assessment by their frequency of using digital games for formative assessment (21, 30). For example, 17.5% of teachers who rarely use games for formative assessment report that they do not face any barriers in conducting formative assessment (with or without digital games), compared to 48.0% of teachers who use games daily for formative assessment.

| | Teachers' frequency of game use for formative assessment | | | | | | | | | | χ^2 | |
| | Rarely | | Monthly | | Weekly | | Daily | | | | | |
	N	%	N	%	N	%	N	%	df	N	F	p
Do not face any barriers in conducting formative assessment	20	17.5%	32	26.0%	23	24.2%	12	48.0%	3	357	10.638	0.014
Face the barrier of Insufficient training or preparation for making use of information from formative assessment	30	26.3%	15	12.2%	15	15.8%	1	4.0%	3	357	12.066	0.007

Data from teacher respondents who reported using digital games for teaching at least monthly [Rarely (n=114), Monthly (n=123), Weekly (n=95), Daily (n=25)]

Table 5.4: Percent of teachers who report facing the barrier of lack of time to administer formative assessment by their frequency of using built in assessment systems when assessing student learning with digital games (21, 31). For example, 49.4% of teachers who rarely use built in assessment systems when they assess student learning with digital games report facing the barrier of lack of time to administer formative assessment, compared to 29.0% of teachers who always use built in assessment systems when they assess student learning with digital games.

	Frequency of using built in assessment systems when assessing student learning with digital games										
	Rarely		Occasionally		Sometimes		Always				χ^2	
	N	%	N	%	N	%	N	%	df	N	F	p
Face the barrier of lack of time to administer formative assessment	44	49.4%	36	46.8%	28	31.8%	29	29.0%	3	354	12.154	0.007

Data from teacher respondents who reported using digital games for teaching at least monthly [Rarely (n=89), Occasionally (n=77), Sometimes (n=88), Always (n=100)]

Table 5.5: Teachers' formative assessment practices by their frequency of using student scores when assessing student learning with digital games (31). For example, 52.7% of teachers who occasionally use student scores when they assess student learning with digital games check for procedures and processes during formative assessment (conducted with or without digital games), compared to 75.3% of teachers who always use student scores when they assess student learning with digital games.

| | Frequency of using student scores when assessing student learning with digital games | | | | | | | | | | | |
| | Rarely | | Occasionally | | Sometimes | | Always | | | | χ^2 | |
	N	%	N	%	N	%	N	%	df	N	F	p
Check for procedures and processes during formative assessment (16)	47	62.7%	39	52.7%	78	67.8%	70	75.3%	3	357	9.838	0.020
Conduct formative assessment by having students solve a problem at least once during each lesson (18)	39	52.0%	43	58.1%	73	63.5%	70	75.3%	3	357	10.673	0.014
Use information from formative assessment to track student progress on a daily basis (19)	14	19.7%	17	24.3%	42	37.5%	37	40.7%	3	344	11.533	0.009

Data from teacher respondents who reported using digital games for teaching at least monthly [Check for procedures and processes during formative assessment and Have students solve a problem for formative assessment during each lesson: Rarely (n=75), Occasionally (n=74), Sometimes (n=115), Always (n=93); Use information from formative assessment to track student progress during each lesson: Rarely (n=71), Occasionally (n=70), Sometimes (n=112), Always (n=91)]

Table 5.6: Teachers' formative assessment practices by their frequency of creating their own when assessing student learning with digital games (31). For example, 23.2% of teachers who occasionally create their own assessments when they assess student learning with digital games check for metacognitive knowledge during formative assessment (conducted with or without digital games), compared to 46.3% of teachers who always create their own assessments when they assess student learning with digital games.

	Frequency of creating their own assessments when assessing student learning with digital games											
	Rarely		Occasionally		Sometimes		Always				χ^2	
	N	%	N	%	N	%	N	%	df	N	F	p
Check for metacognitive knowledge during formative assessment (16)	40	29.6%	16	23.2%	37	42.5%	31	46.3%	3	358	11.887	0.008
Use information from formative assessment to change the lesson in real time on a daily basis (19)	79	60.3%	42	64.6%	65	80.2%	52	82.5%	3	340	15.528	0.001
Use information from formative assessment to find or create alternative instructional strategies for teaching a topic on a daily basis (19)	32	24.2%	11	16.9%	25	30.1%	24	37.5%	3	344	7.884	0.048

Data from teacher respondents who reported using digital games for teaching at least monthly [Check for metacognitive knowledge during formative assessment: Rarely (n=135), Occasionally (n=69), Sometimes (n=87), Always (n=67); Use information from formative assessment to change lesson in real time on a daily basis: Rarely (n=131), Occasionally (n=65), Sometimes (n=81), Always (n=63); Use information from formative assessment to find or create alternative instructional strategies on a daily basis: Rarely (n=132), Occasionally (n=65), Sometimes (n=83), Always (n=64)]

Table 5.7: Teachers' formative assessment practices by their frequency of using whole class discussion when assessing student learning with digital games (31). For example, 72.5% of teachers who rarely use whole class discussion when they assess student learning with digital games conduct formative assessment (with or without digital games) by asking probing questions during each lesson, compared to 91.5% of teachers who always use whole class discussion when they assess student learning with digital games.

| | Frequency of using whole class discussion when assessing student learning with digital games | | | | | | | | | | | |
| | Rarely | | Occasionally | | Sometimes | | Always | | | | χ^2 | |
	N	%	N	%	N	%	N	%	df	N	F	p
Conduct formative assessment by asking probing questions during each lesson (18)	66	72.5%	78	76.5%	83	79.8%	54	91.5%	3	356	8.291	0.040
Use information from formative assessment to change the lesson in real time on a daily basis (19)	56	62.9%	64	66.7%	74	73.3%	44	84.6%	3	338	8.474	0.037

Data from teacher respondents who reported using digital games for teaching at least monthly [Conduct formative assessment by asking probing questions during each lesson: Rarely (n=91), Occasionally (n=102), Sometimes (n=104), Always (n=59); Use information from formative assessment to change the lesson in real time on a daily basis: Rarely (n=89), Occasionally (n=96), Sometimes (n=101), Always (n=52)]

Table 5.8: Teachers' practices for sharing information from formative assessment by their frequency of using whole class discussion when assessing student learning with digital games (20, 31). For example, 30.8% of teachers who rarely use whole class discussion when they assess student learning with digital games use information from formative assessment (conducted with or without digital games) to give feedback to parents weekly or more often, compared to 51.0% of teachers who sometimes use whole class discussion when they assess student learning with digital games.

| | Frequency of using whole class discussion when assessing student learning with digital games | | | | | | | | | | | |
| | Rarely | | Occasionally | | Sometimes | | Always | | | | χ^2 | |
	N	%	N	%	N	%	N	%	df	N	F	p
Use information from formative assessment to give feedback to parents weekly or more often	28	30.8%	34	33.7%	52	51.0%	25	42.4%	3	353	10.181	0.017
Share information from formative assessment with administrators weekly or more often	11	12.1%	25	24.8%	30	28.8%	16	27.1%	3	355	8.837	0.032

Data from teacher respondents who reported using digital games for teaching at least monthly [Use information from formative assessment to give feedback to parents weekly or more often: Rarely (n=91), Occasionally (n=101), Sometimes (n=102), Always (n=59); Share information from formative assessment with administrators weekly or more often: Rarely (n=91), Occasionally (n=101), Sometimes (n=104), Always (n=59)]

Table 5.9: Percent of teachers who report that they do not face any barriers to conducting formative assessment by their frequency of using whole class discussion when assessing student learning with digital games (21, 31). For example, 17.6% of teachers who occasionally use whole class discussion when they assess student learning with digital games report that they do not face any barriers to conducting formative assessment (with or without digital games), compared to 34.5% of teachers who always use whole class discussion when they assess student learning with digital games.

| | Frequency of using whole class discussion when assessing student learning with digital games | | | | | | | | | | | |
| | Rarely | | Occasionally | | Sometimes | | Always | | | | χ^2 | |
	N	%	N	%	N	%	N	%	df	N	F	p
Do not face any barriers to conducting formative assessment	16	18.0%	18	17.6%	33	31.7%	20	34.5%	3	353	10.654	0.014

Data from teacher respondents who reported using digital games for teaching at least monthly [Rarely (n=89), Occasionally (n=102), Sometimes (n=104), Always (n=58)]

Table 5.10: Teachers' formative assessment practices by their frequency of using digital games to make instructional decisions (32). For example, 85.6% of teachers who rarely use digital games to make instructional decisions check for facts and knowledge during formative assessment, compared to 65.2% of teachers who use digital games daily to make instructional decisions.

| | Frequency of using digital games to make instructional decisions | | | | | | | | | χ^2 | | |
| | Rarely | | Monthly | | Weekly | | Daily | | | | | |
	N	%	N	%	N	%	N	%	df	N	F	p
Check for facts and knowledge during formative assessment (16)	143	85.6%	78	80.4%	45	70.3%	15	65.2%	3	351	10.234	0.017
Check for motivation and engagement during formative assessment (16)	50	29.9%	42	43.3%	30	46.9%	14	60.9%	3	351	12.829	0.005
Use information from formative assessment to track student progress daily (19)	45	28.0%	29	30.5%	19	31.1%	15	71.4%	3	338	16.344	0.001
Use information from formative assessment to give feedback to students daily (19)	102	63.8%	60	63.2%	52	85.2%	19	90.5%	3	337	15.668	0.001
Use information from formative assessment to assign additional work daily (19)	16	10.3%	12	12.9%	4	6.6%	6	28.6%	3	331	7.906	0.048

Data from teacher respondents who reported using digital games for teaching at least monthly [Check for facts and knowledge during formative assessment and Check for motivation and engagement during formative assessment: Rarely (n=167), Monthly (n=97), Weekly (n=64), Daily (n=23); Use information from formative assessment to track student progress daily: Rarely (n=161), Monthly (n=95), Weekly (n=61), Daily (n=21); Use information from formative assessment to give feedback to students daily: Rarely (n=160), Monthly (n=95), Weekly (n=61), Daily (n=21); Use information from formative assessment to assign additional work daily: Rarely (n=156), Monthly (n=93), Weekly (n=61), Daily (n=21)]

Table 5.11 Percent of teachers who share information from formative assessment with administrators weekly or more often by their frequency of using digital games to make instructional decisions (20, 32). For example, 17.4% of teachers who rarely use digital games to make instructional decisions share information from formative assessment (conducted with or without digital games) with administrators weekly or more often, compared to 39.1% of teachers who use digital games daily to make instructional decisions.

| | Frequency of using digital games to make instructional decisions | | | | | | | | | χ^2 | | |
| | Rarely | | Monthly | | Weekly | | Daily | | | | | |
	N	%	N	%	N	%	N	%	df	N	F	p
Share information from formative assessment with administrators weekly or more often	29	17.4%	19	19.8%	21	32.8%	9	39.1%	3	350	10.542	0.014

Data from teacher respondents who reported using digital games for teaching at least monthly [Rarely (n=167), Monthly (n=96), Weekly (n=64), Daily (n=23)]

Table 5.12: Percent of teachers who report facing each barrier to formative assessment by their frequency of using digital games to make instructional decisions (21, 32). For example, 34.7% of teachers who use digital games monthly or less often to make instructional decisions report facing the barrier that the curriculum doesn't provide materials/ resources for formative assessment, compared to 22.1% of teachers who use digital games weekly or more often to make instructional decisions.

| | Frequency of using digital games to make instructional decisions | | | | | | | |
| | Monthly or less often | | Weekly or more often | | | | χ^2 | |
	N	%	N	%	df	N	F	p
Curriculum doesn't provide materials/resources for formative assessment	91	34.7%	19	22.1%	1	348	4.785	0.029
Lack of time to administer formative assessment	116	44.3%	19	22.1%	1	348	13.417	<0.001
Insufficient training/preparation for doing formative assessment	41	15.6%	5	5.8%	1	348	5.460	0.019
Do not face any barriers in conducting formative assessment	55	21.0%	30	34.9%	1	348	6.769	0.009

Data from teacher respondents who reported using digital games for teaching at least monthly [Monthly or more often (n=262), Weekly or more often (n=86)]

Table 5.13: Teachers' formative assessment practices by their frequency of using digital games to document students' overall performance or as part of a grading system (32). For example, 31.9% of teachers who rarely use digital games to document students' overall progress, or as part of a grading system, check for motivation and engagement during formative assessment (conducted with or without digital games), compared to 60.9% of teachers who use digital games daily to document students' overall progress, or as part of a grading system.

| | Frequency of using digital games to document students' overall progress or as part of a grading system | | | | | | | | χ^2 | | |
| | Rarely | | Monthly | | Weekly | | Daily | | | | | |
	N	%	N	%	N	%	N	%	df	N	F	p
Check for motivation and engagement during formative assessment (16)	58	31.9%	37	37.4%	28	57.1%	14	60.9%	3	353	15.427	0.001
Use information from formative assessment to track student progress daily (19)	42	24.0%	34	35.1%	17	37.0%	14	63.6%	3	340	16.302	0.001
Use information from formative assessment to assign additional work daily (19)	16	9.4%	8	8.4%	10	21.7%	5	22.7%	3	333	8.919	0.030
Use information from formative assessment to find or create alternative instructional strategies for teaching a topic daily (19)	43	24.7%	23	23.5%	13	28.3%	12	54.5%	3	340	9.631	0.022

Data from teacher respondents who reported using digital games for teaching at least monthly [Check for motivation and engagement during formative assessment: Rarely (n=182), Monthly (n=99), Weekly (n=49), Daily (n=23); Use information from formative assessment to track student progress daily: Rarely (n=175), Monthly (n=97), Weekly (n=46), Daily (n=22); Use information from formative assessment to assign additional work daily: Rarely (n=170), Monthly (n=95), Weekly (n=46), Daily (n=22); Use information from formative assessment to find or create alternative instructional strategies for teaching a topic daily: Rarely (n=174), Monthly (n=98), Weekly (n=46), Daily (n=22)]

Table 5.14: Teachers' practices for sharing information from formative assessment by their frequency of using digital games to document students' overall performance or as part of a grading system (20, 32). For example, 33.0% of teachers who rarely use digital games to document students' overall progress, or as part of a grading system, use information from formative assessment (conducted with or without digital games) to give feedback to parents weekly or more often, compared to 59.6% of teachers who use digital games weekly to document students' overall progress, or as part of a grading system.

| | Frequency of using digital games to document students' overall progress or as part of a grading system | | | | | | | | | χ^2 | | |
| | Rarely | | Monthly | | Weekly | | Daily | | | | | |
	N	%	N	%	N	%	N	%	df	N	F	p
Use information from formative assessment to give feedback to parents weekly or more often	60	33.0%	40	40.4%	28	59.6%	10	43.5%	3	351	11.376	0.010
Share information from formative assessment with teaching colleagues weekly or more often	106	58.2%	71	71.7%	35	71.4%	18	78.3%	3	353	8.299	0.040
Share information from formative assessment with administrators weekly or more often	31	17.0%	21	21.2%	19	39.6%	9	39.1%	3	352	14.779	0.002
Discuss information from formative assessment with administrators weekly or more often	28	15.5%	17	17.2%	17	35.4%	9	39.1%	3	351	15.068	0.002

Data from teacher respondents who reported using digital games for teaching at least monthly [Use information from formative assessment to give feedback to parents weekly or more often: Rarely (n=182), Monthly (n=99), Weekly (n=47), Daily (n=23); Share information from formative assessment with teaching colleagues weekly or more often: Rarely (n=182), Monthly (n=99), Weekly (n=49), Daily (n=23); Share information from formative assessment with administrators weekly or more often: Rarely (n=182), Monthly (n=99), Weekly (n=48), Daily (n=23); Discuss information from formative assessment with administrators weekly or more often: Rarely (n=181), Monthly (n=99), Weekly (n=48), Daily (n=23)]

Table 5.15: Teachers' formative assessment practices by their frequency of using digital games to monitor student time on task (32). For example, 48.1% of teachers who use digital games monthly to monitor student time on task check for metacognitive knowledge during formative assessment (conducted with or without digital games), compared to 23.1% of teachers who use digital games daily to monitor student time on task.

| | Frequency of using digital games to monitor student time on task | | | | | | | | | | χ^2 | |
| | Rarely | | Monthly | | Weekly | | Daily | | | | | |
	N	%	N	%	N	%	N	%	df	N	F	p
Check for metacognitive knowledge during formative assessment (16)	53	33.1%	38	48.1%	20	27.4%	9	23.1%	3	351	10.392	0.015
Use information from formative assessment to track student progress daily (19)	43	27.7%	17	22.4%	24	34.8%	21	55.3%	3	338	14.319	0.003

Data from teacher respondents who reported using digital games for teaching at least monthly [Check for metacognitive knowledge during formative assessment: Rarely (n=160), Monthly (n=79), Weekly (n=73), Daily (n=39); Use information from formative assessment to track student progress daily: Rarely (n=155), Monthly (n=76), Weekly (n=69), Daily (n=38)]

Table 5.16: Percent of teachers who share information from formative assessment with administrators weekly or more often by their frequency of using digital games to monitor student time on task (20, 32). For example, 15.4% of teachers who use digital games monthly to monitor student time on task share information from formative assessment (conducted with or without digital games) with administrators weekly or more often, compared to 41.0% of teachers who use digital games daily to monitor student time on task.

| | Frequency of using digital games to monitor student time on task | | | | | | | | | | χ^2 | |
| | Rarely | | Monthly | | Weekly | | Daily | | | | | |
	N	%	N	%	N	%	N	%	df	N	F	p
Share information from formative assessment with administrators weekly or more often	33	20.6%	12	15.4%	19	26.0%	16	41.0%	3	350	10.639	0.014

Data from teacher respondents who reported using digital games for teaching at least monthly [Rarely (n=160), Monthly (n=78), Weekly (n=73), Daily (n=39)]

Table 5.17: Percent of teachers who report facing each barrier to formative assessment by their frequency of using digital games to monitor student time on task (21, 32). For example, 42.4% of teachers who use digital games monthly or less often to monitor student time on task report facing the barrier of lack of time to administer formative assessment, compared to 30.4% of teachers who use digital games weekly or more often to monitor student time on task.

	Frequency of using digital games to monitor student time on task							
	Monthly or less often		Weekly or more often				χ^2	
	N	%	N	%	df	N	F	p
Lack of time to administer formative assessment	100	42.4%	34	30.4%	1	348	4.631	0.031
Formative assessments don't give the information needed for instructional modification	19	8.1%	2	1.8%	1	348	5.258	0.022

Data from teacher respondents who reported using digital games for teaching at least monthly [Monthly or more often (n=236), Weekly or more often (n=112)]

Appendix 6 – Cluster Analysis

Note: The total "n" for each item varies due to either missing responses, or because some items were only presented to a subset of respondents (e.g., only math teachers).

Principal component analysis was performed analyzing four questions about teachers' perceived effectiveness of digital games for teaching for a range of purposes. The analysis yielded one factor, game effectiveness, which explained 60.783% of the variance.

Table 6.1: Factor loadings and commonalities based on a principal component analysis using 4 items from the survey about teachers' perceived effectiveness of digital game use for teaching for a range of purposes.

Initial items	Factor Loading Game Effectiveness	Commonality
Feel digital games are effective for providing useful information about student learning	0.813	0.662
Feel digital games are effective for helping students reinforce or master previously taught content	0.787	0.619
Feel digital games are effective for motivating students to learn content	0.766	0.587
Feel digital games are effective for teaching students new content	0.751	0.564
Eigenvalue	2.431	
% Variance	60.783%	
KMO	0.777	

A second principal component analysis was run using a Varimax rotation with Kaiser normalization analyzing thirteen questions about teachers' frequency using digital games for teaching for a range of purposes. Fourteen questions were initially included, however the item *how often do you use digital games for summative assessment* was not included in the final analysis because of its small commonality of .381. This analysis produced three factors, which explained 65.628% of the total variance. The three factors that emerged are game use frequency for assessing students, game use frequency for covering mandatory content, and game use frequency for covering and assessing supplemental content.

Table 6.2 Part 1: Factor loadings and commonalities based on a principal component analysis using 13 items from the survey about teachers' frequency of digital game use for teaching for a range of purposes.

Initial items	Factor Loadings			
	Game use frequency for assessing students	Game use frequency for covering mandatory content	Game use frequency for covering and assessing supplemental content	Commonality
Frequency of digital game use to understand student mastery of concepts/content at the START of a unit	0.784	0.081	0.151	0.644
Frequency of digital game use to understand student mastery of concepts/content at the END of a unit	0.720	0.257	0.126	0.600
Frequency of digital game use to make instructional decisions	0.695	0.293	0.290	0.654
Frequency of digital game use to group students	0.637	0.235	0.271	0.535
Frequency of digital game use to document students' overall performance and/or as part of a grading system	0.611	0.157	0.501	0.649
Frequency of digital game use to cover content mandated by state/national standards such as the Common Core State Standards, National Curriculum Standards for Social Studies, Next Generation Science Standards, etc.	0.149	0.873	0.227	0.836
Frequency of digital game use to cover content mandated by local/district curriculum standards	0.146	0.869	0.221	0.825
Frequency of digital game use to prepare students for mandatory district/state tests	0.393	0.686	-0.039	0.627
Frequency of digital game use to teach supplemental content (not mandated by curriculum standards)	0.100	0.085	0.851	0.741
Frequency of digital game use to assess students on supplemental knowledge and/or skills	0.294	0.129	0.786	0.721
Frequency of digital game use to gauge student engagement with material	0.396	0.397	0.549	0.616
Frequency of digital game use to conduct formative assessment of students' standards-based curriculum knowledge and/or skills	0.372	0.424	0.451	0.521

Table 6.2 Part 2: Factor loadings and commonalities based on a principal component analysis using 13 items from the survey about teachers' frequency of digital game use for teaching for a range of purposes.

| Initial items | Factor Loadings | | | |
	Game use frequency for assessing students	Game use frequency for covering mandatory content	Game use frequency for covering and assessing supplemental content	Commonality
Frequency of digital game use to monitor student time-on-task	0.431	0.413	0.440	0.550
Eigenvalue	3.171	2.759	2.589	
% of Total Variance	24.394%	21.220%	19.915%	
% Total Variance	65.528%			
KMO	0.902			

A cluster analysis was run using the 4 principal components described above: game effectiveness, game use frequency for assessing students, game use frequency for covering mandatory content, and game use frequency for covering and assessing supplemental content. First, a hierarchical cluster analysis using Ward's method was used to determine the number of clusters needed. The agglomeration table was used to decide on 4 clusters. The final clusters were then created using k-means clustering.

Table 6.3: Cluster make up: Number of teachers in each cluster and mean values for each principal component by cluster

Principal component	Cluster 1 (n=77)	Cluster 2 (n=72)	Cluster 3 (n=136)	Cluster 4 (n=136)
Game effectiveness	0.69875	0.59112	0.3333	-0.94208
Game use frequency for assessing students	1.63756	-0.34317	-0.44699	-0.18699
Game use frequency for covering mandatory content	0.35685	-0.36407	0.63189	-0.79522
Game use frequency for covering and assessing supplemental content	0.19525	1.33375	-0.43561	-0.51513

Figure 6.1: Scatterplots of teachers' values for pairs of principal components by cluster. For example, the upper right box plots each teacher's principal component value for game use frequency for covering and assessing supplemental content on the horizontal axis and their value for game effectiveness on the vertical axis.
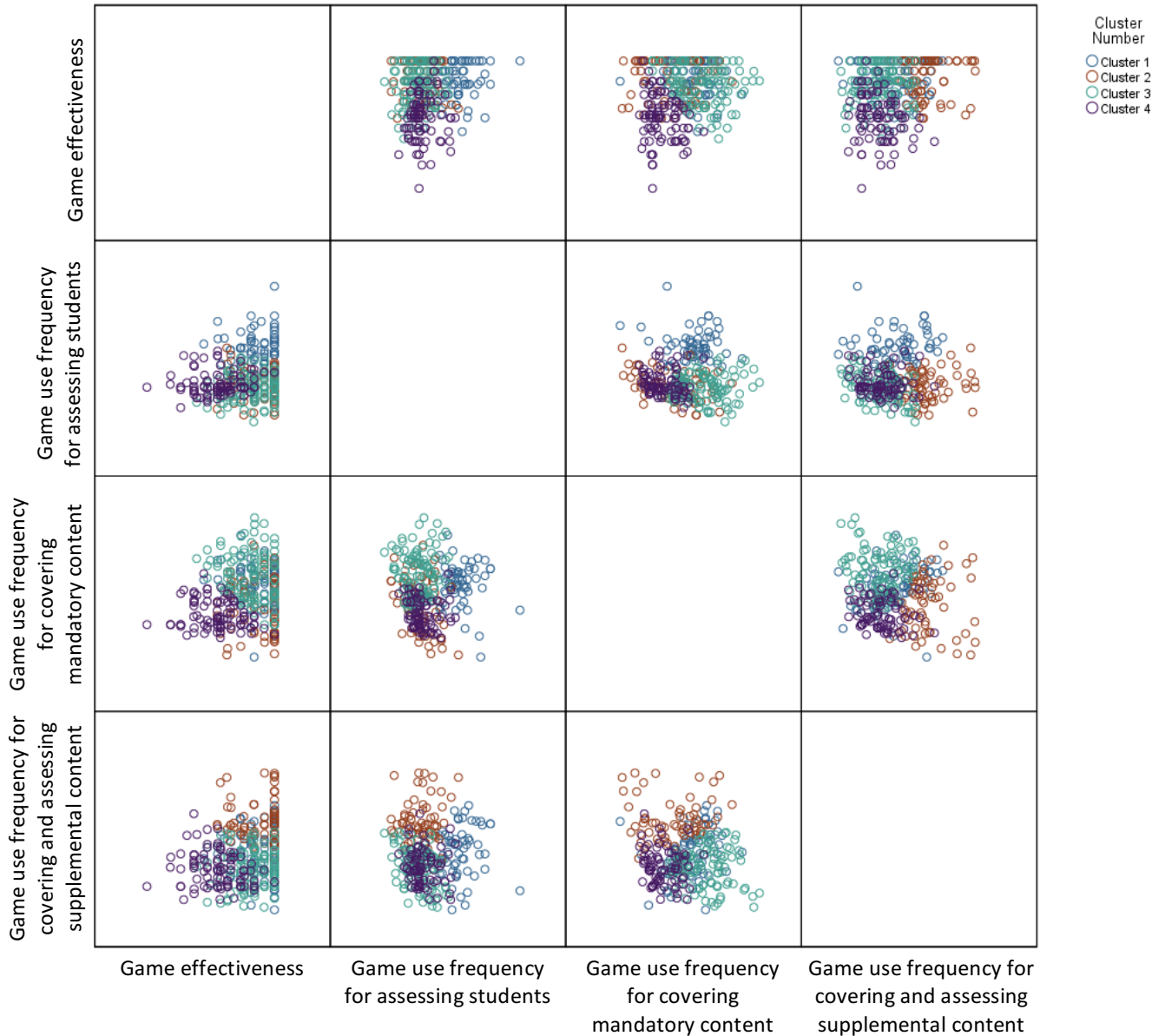
Table 6.4: Teachers' classroom type, including subject area(s) for subject matter teachers, and gradeband(s) by cluster

	Cluster 1 (n=77)		Cluster 2 (n=72)		Cluster 3 (n=136)		Cluster 4 (n=136)		Total (n=421)	
	N	%	N	%	N	%	N	%	N	%
Teacher type										
Self-contained classroom teacher	27	35.1%	22	30.6%	50	36.8%	35	25.7%	134	31.8%
Subject matter only teacher	38	49.4%	39	54.2%	67	49.3%	86	63.2%	230	54.6%
Math	18	23.4%	16	22.2%	40	29.4%	36	26.5%	110	26.1%
Science	14	18.2%	7	9.7%	12	8.8%	23	16.9%	56	13.3%
History/SS	8	10.4%	7	9.7%	7	5.1%	16	11.8%	38	9.0%
ELA	4	5.2%	7	9.7%	10	7.4%	14	10.3%	35	8.3%
Specialist teacher	12	15.6%	11	15.3%	19	14.0%	15	11.0%	57	13.5%
Gradeband										
K-2	16	20.8%	10	14.1%	23	16.9%	16	11.8%	65	15.5%
3-5	36	46.8%	26	36.6%	53	39.0%	36	26.5%	151	36.0%
6-8	34	44.2%	43	60.6%	62	45.6%	69	50.7%	208	49.5%
9-12	14	18.2%	14	19.7%	23	16.9%	43	31.6%	94	22.4%

One teacher in cluster 2 did not indicate grade(s) taught, therefore, n=71 for cluster 2, and n=420 for the total for all clusters for all gradeband values. Subject matter teachers were asked to select all subjects they teach. Teachers were asked to select all grades they teach.

There were no significant differences in cluster membership by age or years of teaching experience.

Table 6.5: Mean age and years of teaching experience by cluster

	Total		Cluster 1		Cluster 2		Cluster 3		Cluster 4		ANOVA	
	N	mean (sd)	N	mean (sd)	N	mean (sd)	N	mean (sd)	N	mean (sd)	F	p
Age	416	42.3 (10.9)	75	44.5 (11.5)	71	42.0 (11.2)	135	40.9 (10.6)	135	42.7 (10.7)	1.842	0.139
Years of teaching experience	417	13.9 (9.1)	76	15.5 (9.5)	71	14.5 (9.9)	135	12.3 (7.7)	135	14.3 (9.5)	2.377	0.069

There were no significant differences in cluster membership by gender, gradeband (comparing teachers who only teach in one gradeband), teacher type, subject matter (comparing math only, science only, and ELA/History only subject matter teachers), or classroom type.

Table 6.6: Teachers' gender, gradeband, subject matter, and classroom type by cluster. For example, 22.4%% of teachers in Cluster 1 are male, compared to 36.1% of teachers in Cluster 2.

	Cluster 1		Cluster 2		Cluster 3		Cluster 4		Chi-squared			
	N	%	N	%	N	%	N	%	df	N	f	p
Gender												
Male	17	22.4%	26	36.1%	33	24.3%	38	28.4%	3	418	4.457	0.216
Female	59	77.6%	46	63.9%	103	75.7%	96	71.6%				
Gradeband												
K-2	5	8.5%	2	3.8%	13	11.2%	8	7.1%	9	339	16.312	0.061
3-5	20	33.9%	10	19.2%	38	32.8%	22	19.6%				
6-8	22	37.3%	29	55.8%	47	40.5%	49	43.8%				
9-12	12	20.3%	11	21.2%	18	15.5%	33	29.5%				
Subject area												
Math only subject teacher	9	40.9%	10	45.5%	34	66.7%	27	44.3%	6	156	8.567	0.199
Science only subject teacher	7	31.8%	4	18.2%	7	13.7%	15	24.6%				
ELA/ History only subject teacher	6	27.3%	8	36.4%	10	19.6%	19	31.1%				
Classroom type												
Self-contained classroom teacher	27	41.5%	22	36.1%	50	42.7%	35	28.9%	3	364	5.639	0.131
Subject matter only teacher	38	58.5%	39	63.9%	67	57.3%	86	71.1%				

Data from all teacher respondents. Gradeband analysis only includes only teachers who teach in one gradeband. Subject area analysis includes subject matter teachers who teach in only one subject area: Math, Science, ELA/History. Classroom type analysis excludes specialist teachers. [Gender: Cluster 1 (n=76), Cluster 2 (n=72), Cluster 3 (n=136), Cluster 4 (n=134); Gradeband: Cluster 1 (n=59), Cluster 2 (n=52), Cluster 3 (n=116), Cluster 4 (n=112); Subject matter only teachers: Cluster 1 (n=22), Cluster 2 (n=22), Cluster 3 (n=51), Cluster 4 (n=61); Classroom Type: Cluster 1 (n=65), Cluster 2 (n=61), Cluster 3 (n=117), Cluster 4 (n=121)]

Table 6.7: Teachers' perceived effectiveness of digital games for various purposes by cluster. The first principal component used in the cluster analysis was extracted from the items below. For example, 90.9% of teachers in Cluster 2 feel digital games can be effective or very effective for teaching students new content, compared to 31.6% of the teachers in Cluster 4.

Feel digital games can be effective or very effective for:	Cluster										χ^2	
	1		2		3		4					
	N	%	N	%	N	%	N	%	df	N	F	p
Teaching students new content	70	90.9%	57	79.2%	89	65.4%	43	31.6%	3	421	89.817	<0.001
Motivating students to learn content	75	97.4%	72	100.0%	135	99.3%	104	77.0%	3	420	59.482	<0.001
Providing useful information about student learning	73	94.8%	58	80.6%	107	79.3%	52	38.2%	3	420	95.367	<0.001
Helping students reinforce or master previously taught content	76	98.7%	70	98.6%	135	99.3%	107	78.7%	3	420	53.706	<0.001

Data from all teacher respondents [Teaching students new content: Cluster 1 (n=77), Cluster 2 (n=72), Cluster 3 (n=136), Cluster 4 (n=136); Motivating students to learn content: Cluster 1 (n=77), Cluster 2 (n=72), Cluster 3 (n=136), Cluster 4 (n=135); Providing useful information about student learning: Cluster 1 (n=77), Cluster 2 (n=72), Cluster 3 (n=135), Cluster 4 (n=136); Helping students reinforce of master previously taught content: Cluster 1 (n=77), Cluster 2 (n=71), Cluster 3 (n=136), Cluster 4 (n=136)]

Table 6.8 Part 1: Percent of teachers who use digital games weekly or more often for each purpose by cluster. The final three principal components used in the cluster analysis were extracted from the items below, excluding the summative assessment item. For example, 75.8% of teachers in Cluster 1 use digital games weekly or more often to cover content mandated by local/district curriculum standards, compared to 12.7% of teachers in cluster 4.

| | Cluster | | | | | | | | | | χ^2 | |
| | 1 | | 2 | | 3 | | 4 | | | | | |
	N	%	N	%	N	%	N	%	df	N	F	p
Cover content mandated by local/district curriculum standards	50	75.8%	31	47.0%	79	64.8%	13	12.7%	3	356	84.794	<0.001
Cover content mandated by state/national standards such as the Common Core State Standards, National Curriculum Standards for Social Studies, Next Generation Science Standards, etc.	49	73.1%	31	47.0%	80	65.6%	11	10.8%	3	357	88.693	<0.001
Conduct formative assessment of students' standards-based curriculum knowledge and/or skills	40	60.6%	30	45.5%	36	29.5%	15	14.7%	3	356	42.704	<0.001
Conduct summative (end-of-unit, end-of-year) assessment of students' standards-based curriculum knowledge and/or skills	21	31.3%	9	13.6%	11	9.0%	4	4.0%	3	355	29.423	<0.001
Teach supplemental content (not mandated by curriculum standards)	36	53.7%	55	83.3%	23	19.2%	12	11.9%	3	354	114.128	<0.001
Assess students on supplemental knowledge and/or skills	37	56.1%	48	72.7%	16	13.1%	8	7.8%	3	356	117.701	<0.001
Understand student mastery of concepts/content at the START of a unit	37	56.9%	0	0.0%	1	0.8%	2	2.0%	3	350	163.385	<0.001

Table 6.8 Part 2: Percent of teachers who use digital games weekly or more often for each purpose by cluster. The final three principal components used in the cluster analysis were extracted from the items below, excluding the summative assessment item. For example, 71.2% of teachers in Cluster 1 use digital games weekly or more often to understand student mastery of concepts/content at the END of a unit, compared to 6.0% of teachers in cluster 4.

| | Cluster | | | | | | | | | | χ^2 | |
| | 1 | | 2 | | 3 | | 4 | | | | | |
	N	%	N	%	N	%	N	%	df	N	F	p
Understand student mastery of concepts/content at the END of a unit	47	71.2%	10	15.2%	20	16.8%	6	6.0%	3	351	105.674	<0.001
Make instructional decisions	45	69.2%	15	23.1%	20	16.8%	6	6.1%	3	348	91.841	<0.001
Group students	33	50.8%	9	13.6%	11	9.2%	4	4.0%	3	349	72.083	<0.001
Document students' overall performance and/or as part of a grading system	33	50.8%	22	33.3%	10	8.4%	7	7.0%	3	350	64.910	<0.001
Monitor student time-on-task	41	64.1%	31	47.0%	33	27.7%	7	7.1%	3	348	66.098	<0.001
Gauge student engagement with material	45	70.3%	45	68.2%	43	36.1%	11	11.1%	3	348	80.374	<0.001
Prepare students for mandatory district/state tests	39	60.0%	7	10.8%	40	33.6%	5	5.0%	3	349	73.260	<0.001

Data from all teacher respondents [Cover content mandated by local/district curriculum standards: Cluster 1 (n=66), Cluster 2 (n=66), Cluster 3 (n=122), Cluster 4 (n=102); Cover content mandated by state/national standards such as the Common Core State Standards, National Curriculum Standards for Social Studies, Next Generation Science Standards, etc.: Cluster 1 (n=67), Cluster 2 (n=66), Cluster 3 (n=122), Cluster 4 (n=102); Conduct formative assessment of students' standards-based curriculum knowledge and/or skills: Cluster 1 (n=66), Cluster 2 (n=66), Cluster 3 (n=122), Cluster 4 (n=102); Conduct summative (end-of-unit, end-of-year) assessment of students' standards-based curriculum knowledge and/or skills: Cluster 1 (n=67), Cluster 2 (n=66), Cluster 3 (n=122), Cluster 4 (n=100); Teach supplemental content (not mandated by curriculum standards) : Cluster 1 (n=67), Cluster 2 (n=66), Cluster 3 (n=120), Cluster 4 (n=101); Assess students on supplemental knowledge and/or skills: Cluster 1 (n=66), Cluster 2 (n=66), Cluster 3 (n=122), Cluster 4 (n=102); Understand student mastery of concepts/content at the START of a unit: Cluster 1 (n=65), Cluster 2 (n=66), Cluster 3 (n=119), Cluster 4 (n=100); Understand student mastery of concepts/content at the END of a unit: Cluster 1 (n=66), Cluster 2 (n=66), Cluster 3 (n=119), Cluster 4 (n=100); Make instructional decisions: Cluster 1 (n=65), Cluster 2 (n=65), Cluster 3 (n=119), Cluster 4 (n=99); Group students: Cluster 1 (n=65), Cluster 2 (n=66), Cluster 3 (n=119), Cluster 4 (n=99); Document students' overall performance and/or as part of a grading system: Cluster 1 (n=65), Cluster 2 (n=66), Cluster 3 (n=119), Cluster 4 (n=100); Monitor student time-on-task: Cluster 1 (n=64), Cluster 2 (n=66), Cluster 3 (n=119), Cluster 4 (n=99); Gauge student engagement with material: Cluster 1 (n=64), Cluster 2 (n=66), Cluster 3 (n=119), Cluster 4 (n=99); Prepare students for mandatory district/state tests: Cluster 1 (n=65), Cluster 2 (n=65), Cluster 3 (n=119), Cluster 4 (n=100)]

In addition to the differences across the variables used to cluster the teachers, there were significant differences in teachers' formative assessment and game use practices across the groups.

Table 6.9: Teachers' game use frequency and comfort by cluster. For example. 69.4% of teachers in Cluster 2 use games for personal use weekly or more often, compared to 44.9% of teachers in Cluster 4.

| | Cluster | | | | | | | | | | | |
| | 1 | | 2 | | 3 | | 4 | | | | χ^2 | |
	N	%	N	%	N	%	N	%	df	N	F	p
Use games for personal use weekly or more often	53	68.8%	50	69.4%	90	66.7%	61	44.9%	3	420	20.724	<0.001
Use digital games as a teaching tool weekly or more often	57	74.0%	58	80.6%	92	67.6%	44	32.4%	3	421	65.387	<0.001
Are moderately or very comfortable using games for teaching	75	97.4%	70	97.2%	127	93.4%	92	67.6%	3	421	61.686	<0.001

Data from all teacher respondents [Use games for personal use weekly or more often: Cluster 1 (n=77), Cluster 2 (n=72), Cluster 3 (n=135), Cluster 4 (n=136); Use digital games as a teaching tool weekly or more often and are moderately or very comfortable using games for teaching: Cluster 1 (n=77), Cluster 2 (n=72), Cluster 3 (n=136), Cluster 4 (n=136)]

Table 6.10: Teachers' reported barriers to game use by cluster. For example. 33.3% of teachers in Cluster 2 report that teachers at their school face the barrier of difficulty finding games that fit the school's curriculum in using digital games in the classroom, compared to 61.5% of teachers in Cluster 4.

| | Cluster | | | | | | | | | | χ^2 | |
| | 1 | | 2 | | 3 | | 4 | | | | | |
	N	%	N	%	N	%	N	%	df	N	F	p
Teachers at their school face the barrier of difficulty finding games that fit the school's curriculum in using digital games in the classroom	29	38.7%	23	33.3%	57	43.2%	83	61.5%	3	411	19.403	<0.001
Teachers at their school face the barrier of being unsure where to find quality games in using digital games in the classroom	28	37.3%	30	43.5%	55	41.7%	79	58.5%	3	411	11.850	0.008

Data from all teacher respondents [Cluster 1 (n=75), Cluster 2 (n=69), Cluster 3 (n=132), Cluster 4 (n=135)]

Table 6.11: Types of games teachers report students using in their classroom weekly or more often by cluster. For example. 83.8% of teachers in Cluster 1 report that students use educational games in their classroom weekly or more often, compared to 34.0% of teachers in Cluster 4.

| | Cluster | | | | | | | | | | χ^2 | |
| | 1 | | 2 | | 3 | | 4 | | | | | |
	N	%	N	%	N	%	N	%	df	N	F	p
Students use educational games in their classroom weekly or more often	57	83.8%	53	80.3%	90	74.4%	35	34.0%	3	358	66.135	<0.001
Students use puzzle games in their classroom weekly or more often	19	28.4%	14	21.2%	22	18.0%	8	7.8%	3	357	12.625	0.006
Students use trivia games in their classroom weekly or more often	19	28.4%	11	16.7%	12	9.8%	7	6.9%	3	356	18.05	<0.001
Students use physical games in their classroom weekly or more often	13	19.7%	2	3.0%	7	5.7%	6	6.0%	3	354	16.037	0.001

Data from all teacher respondents [Educational games: Cluster 1 (n=68), Cluster 2 (n=66), Cluster 3 (n=121), Cluster 4 (n=103); Puzzle games: Cluster 1 (n=67), Cluster 2 (n=66), Cluster 3 (n=122), Cluster 4 (n=102); Trivia games: Cluster 1 (n=67), Cluster 2 (n=66), Cluster 3 (n=122), Cluster 4 (n=101); Physical games: Cluster 1 (n=66), Cluster 2 (n=66), Cluster 3 (n=122), Cluster 4 (n=100)]

Table 6.12: Teachers' practices for assessing student learning with digital games by cluster. For example. 80.6% of teachers in Cluster 1 sometimes or always use the built-in assessments or assessment systems that come with certain games when they assess student learning with digital games, compared to 27.7% of teachers in Cluster 4.

	Cluster									χ^2		
	1		2		3		4					
	N	%	N	%	N	%	N	%	df	N	F	p
When assess student learning with digital games sometimes or always use the built-in assessments or assessment systems that come with certain games	54	80.6%	38	57.6%	69	57.0%	28	27.7%	3	355	47.753	<0.001
When assess student learning with digital games sometimes or always look at students' scores on certain games to assess their knowledge/skills on topics covered in other formats (e.g., textbook, lectures, discussions, other media)	55	83.3%	46	69.7%	72	59.5%	35	34.3%	3	355	44.829	<0.001
When assess student learning with digital games sometimes or always create own tests/quizzes (paper, online tools, essays, etc.) to assess what students have learned by playing a digital game(s)	47	70.1%	34	51.5%	41	33.9%	32	31.4%	3	356	31.774	<0.001
When assess student learning with digital games sometimes or always use whole-class discussions to assess what students have learned through their digital game play	51	76.1%	45	68.2%	42	35.0%	26	25.7%	3	354	59.997	<0.001

Data from all teacher respondents [Built-in assessments or assessment systems: Cluster 1 (n=67), Cluster 2 (n=66), Cluster 3 (n=121), Cluster 4 (n=101); Students' scores: Cluster 1 (n=66), Cluster 2 (n=66), Cluster 3 (n=121), Cluster 4 (n=102); Create own tests/quizzes: Cluster 1 (n=67), Cluster 2 (n=66), Cluster 3 (n=121), Cluster 4 (n=102); Use whole-class discussions: Cluster 1 (n=67), Cluster 2 (n=66), Cluster 3 (n=120), Cluster 4 (n=101)]

Table 6.13: Teachers' formative assessment practices by cluster. For example, 50.0% of teachers in Cluster 1 use formative assessment before a lesson regularly or more often, compared to 32.3% of teachers in Cluster 4.

	Cluster										χ^2	
	1		2		3		4					
	N	%	N	%	N	%	N	%	df	N	F	p
Use formative assessment before a lesson regularly or more often	38	50.0%	34	47.9%	55	40.7%	43	32.3%	3	415	8.075	0.044
Check for motivation and engagement during formative assessment	38	49.4%	39	54.2%	40	29.6%	39	28.7%	3	420	21.292	<0.001
Use formative assessment to check for motivation and engagement at least once during each lesson	28	37.8%	30	44.8%	29	21.8%	34	25.0%	3	410	15.099	0.002
Use information from formative assessment to give feedback to students on a daily basis	55	75.3%	56	83.6%	89	67.4%	79	60.3%	3	403	12.859	0.005
Share information from formative assessment with administrators weekly or more often	22	28.6%	23	31.9%	22	16.3%	24	17.8%	3	419	10.123	0.018
Do not face any barriers to conducting formative assessment	28	36.4%	21	29.2%	28	20.9%	26	19.4%	3	417	9.469	0.024

Data from all teacher respondents [Use formative assessment before a lesson regularly or more often: Cluster 1 (n=76), Cluster 2 (n=71), Cluster 3 (n=135), Cluster 4 (n=133); Check for motivation and engagement during formative assessment: Cluster 1 (n=77), Cluster 2 (n=72), Cluster 3 (n=135), Cluster 4 (n=136); Use formative assessment to check for motivation and engagement at least once during each lesson: Cluster 1 (n=74), Cluster 2 (n=67), Cluster 3 (n=133), Cluster 4 (n=136); Use information from formative assessment to give feedback to students on a daily basis: Cluster 1 (n=73), Cluster 2 (n=67), Cluster 3 (n=132), Cluster 4 (n=131); Share information from formative assessment with administrators weekly or more often: Cluster 1 (n=77), Cluster 2 (n=72), Cluster 3 (n=135), Cluster 4 (n=135); Do not face any barriers to conducting formative assessment: Cluster 1 (n=77), Cluster 2 (n=72), Cluster 3 (n=134), Cluster 4 (n=134)]

INTRODUCTION

Barry Fishman, Ph.D. is Arthur F. Thurnau Professor of Learning Technologies in the University of Michigan School of Information and School of Education. His research focuses on: teacher learning and the role of technology in supporting teacher learning, video games as models for learning environments, and the development of usable, scalable, and sustainable learning innovations through design-based implementation research (DBIR). He was co-author of the Obama Administration's 2010 U.S. National Educational Technology Plan, served as Associate Editor of The Journal of the Learning Sciences from 2005-2012, and was the 2001 recipient of the Jan Hawkins Award for Early Career Contributions to Humanistic Research and Scholarship in Learning Technologies. He received his A.B. from Brown University in English and American Literature in 1989, his M.S. from Indiana University in Instructional Systems Technology in 1992, and his Ph.D. in Learning Sciences from Northwestern University in 1996.

Jan L. Plass, Ph.D. is the Paulette Goddard Professor of Digital Media and Learning Sciences at NYU Steinhardt and founding director of CREATE. Dr. Plass is also the co-director of the Games for Learning Institute. His research is at the intersection of cognitive science, learning sciences, and design, and seeks to enhance the design of highly interactive visual environments. His current focus is on cognitive and emotional aspects of information design and interaction design of simulations and educational games for math and science education. Dr. Plass received his MA in Mathematics and Physics Education and his Ph.D. in Educational Technologies from Erfurt University (PH Erfurt, Germany).

Michelle Riconscente, Ph.D. is President of Designs for Learning, a consulting firm at the intersection of learning, assessment and digital interactive design. An expert in evidence-centered design, she leads and advises innovative projects that run the spectrum from interactive learning design and embedded assessments, to independent research and evaluation. Previously, as Director of Learning and Assessment at GlassLab, she provided strategic leadership that resulted in valid and reliable game-based assessments of complex competencies such as proportional reasoning, problem solving and argumentation. She holds a bachelor's degree in mathematics and physics from Brown University and a Ph.D. in educational psychology from the University of Maryland, College Park.

Rachel Snider is a doctoral candidate in Mathematics Education at the University of Michigan School of Education. Her research interests include pre-service teacher education and the intersection of teachers' knowledge and teaching practices. Rachel's dissertation looks at the mathematical knowledge for teaching and reasoning secondary mathematics teachers draw on as they plan and carry out the teaching practices of selecting examples and giving explanations. She has worked with pre-service elementary and secondary teachers in mathematics methods courses, field placements, and mathematics content courses. Before graduate school, Rachel spent 3 years teaching high school mathematics in Westwood, Massachusetts. She received her M.S. and B.S. in Mathematics from the University of Michigan.

Tzuchi Tsai is a doctoral candidate in Educational Leadership at the New York University Steinhardt School of Culture, Education, and Human Development. His research focus is on empowerment and the experience of New York City public school principals. Tzuchi is a research assistant for CREATE and holds an M.Ed. in School Leadership from Harvard University, an M.A. in Mathematics Edu-cation from Columbia University, and a B.S.E. in Biomedical Engineering from Tulane University. Before graduate school, he spent 6 years in New York City public schools teaching middle school mathematics. In his spare time, he enjoys video games and is a fan of Little Big Planet and Portal.

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