LEVEL UP LEARNING:

A national survey on teaching with digital games

By Lori M. Takeuchi & Sarah Vaala

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FOREWORD

BY MILTON CHEN, PH.D.
CHAIR, GAMES & LEARNING PUBLISHING COUNCIL

This survey can trace its origins to a long history in the design of games for learning at Sesame Workshop. As early as its first season in 1969, *Sesame Street* incorporated a classification game for preschoolers: who doesn't know the music and lyrics from "One of These Things Is Not Like the Other?" A later segment, circa 1987, from the Workshop's *Square One TV,* used a game-show format to display a panel of shirts and slacks, and asked, "How many outfits can be created?" Combinatorial mathematics was thus placed within reach of an 8-year-old.

By the mid-80s, the first educational computer games were being introduced into classrooms. Veteran educators (and young parents) will remember Oregon Trail, Carmen Sandiego, and Rocky's Boots, used by a small number of innovative teachers to enliven their classrooms through characters, graphics, and sound. However, the technology trailed far behind the vision of "microworlds" employing full-motion video, rich sound effects and music, as well as creative applications across the curriculum.

In those days before the Internet, the majority of schools had fewer than 10 computers. With the exponential increases in multimedia capacity and dramatic decreases in price, today's digital games offer much more than an occasional game for reinforcement or reward alongside the "basic curriculum." Immersive and complex games are demonstrating their potential to transform that curriculum and launch it on a new trajectory that harnesses story, simulation, and stimulation, along with competition and collaboration, to achieve higher standards and deeper learning.

This study provides an important snapshot of how far we are along that trajectory. As a single survey, its findings are necessarily limited by sample size and self-reporting. However, two fundamental findings should capture the attention of all educators, developers, funders, and policymakers: a majority of teachers are using digital games in their classrooms, and games are increasingly played on mobile devices that travel with their students. In sheer numbers of teachers and students using games of all types, the "games movement" is now mainstream, achieving the Holy Grail of educational innovation: getting to scale.

However, much remains to be done to reach that higher trajectory, in professional development and communication to teachers, in the supply side of developing more creative and complex games, and in research on outcomes. Through this study, teachers are indicating their growing receptivity to using games and a game's power for student engagement. The momentum to date has been largely fueled by bottom-up professional development—teachers spreading the word and teaching each other about games—rather than formal, district-led training tied to state standards. Teachers in this survey are telling us that they are also learners and ready for more in-depth and comprehensive PD about games. The study's typology of game-using teachers—the Dabblers, Players, Barrier Busters, and Naturals—can prompt more powerful, peer-based approaches to professional learning.

Education, more familiar with a glacial pace of change, is now picking up the pace. It is fitting that this report is brought to you by the letters G, L, P, and C, an activity of the Joan Cooney Center at Sesame Workshop, an institution known for making learning engaging and, dare we say it, *joyful.* There is cause for optimism here and for redoubling our efforts to give teachers the support they need and students the learning they deserve.

Dr. Milton Chen is a senior fellow and Executive Director, Emeritus, at The George Lucas Educational Foundation and a trustee at Sesame Workshop. He also serves as chair of the Panasonic Foundation and education committee for the National Park System Advisory Board.

EXECUTIVE SUMMARY

In Fall 2013, the Joan Ganz Cooney Center, on behalf of the Games and Learning Publishing Council, surveyed 694 K-8 teachers from across the United States on whether and how they are using digital games with their students. Here are some key findings and recommendations from this research:

FINDINGS

+ **DIGITAL GAMES HAVE LANDED IN K-8 CLASSROOMS.** Nearly three-quarters (74%) of K-8 teachers report using digital games for instruction. Four out of five of these teachers say their students play at least monthly, and 55% say they do so at least weekly. Digital game-using teachers also say they're using games to deliver content mandated by local (43%) and state/national curriculum standards (41%), and to assess students on supplemental (33%) and core knowledge (29%).

+ **WHO'S USING GAMES WITH THEIR STUDENTS?** Gender does not predict digital game use in instruction, but younger teachers, those who teach at schools serving low-income students, and teachers who play digital games for their own pleasure are more likely to use games with their students. Younger teachers and those who play digital games frequently let their students play more often, too. In turn…

+ **TEACHERS WHO USE GAMES MORE OFTEN REPORT GREATER IMPROVEMENT IN THEIR STUDENTS' CORE AND SUPPLEMENTAL SKILLS.** Coincidentally, the teachers that use games more regularly also use games to hit a wider range of objectives (teach core and supplemental content, assess students) and expose students to a wider variety of game genres and devices.

+ **EDUCATIONAL GAMES RULE IN K-8 CLASSROOMS.** Four out of five game-using teachers say their students primarily play games created for an educational audience, compared to just 5% whose students most often play commercial games. Eight percent of game-using teachers say their students mostly play a hybrid of the first two options—entertainment games that have been adapted for educational use.

+ **FEW TEACHERS ARE USING LEARNING GAMES OF THE IMMERSIVE VARIETY,** the kind that lend themselves to deep exploration and participation in the types of activities that set digital games apart from more didactic forms of instruction. Most teachers instead report using short-form games that students can finish within a single class period. While lack of time is a likely explanation, teachers may also find shorter-form games to be easier to map to curriculum standards.

+ **DIGITAL GAME INTEGRATION IS HARD.** Educators who do not teach with digital games are more likely than game-using teachers to report that they are "not sure how to integrate games" into their teaching, suggesting how consequential this uncertainty can be. That said, 80% of digital game-using teachers wish it were easier to find curriculum-aligned games, and just 39% believe that a sufficient variety of such games even exist.

+ **TEACHERS ARE LEARNING TO TEACH WITH DIGITAL GAMES VIA MORE INFORMAL MEANS** (i.e., from fellow teachers and by self teaching) than formal training programs (i.e., pre-service and in-service). As a result, teachers may not be getting exposure to the broader range of pedagogical strategies, resources, and types of games that can enhance and facilitate digital game integration.

+ **MIXED MARKS ON STEM LEARNING.** Nearly three quarters (71%) of digital game-using teachers report that games have been effective in improving their students' mathematics learning. However, only 42% report the same about their students' science learning, despite research suggesting that games are well suited for teaching complex scientific concepts.

+ **SEEING THE BENEFITS OF CO-PLAY.** Only 37% of game-using teachers report digital games as being effective in improving students' social skills, which is low compared to other skills queried. But teachers whose students primarily play together (in pairs, small groups, as a whole class) were more likely to report improvements in student social skills than teachers whose students play alone.

EXECUTIVE SUMMARY

RECOMMENDATIONS

+ **ESTABLISH AN INDUSTRY-WIDE FRAMEWORK FOR DESCRIBING AND EVALUATING EDUCATIONAL GAMES.** With designations as broad as "educational games," "math games," "literacy games," and so on, how can teachers know, as they browse and search, which titles will best fit students' interests, align with standards, units, and lesson plans, fill available class time, and fit their tight budgets? Game developers, distributors, review sites/services, and educators should together come up with common nomenclature around learning game subcategories, and then use this taxonomy to label, market, and review them. We recommend going beyond the simple adaptation of existing commercial genre names (e.g., puzzle, action games)—as many who have attempted this task before have done—and creating meaningful new terms.

+ **ELEVATE AWARENESS OF ALTERNATIVE MEANS OF INTEGRATING GAMES INTO INSTRUCTION.** When scholars and practitioners first began inspiring us with their visions for digital game-based learning, they certainly weren't writing about drill-and-practice games. Yet this is what so many K-8 teachers are still using with students today. Until teachers and students are freed from organizational constraints that limit longer stretches of student gameplay, there are ways of situating play sessions in relation to the broader lesson plan that can free teachers to use a wider variety of games; teachers simply need help figuring out how. Alternatively, teachers can adopt a flipped model of instruction, whereby students play longer-form games for homework and spend class time discussing key lessons. Professional development programs and resources can help promote these strategies among teachers.

+ **INVEST IN THE CREATION OF INNOVATIVE INTEGRATION MODELS FOR CLASSROOM DIGITAL GAMEPLAY.** We encourage foundations, government agencies, angel funders, and venture capital firms to invest in R&D on solutions that can strike the optimal balance between classroom/curriculum integration, fun/engagement, and learning efficacy, and encourage researcher-developer-educator teams to investigate and invent in the space that lies somewhere in between immersive, entertainment games and educational drill-and-practice titles.

+ **PROVIDE UNIVERSAL TECHNOLOGY TRAINING FOR PRE-SERVICE TEACHERS.** Just 8% of K-8 teachers report receiving pre-service training on digital game integration. Teachers without formal training aren't being exposed to the broader range of instructional strategies that can enhance and facilitate digital game integration. We therefore urge policymakers to allocate funds to states and school districts to set up partnerships with universities and other teacher certification programs to offer adequate technology and digital game training for the future teachers of young children.

+ **CREATE AND PROMOTE ONLINE TRAINING RESOURCES.** According to the survey, in-service teachers rely on colleagues and mentors most for professional learning and advice on digital game based teaching. While a number of excellent teacher-facing websites that serve these purposes already exist, a minority of K-8 teachers say they're using them. This means that we need to do more to promote these online resources, and identify how they can more effectively address teachers' pedagogical questions as well as their lifestyles, learning styles, and organizational constraints.

+ **CONDUCT FOLLOW-UP RESEARCH AND SHARE WIDELY WITH STAKEHOLDERS.** One issue surfaced in the report's profile analyses is the relationship between lower levels of community support and lower valuations of learning related to students' use of digital games among certain teachers. It would therefore be useful to conduct a similar survey with principals, technology administrators, superintendents, and other district-level employees as a way of surfacing their perspectives on digital game-based teaching and learning. Doing so could shed light on the support problem. Finally, teachers and administrators alike should be better informed of the findings from this and other digital game-based learning research. The more all stakeholders know about each other's practices and perceptions, the easier it will be to establish a shared vision and align decision-making across classroom, school, and district levels.

INTRODUCTION

In Fall 2013, the Joan Ganz Cooney Center surveyed nearly 700 K-8 teachers on how they're using digital games in the classroom.

WHY DIGITAL GAMES?

Because digital games—a blanket term covering video, computer, and now mobile and social media games—have the potential to transform K-12 education as we know it, according to many (e.g., Gee, 2003a; Gershenfeld, 2014; Prensky, 2001; Shaffer, Squire, Halverson, & Gee, 2005). Certain varieties of digital games offer complex worlds in which individuals can playfully explore and experiment, repeatedly fail, and ultimately succeed. To navigate these immersive environments, players need to think critically and make meaningful choices under time and other pressures mirrored in real life. Most American children are already familiar (if not obsessed) with digital games, and voluntarily spend the time it takes to up one's performance. As such, the drive to level up can drive deep learning (Gee, 2003b; Squire, 2003), and build collaboration, communication, and creativity skills that will equip students for life beyond school (Brown, 2006; Jenkins, 2009; Steinkuehler & Williams, 2006). By aligning curricular objectives for language arts, math, science, civics, etc. with game objectives so that they're one and the same, digital games have the potential to disrupt, modernize, and improve K-12 teaching and learning.

WHY TEACHERS?

The games themselves will get us only partway there. The rest is up to school boards, superintendents, principals, curriculum administrators, tech coordinators, educator trainers and, of course, teachers. Teachers are the ones who ultimately decide whether and how to use digital games with students. As studies of technology adoption regularly remind us (e.g., Cuban, Kirkpatrick, & Peck, 2001; Smith, Higgins, Wall, & Miller, 2005), simply handing teachers new tools without the necessary contextual supports and training is an invitation for wasted time at best and widespread disenchantment with the tool at worst. Digital game-based teaching requires fundamental shifts in one's pedagogical approaches to content (Mishra & Koehler, 2006), even among younger teachers who may have grown up playing games (Lei, 2009). This study is an attempt to gauge where U.S. teachers are today with integrating digital games into instruction. What kinds of teachers are teaching with games? What results are they seeing with which students? What do they struggle with most? Answers to these questions and more can help us design games, tools, resources, and training that can better support teachers in their efforts to transform the K-12 classroom.

WHY K-8?

We decided to focus the survey on K-8 teachers for a few reasons. First, developmental, structural, and curricular differences across K-12 schooling can be vast; eliminating high school teachers from the sample would allow us to pay closer attention to a narrower range of grade-specific issues. Furthermore, the digital media use of elementary school-age children continues to be under-researched compared to their preschool and adolescent counterparts (Takeuchi, 2012), and what young children do in the earliest years of their schooling can shape attitudes and dispositions toward learning for the rest of their lives. These reasons, in turn, call for the study of their teachers.

WHY NOW?

The *digital game-based learning* and *serious games* communities emerged in force around the turn of the millennium (Djaouti, Alvarez, Jessel, & Rampnoux, 2011) and in the years that followed, James Paul Gee, Kurt Squire, and other scholars began inspiring us with their visions for this new approach to teaching and learning. The present survey illustrates how far game-based learning[1] has

1 For brevity's sake, the word "digital" is occasionally dropped from references to digital games. In these cases, readers can assume that we mean digital games unless we specifically refer to board games or non-digital games.

progressed over the past decade in terms of actual classroom practice. The survey also situates these practices at this particular moment in history, when various forces have aligned to facilitate the uptake of digital games as learning tools in the U.S., including:

+ The explosive entry of tablets into schools, which has opened K-12 classrooms up to the affordable but often overwhelming world of game apps (Guernsey, Levine, Chiong, & Severns, 2012).

+ The widespread adoption of the Common Core State Standards (CCSS) and Next Generation Science Standards (NGSS), which emphasize the use of digital tools and systems to promote deeper learning and assess student progress. Teachers are seeking ways to cover the new standards, and digital games offer a particularly appealing option (Shute, 2011; Tucker, Tucker, & Smith, in press).

+ The high-tech sector's response to addressing the CCSS and NGSS. In recent years, we've seen a steady stream of products and services aimed at facilitating curriculum integration and assessment under the new standards (Richards, Stebbins, & Moellering, 2013).

+ President Obama's endorsement of video games as a promising way to excite students about science, technology, engineering, and mathematics, and inspire the next generation of innovators (OSTP, 2011).

The report ahead will examine findings vis-à-vis these critical developments.

WHY A SURVEY?

If we continue to preach only that games can be effective, we run the risk of creating the impression that all *games are good for a*ll *learners and for* all *learning outcomes, which is categorically not the case. What is needed now is (1) research explaining* why *DGBL (digital game-based learning) is engaging and effective, and (2) practical guidance for* how *(when, with whom, and under what conditions) games can be integrated into the learning process to maximize their learning potential.* (Van Eck, 2006, p. 2).

While establishing effectiveness is still the aim of many studies of learning games, a 2013 meta-analysis of 69 studies published over a 12-year period has taken Richard Van Eck's suggestions to heart. Unlike other recent meta-analyses of similar focus—which typically only determine *whether* students learn more from digital gameplay than non-game instruction—Clark, Tanner-Smith, and Killingsworth's (2014) study also tackled Van Eck's *why* question. Their synthesis of "value-added comparisons" (Mayer, 2011) demonstrated that certain game features support learning better than others, offering game developers specific guidance on how to optimize the learning potential of their products.[2] We believe that a survey of teachers may provide complementary guidance to developers, training programs, and educators by documenting when, with whom, and under what conditions teachers believe students are benefiting from classroom gameplay under *ordinary* or *naturalistic* (as opposed to controlled experimental study) conditions. Knowing what teachers believe to be effective is key, as even the most engaging and efficacious games will have zero effect on student learning if teachers aren't letting them play.

Given the ever-evolving nature of the digital learning games landscape, readers should consider findings from this survey as a snapshot in time rather than a definitive state of the field. However, we believe these data can inspire stakeholders' thinking about where the field is headed and where they eventually want it to go, and guide certain decisions they make along the way.

ORGANIZATION OF THE REPORT

Following descriptions of the methods used to conduct this research and of the population of teachers surveyed, we present findings in four sections, each organized by a driving question:

+ **THE PLAYERS:** Who's using games to teach?

+ **PRACTICES:** How are teachers using digital games in the classroom?

+ **PROFILES:** Are there certain types of game-using teachers?

+ **PERCEPTIONS:** What are teachers' experiences using games in instruction?

We then summarize what we believe to be both promising and dismaying about the findings, and conclude with a set of recommendations for the game-based learning community.

2 For example, materials designed to supplement game content and high levels of scaffolding may be more effective, and single play sessions and competitive single-player structures may be less effective, at producing learning gains.

OUR METHODS

Surveys have their limitations. But here we are able to get a sense of how teachers are using digital games, and find opportunities to learn more.

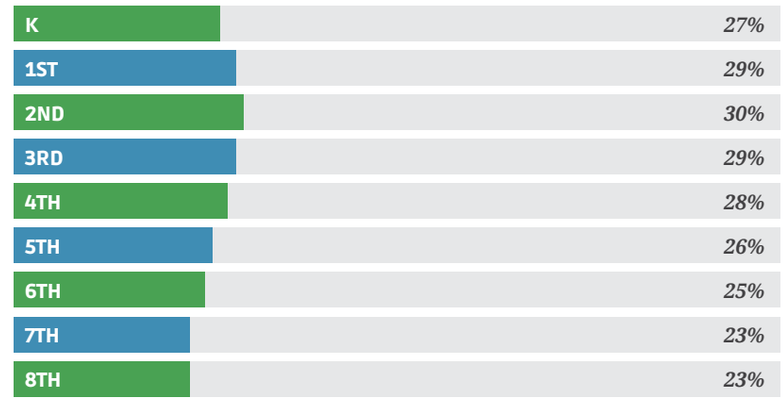

Chart A-1
Grade levels taught by survey respondents

Teachers could select all grades they teach.

BACKGROUND

Earlier studies have queried U.S. teachers on their perceptions of and attitudes toward digital game-based teaching (e.g., Kenny & McDaniel, 2009; Lei, 2009; Pastore & Falvo, 2010; Ruggiero, 2013; Schrader, Zheng, & Young, 2006),[1] but for convenience's sake, these studies have typically drawn respondents from one or a small set of pre-service teacher training programs. Futurelab (2009) managed to survey a national sample of in-service (practicing) teachers on their use of digital games for leisure and teaching (N > 1,600), but did so in the United Kingdom. The present survey is unique in that it canvassed a national sample of practicing teachers in the U.S., and K-8 teachers in particular.

The present study has also been a few years in the making. In March 2012, the Cooney Center, with support from the Bill & Melinda Gates Foundation and BrainPOP, surveyed 505 K-8 teachers who use digital games in instruction. The study surfaced information on how teachers use games to deliver content and assess students, professional learning around DGBL, and perceived implementation barriers (see Millstone, 2012; VeraQuest, 2012). However, it did not capture the responses of *non*-game-using teachers, a population that could provide greater insight into why games are not being used for instruction on a more universal basis. We therefore decided to field a follow-up survey to a broader population of K-8 teachers, which would also include those who do not use games to teach. Cognizant of the many surveys of teachers and technology that were being released at the time, we analyzed findings from five in particular[2], published between February 2012 and February 2013 (see Pressey, 2013) to identify gaps that the present survey should aim to fill. The analysis helped us hone in on four broad areas of inquiry:

+ Who is using digital games in their teaching?
+ How are teachers using digital games with their students?
+ What do teachers believe their students are learning and which students do they think are benefiting most?
+ What are teachers' greatest challenges in using digital games in the classroom?

PARTICIPANTS

The Cooney Center worked with online survey developer VeraQuest to design a survey instrument that would address the above questions. VeraQuest

1 Rather than provide a full review of the research here, we will discuss earlier studies in the context of the present survey's findings.

2 The Gates Foundation's Technology and Effective Teaching in the U.S. (February 2012); The Joan Ganz Cooney Center's National Survey of Teacher Attitudes & Beliefs on Digital Games & Learning (May 2012); Common Sense Media's Children, Teens, and Entertainment Media (Fall 2012); PBS LearningMedia's Teacher Technology Usage Survey (January 2013); and Pew Research Center's Internet & American Life Project Online Survey of Teachers (February 2013)

recruited survey respondents from the uSamp Panel, which comprises over 2 million members enrolled through a number of U.S. survey panels. Respondents receive points for the surveys they complete and may redeem these points for a variety of products. VeraQuest randomly selected adult respondents from a targeted panel of K-8 classroom teachers such that the sample would be generally proportional to the demographic and geographic strata of U.S. teachers.

The study qualified as exempt from full review by the institutional review board Ethical and Independent Review Services. Recruited panelists were presented with information about the survey's purpose and length (20 minutes), their rights and privacy, compensation (none beyond what they ordinarily receive as online panelists), and the research agency (the Cooney Center), and offered the option to accept or decline participation with no penalty to their status as an online survey panelist.

VeraQuest fielded the 36-item survey between October 22 and November 11, 2013 and collected 694 completed responses representing 47 states[3] and the District of Columbia. The mean number of years that teachers in the survey population have been teaching is 14.5 years (SD = 10.52), which comes close to the national averages for elementary (14.0 years) and middle school (13.6 years) teachers. The mean age of survey respondents is 45 years old (SD = 12.83), which is slightly higher than the national average of 42 years old (Goldring, Gray, & Bitterman, 2013). Additional occupational and demographic characteristics of the respondents and the students they teach are illustrated in the charts displayed on pages 9 through 12.

Chart A-2
Gender of survey respondents compared to national population of U.S. teachers

National data taken from the 2011-2012 Schools and Staffing Survey (Goldring, Gray, & Bitterman, 2013)

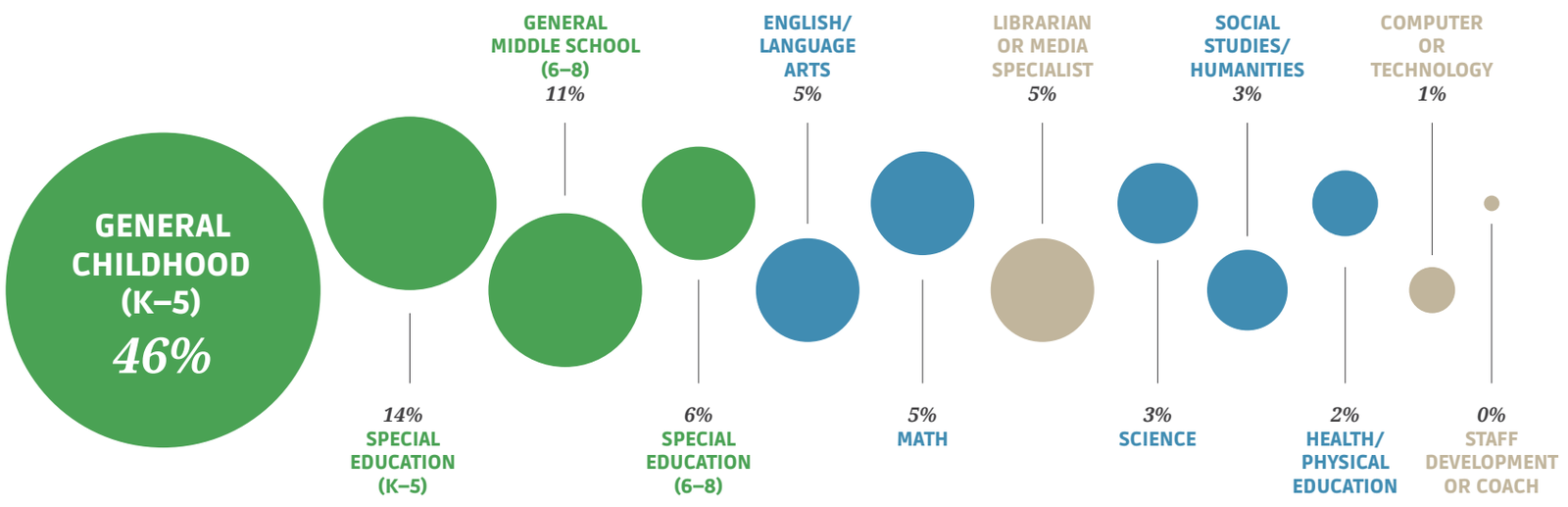

Chart A-3
Teaching position of survey respondents

3 Teachers from Delaware, Maryland, and Rhode Island did not take the survey.

ANALYSIS

Statistical analyses were conducted in SPSS. Descriptive analyses for this study include frequency tallies, percentages, and means. We used cross tabulations with chi square tests to determine differences between observed and expected frequencies in nominal or dichotomous items. In cases where the chi square test was significant, we compared column proportions using z-tests to determine cell values that were significantly different from each other ($p < .05$). For ordinal- and interval-level items, we used analysis of variance (ANOVA) tests to check for significant differences in means. Where significant differences in means were detected, F values and corresponding p values are noted. A detailed account of how we conducted our cluster analysis to create the teacher profiles is provided in Appendix B.

We consulted the following digital game researchers, educators, and developers to help us interpret some of the patterns that emerged from the data. Where appropriate, their contributions are cited in the text.

+ **GABRIEL ADAUTO,** Chief Technology Officer and Co-Founder, Motion Math
+ **SUJATA BHATT,** Founder, Incubator School
+ **ANDRÉ DENHAM, PHD,** Assistant Professor of Instructional Technology, University of Alabama
+ **ELISABETH GEE, PHD,** Delbert & Jewell Lewis Chair in Reading & Literacy and Professor, Arizona State University's Teachers College
+ **DAN WHITE,** Founder and Executive Producer, Filament Games

SCHOOL/COMMUNITY CHARACTERISTICS

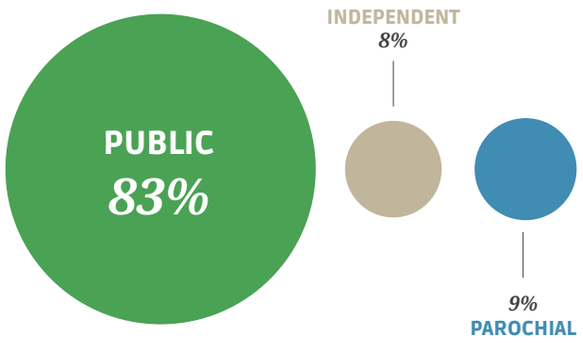

Chart B-1
Type of schools represented by survey respondents

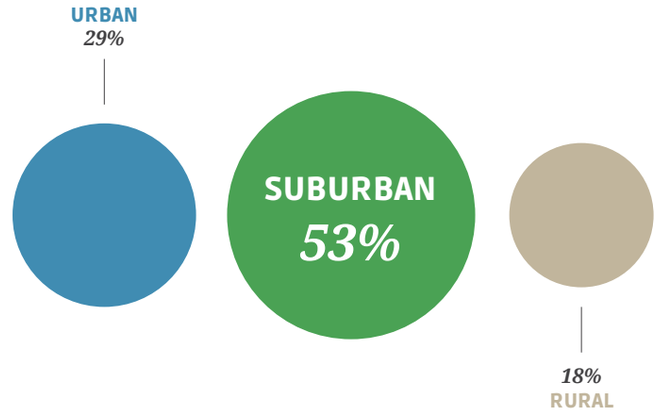

Chart B-2
Community settings represented by survey respondents

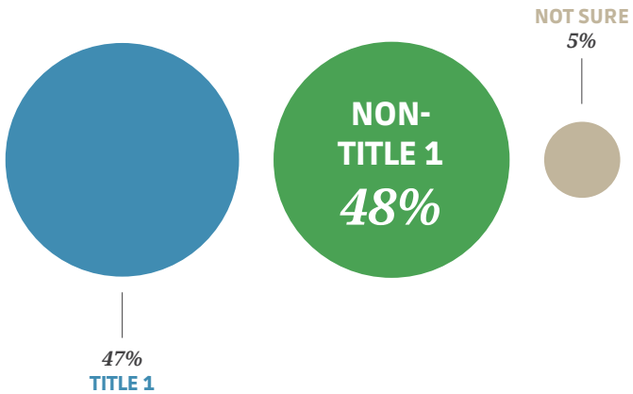

Chart B-3
Survey respondents that teach in Title 1 (high poverty) schools

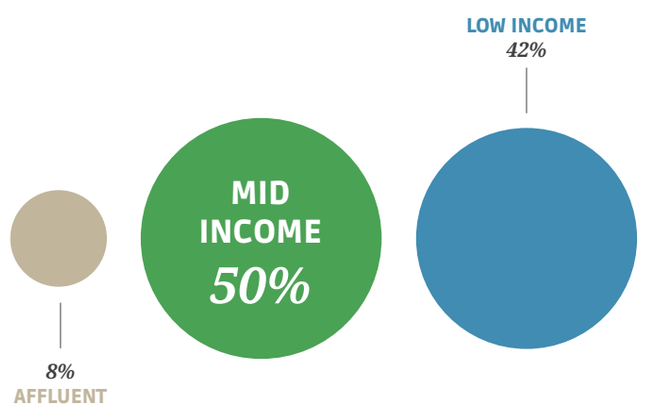

Chart B-4
Financial background of the majority of students that respondents teach

STUDENT CHARACTERISTICS

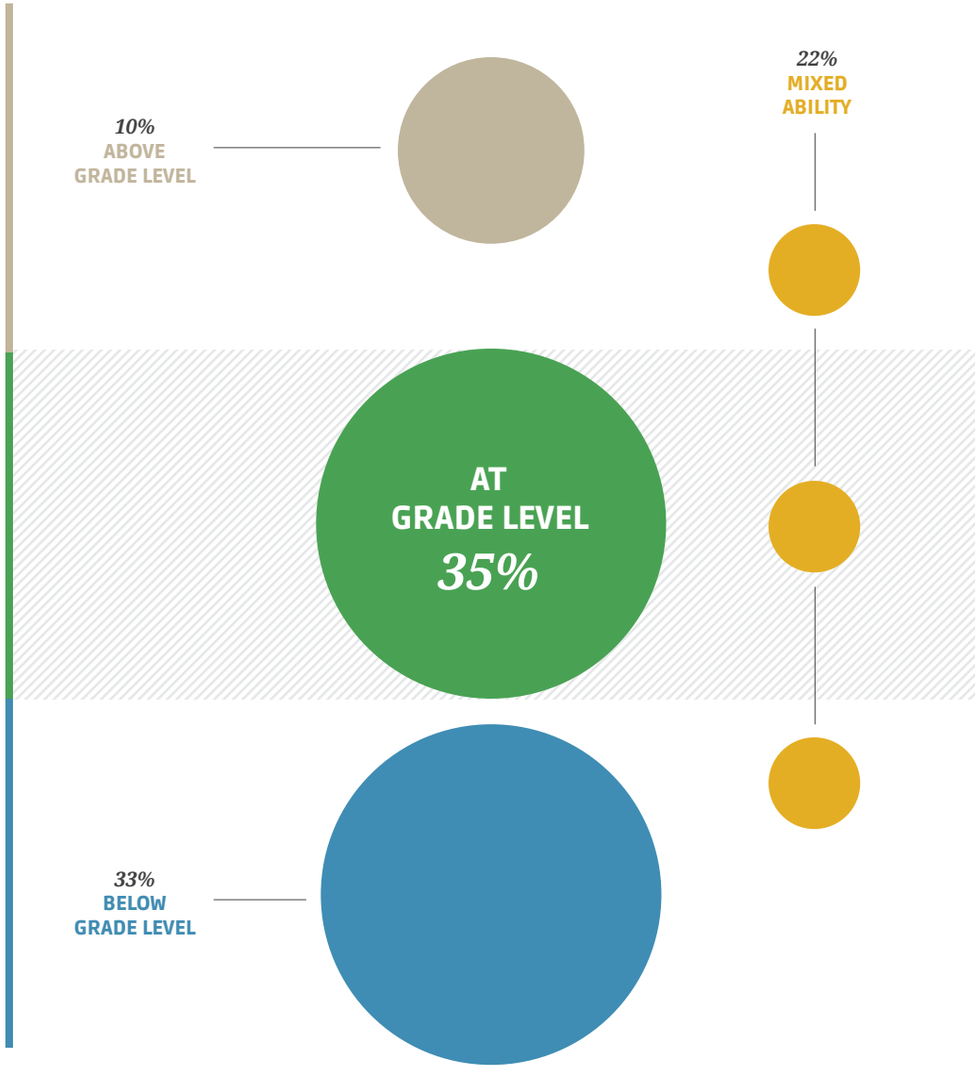

Chart C-1
General performance level of students in all classes taught by respondents

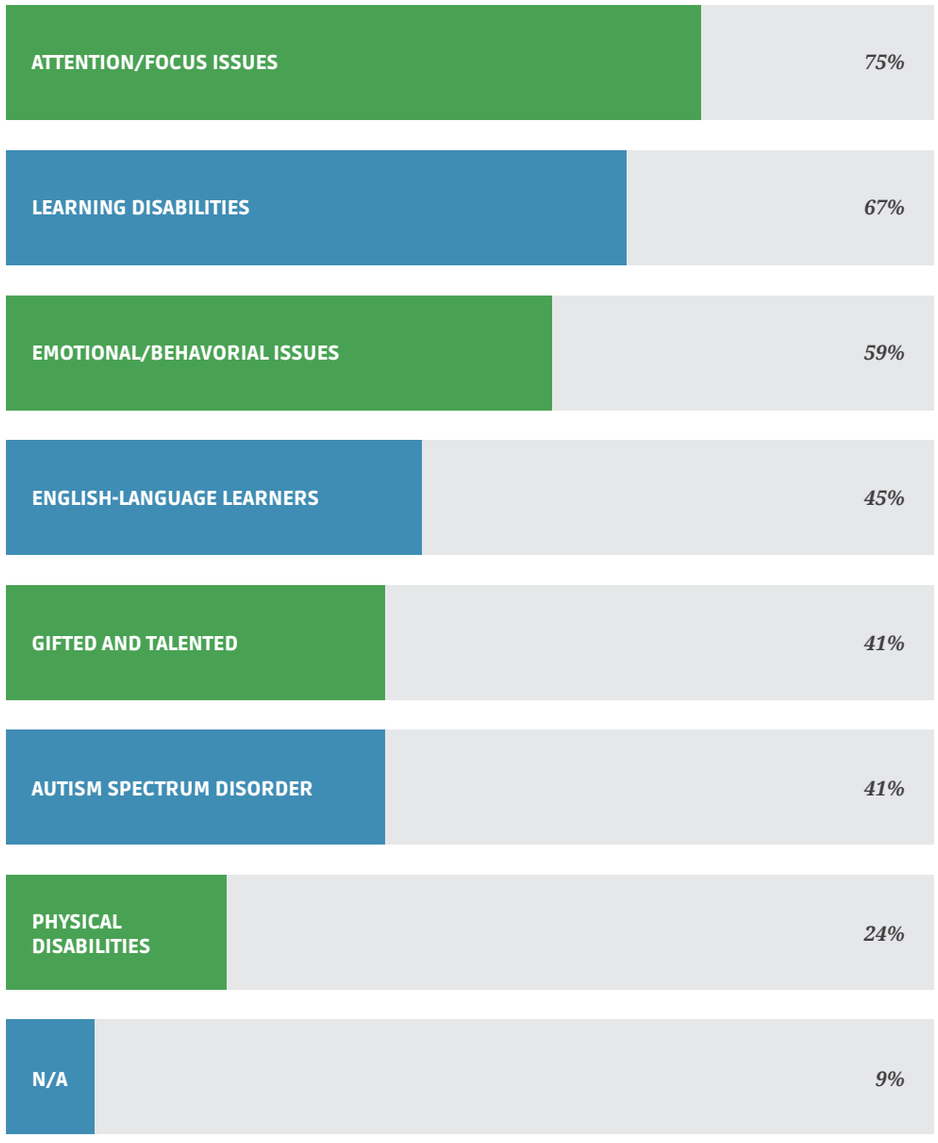

Chart C-2
Characteristics of students taught by respondents

Teachers could select all that apply.

WHAT WE FOUND

Here we report on findings broken down by the players, their practices, profiles of game-using teachers, and their perceptions of the value of digital games.

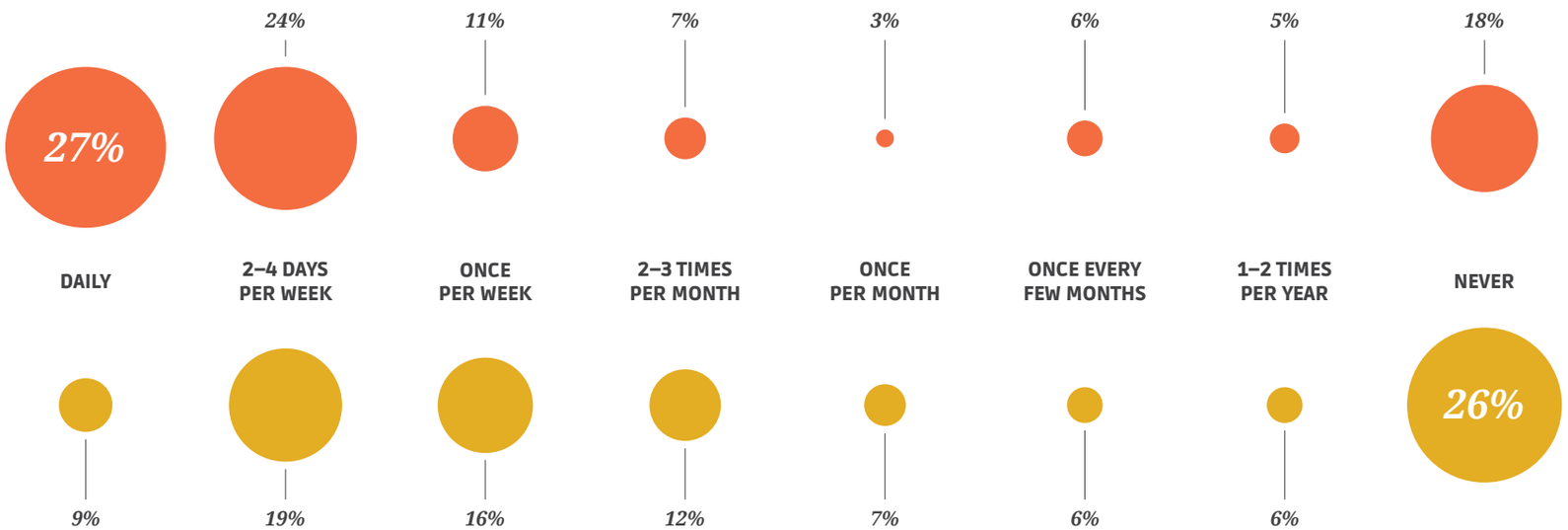

Chart 1
Frequency with which teachers play and teach with digital games

N = 694

THE PLAYERS

WHO'S USING GAMES IN THE CLASSROOM?

We asked all K-8 teachers who took part in the survey (N = 694) whether they play video/digital games for pleasure. More than four out of five teachers (82%) indicated that they *ever* play computer or video games, smart phone game apps, and/or social media games, including 62% who play *at least weekly*, and 27% who play *every day*. Only 18% of those surveyed indicated that they *never* play digital games (see Chart 1 and Figure A).

To contextualize these findings, the Entertainment Software Association (ESA) reported in 2014 that 59% percent of Americans play computer and video games. This figure is low compared to the 82% of American teachers who play digital games, but it should be noted that the ESA surveyed all age groups, from young children to octogenarians. The average age of teachers who took part in our survey, on the other hand, was 45. A more comparable statistic may be the ESA's 2013 finding that 74% of U.S. mothers play video games, and that 38% of these moms play on a daily basis. In fact, Americans ages 36 and up comprise the greatest share of the game-playing public at 39%, compared to 32% for adults between 18 and 35, and 29% for kids ages 17 and younger (ESA, 2014). Taken together, the ESA and our teacher survey data indicate that children and teens aren't the only ones playing digital games these days. Whether teachers play games at a higher rate than other

Figure A
Playing and Teaching
Page 14

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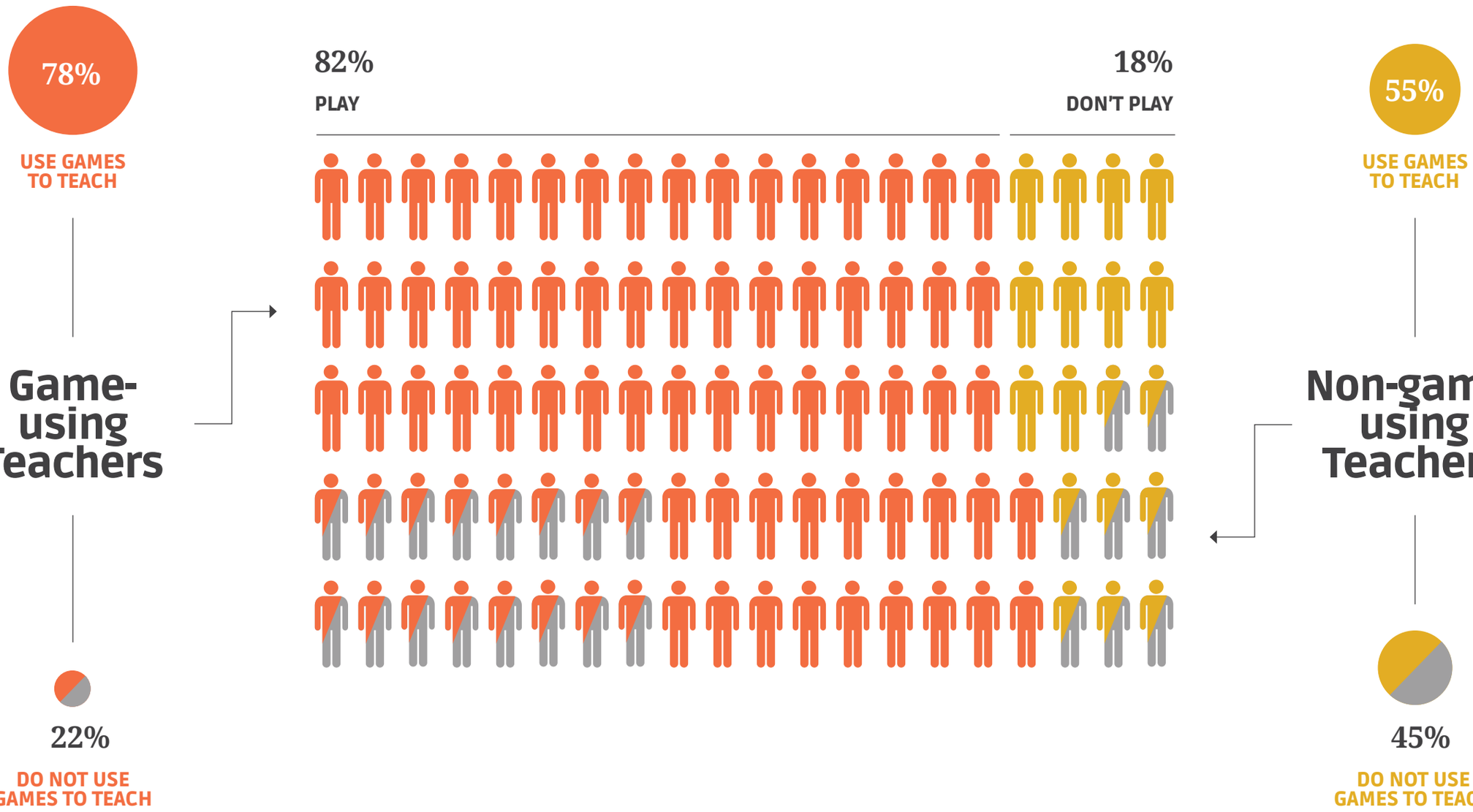
Figure A

PLAYING AND TEACHING

Do you play video/digital games for entertainment or other non-work/ non-professional related reasons?

YES ← → **NO**



N = 694

adults in their same age groups, however, warrants further investigation.

Chart 2
K–8 Media Utilization
Page 16

The survey asked teachers whether they ever use digital games for instructional purposes with their students. Almost three-quarters (74%) said they do and 26% said they do not. Throughout the report we will distinguish between these two groups as the GUTs (Game Using Teachers) and the NUTs (Non-game-Using Teachers).[1]

The survey presented respondents with a list of 10 common classroom media platforms and asked them to indicate how often, if ever, they use each in their classrooms. The orange bars in Chart 2 show the percentages of U.S. K-8 teachers who use each. As one might predict, computers and the Internet are the most commonly used devices, with 91% and 88% of teachers reporting that they ever use them. Non-digital games—including board games, card games, and even non-mediated games such as Simon Says and Duck, Duck, Goose!—were third on the list, with 82% of teachers reporting ever using them. Video game and basic e-reader devices fall comparatively low on the list, with utilization rates of only 20% and 21%, respectively. Tablets fall somewhere in the middle at 48%, and we anticipate this figure will climb over the next two years, given trends in district-wide tablet adoption programs (Leonard, 2013).

The story becomes more interesting when we break utilization rates down by GUTs and NUTs, as indicated by the gold and tan bars in Chart 2. For every device on the list, digital game-using teachers report significantly higher use rates than non-game-using teachers, and the discrepancies are especially pronounced on newer devices such as tablets and e-reader devices. These data suggest that GUTs differ from NUTs not only in their use of digital games in instruction, but in their use of technology more generally. The difference in use of non-digital games in instruction is also notable—92% among GUTs and 59% among NUTs—indicating that teachers who don't use digital games in the classroom are less likely to use games of any type with their students.

Chart 3
Game-using teachers vs. non-game-using teachers by gender

PREDICTORS OF DIGITAL GAME USE IN TEACHING

GUTs tend to use technology to teach more than NUTs do, but are there other tendencies or characteristics that separate the GUTs from the NUTs? We ran a few statistical analyses to test some common assumptions about teachers as well as video game players as they relate to classroom digital game use. Here's what we discovered:

Q. Are male teachers more likely than female teachers to use games with their students?

A. NO. There's a common misconception that video games are a largely male pastime when, according to 2014 ESA estimates, women make up 48% of the U.S. game-playing population. In fact, the number of female gamers ages 50 and older increased by 32% from 2012 to 2013 (ESA, 2014). Our survey data reflects this trend: 69% of male and 75% of female teachers use games in instruction, a difference that was not found to be statistically significant (see Chart 3).

Q. Is the number of years an individual has been teaching predictive of whether he/she uses digital games in instruction?

1 For the sake of brevity and a pronounceable acronym, we omitted the D for "digital." All references to GUTs and NUTs, however, refer to teachers who either use or do not use digital games in particular.

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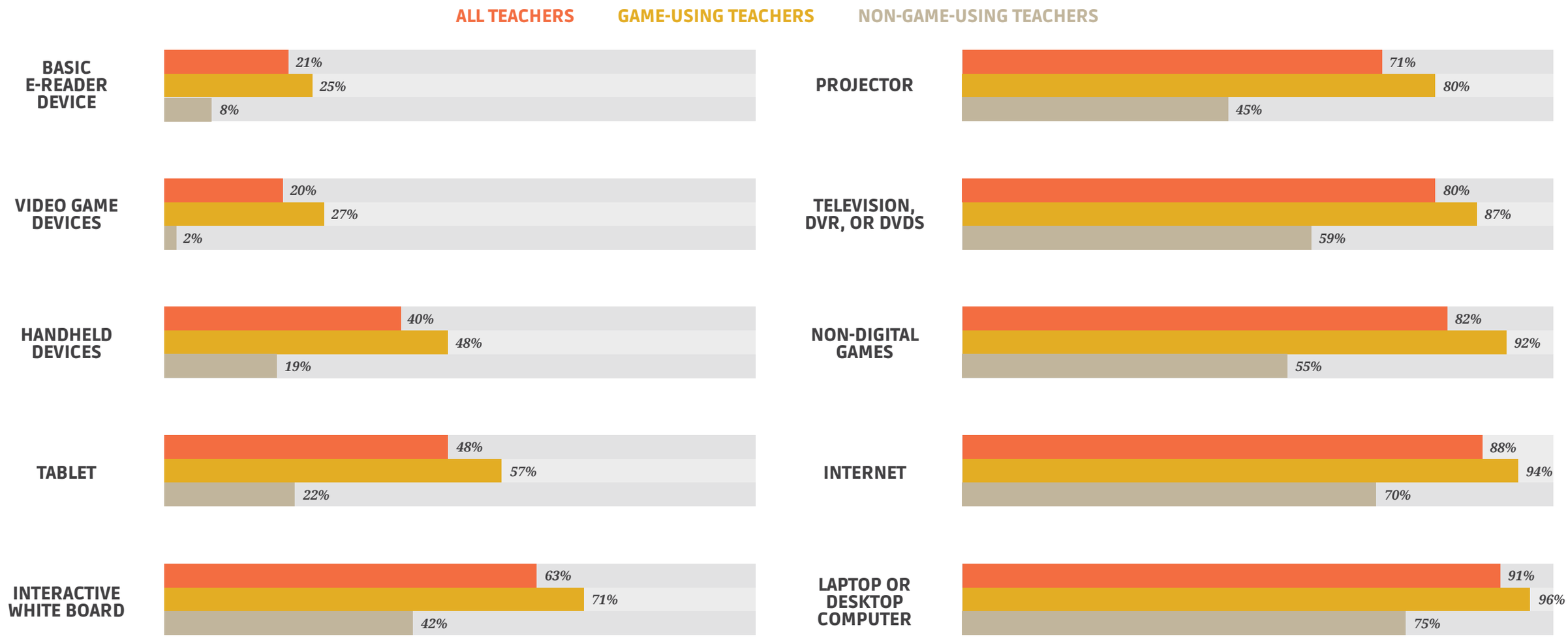
Chart 2

MEDIA UTILIZATION RATES IN K–8 CLASSROOMS

What media do you use in the classroom?



All teachers N = 694
Game-using teachers N = 513
Non-game-using teachers N = 181

A. YES. GUTs have been teaching, on average, for 13.87 years (SD = 9.98), compared to 16.45 years among NUTs (SD = 11.74; t (692) = 2.86, $p < .01$). As a whole, GUTs have spent fewer years teaching than NUTs.

Q. Is the number of years an individual has been teaching predictive of the frequency with which he/she uses digital games in instruction?

A. YES, significantly but not strongly. Fewer years of teaching are correlated with greater frequency of digital game use for teaching (r = -0.15, $p < .001$). In other words, less experienced teachers use digital games slightly more often with their students than veteran teachers.

Q. Are teachers who play games for pleasure more likely to use digital games to teach?

A. YES. We found that 78% of teachers who play digital games also use them in instruction, whereas only 55% of teachers who do not play games use them with their students ($\chi^2(1, N = 694) = 29.33, p < .001$).

Q. Does frequency of a teacher's gameplay predict the frequency of his or her use of digital games to teach?

A. YES. Teachers who play games often report using them more often with students. While significant, this relationship is not dramatic (r = 0.14, $p < .01$).

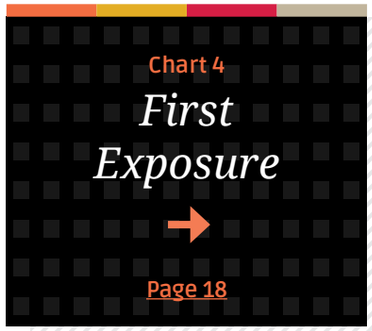
Q. Is there a relationship between the income level of a school's student population and whether a teacher uses digital games in instruction?

A. YES. Using the Title 1 designation as a proxy for the income level of a school's student population, we found that a greater percentage of teachers who use games in instruction work in Title 1 schools (82%) than in non-Title 1 schools (71%). ($\chi^2(2, N = 576) = 8.150, p < .05$).

To summarize, gender does not predict digital game use in instruction, but school Title 1 status, teacher age (extrapolated from number of years teaching), and an individual's penchant for *playing* digital games does. Younger teachers and those who play digital games frequently let their students play more often, too.

PROFESSIONAL LEARNING

All teachers need adequate training on how to integrate digital games into their teaching (Becker, 2007; Mishra & Koehler, 2006), even if they are digital natives or even self-proclaimed gamers (Lei, 2009). The survey therefore asked respondents (just the GUTs; N = 513) where they *first learned* to use games for instruction and, because both the games and the platforms students use to access them are constantly evolving, where they go for *ongoing* professional development (PD) on the topic.



To get a sense for how teachers at different stages of their careers are *first* learning to use games for instruction—and at this particular moment in history—Chart 4 displays responses by range of years teaching. Across all year bands, the greatest proportion of teachers report learning from another person: a fellow teacher, coach, or supervisor. In all but the most veteran group (25+ years), self-teaching (*I figured it out myself*) is the second most cited source of initial learning. Chart 4 also shows that younger teachers, for the most part, are more likely to learn through pre-service programs than more veteran teachers are, and veteran teachers are more likely to learn through in-service programs ($\chi^2(28, N = 513) = 47.45, p < .05$). This makes sense, as formal training programs on digital game integration are more common today than they were several years ago. Among the least experienced teachers surveyed (0-4 years), the high rate of first learning from fellow teachers is notable (41%), as it may indicate that starting teachers today have access to far more peers who use games for instructional purposes. Also notable is that regardless of years spent teaching, few GUTs are first learning via online resources.

When it comes to ongoing PD on digital game integration, teachers are again consulting fellow teachers most often for help (68%). Less common resources include online discussion forums for educators such as Edutopia, EdWeb, and Teachers.Net (25%) as well as video tutorial sharing sites like YouTube and TeacherTube (23%). Fewer teachers visit game-focused online discussion forums such as BrainPOP's GameUp, Playfullearning.com (13%); social networking sites such as Twitter, Facebook, LinkedIn, and Edmodo (13%); and game-specific communities like Gamestar Mechanic, Minecraft.edu, Gamemaker, and Scratch (7%). Fifteen percent of GUTs say they do not seek ongoing PD on digital game integration.

PRACTICES

HOW ARE TEACHERS USING DIGITAL GAMES IN THE CLASSROOM?

Nearly three-quarters (74%) of K-8 teachers in the U.S. report bringing digital games into their classrooms, but what *exactly* are they doing with them? What purposes

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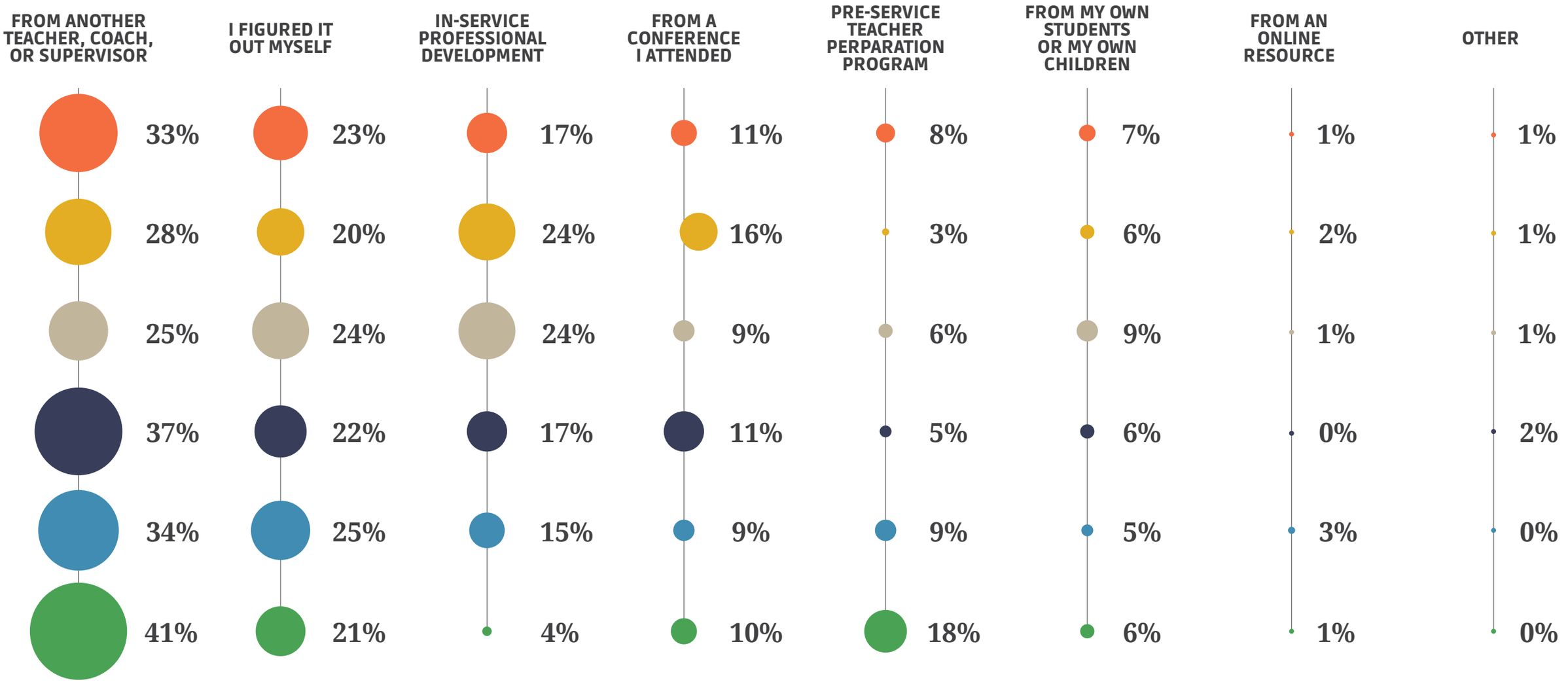
Chart 4

FIRST EXPOSURE

How did you first learn about using games in the classroom?

ALL TEACHERS | 25+ YEARS | 15–24 YEARS | 10–14 YEARS | 5–9 YEARS | 0–4 YEARS



All N = 513, 0-4 years N = 84,
5-9 Years N = 117, 10-14 years N = 109,
15-24 years N = 107, 25+ years N = 96

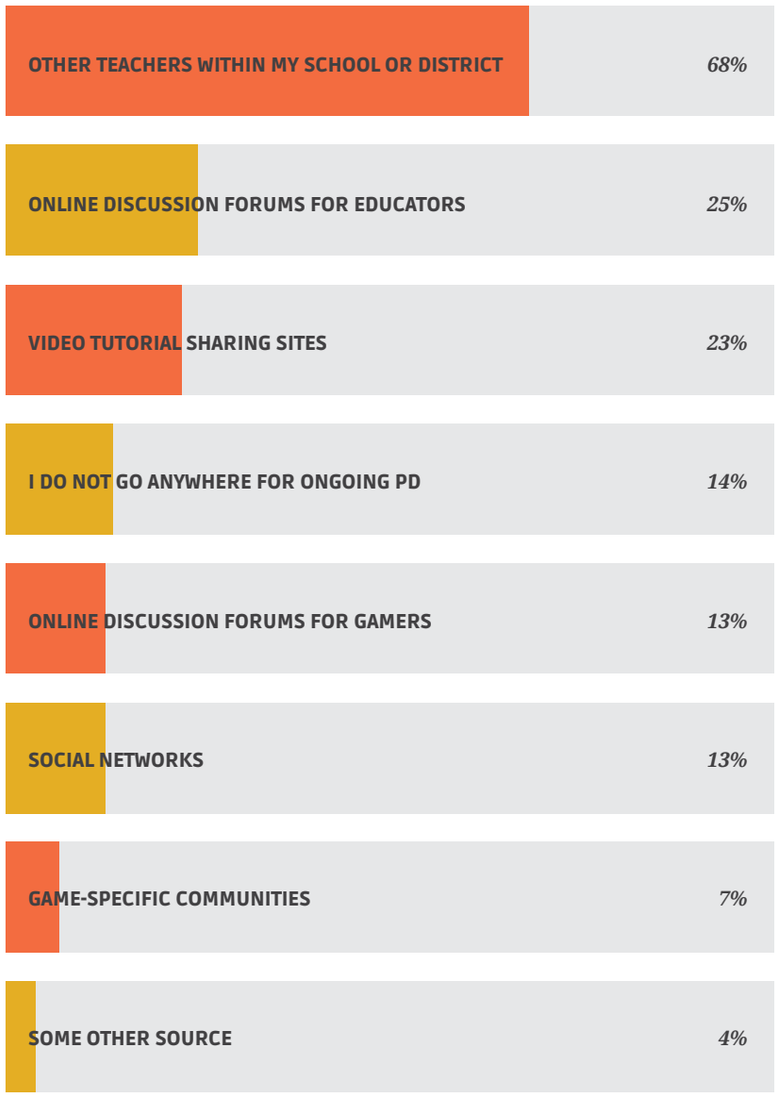


Chart 5
Where do you go for ongoing professional learning about integrating digital games into your teaching practice?

N = 513; check all that apply

are games serving in delivering curricular content, and how do these purposes compare to what teachers are doing with other classroom technologies? How often are students playing, and do they play individually or in groups? What game genres and titles are most popular in K-8 classrooms, and how are teachers selecting them for student use? This next set of charts tackle these questions, offering a look at digital game pedagogy in practice.

PURPOSES OF DIGITAL GAMES AND GAMING PLATFORMS

The survey asked teachers how they're using digital games to deliver content to their students and, in turn, how they might be using games to assess student content knowledge and skills. Teachers were allowed to select all relevant responses (see Charts 6 and 7).

As Chart 6 illustrates, K-8 teachers are, for the most part, using digital games to *deliver* content more often than they're using games to *assess* student content knowledge. They are also using games more frequently to assess students on a formative rather than summative basis. And teachers are more frequently using games to teach *supplemental* content than standards-based curricula (i.e., local/district *and* state/national), but not by a substantial margin.

When we examine responses by grade level of responding teachers, a few trends emerge.[2] For instance, middle grade teachers are *less* likely to use games to deliver mandated curricula (either local or national) than primary grade teachers are, which may have something to do with the shorter blocks of time middle school teachers have to cover content with students, or textbook/worksheet-based curricula and pacing plans. Meanwhile, elementary grade (4-6) teachers are *more* likely than primary grade (K-3) teachers to use games to assess students on supplemental knowledge and formatively assess them on core knowledge. Explanations for these differences between lower and upper elementary teachers are less obvious and would require additional research to understand these trends.

Chart 6
Content Delivery
Page 20

Chart 7
Assessing Performance
Page 21

Just under a quarter of K-8 GUTs do not assess student performance with *or* around digital games in any way. The rest report creating their own tests/quizzes (30%) or holding whole-class discussions (31%) to measure student learning through gameplay; or interpreting students' game scores as evidence of their knowledge on topics covered in other formats (39%). Forty-three percent of GUTs use the built-in assessment systems that come with the games their students play. These respondents (N = 218) were also asked to indicate how they're using built-in assessment systems. As illustrated in Chart 7, 56% base instructional decisions on what they learn from these assessments, and 54% say that they have been helpful in gauging student mastery of concepts/content at the end of a unit. Other oft-cited purposes of built-in assessments include documenting students' overall performance (43%) and gauging student engagement (42%).

Digital games may be played on a variety of devices—not just dedicated gaming platforms like Xboxes and Nintendo DSes, but also touchscreen tablets, laptops, cell phones, and interactive whiteboards. In fact, as Chart 2 (p. 16) indicates, dedicated gaming platforms are far fewer in number in K-8 classrooms than their multipurpose counterparts. Curious to know what

2 Differences reported here are not significantly different, but point to trends worth investigating in future surveys.

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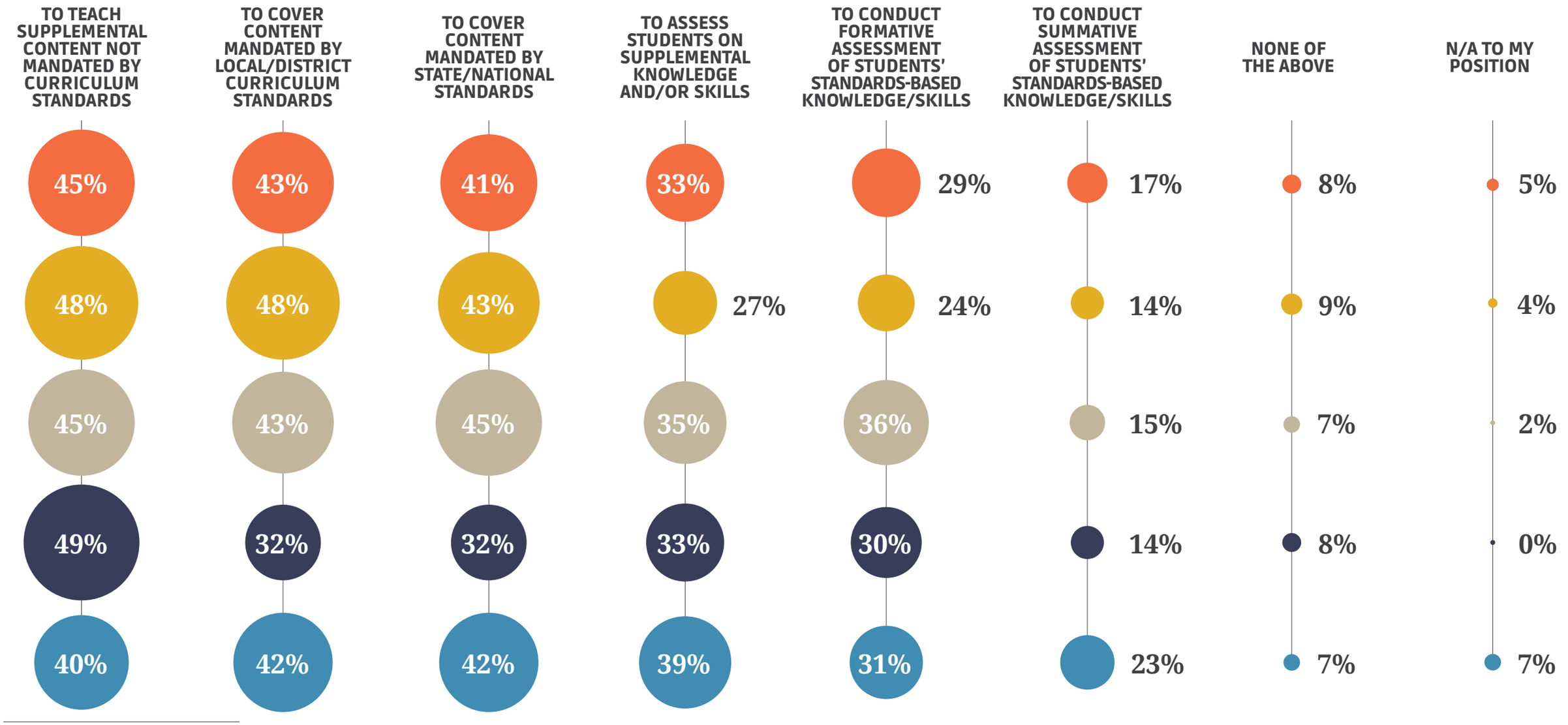
Chart 6

CONTENT DELIVERY

How do you use digital games to deliver core or supplemental curriculum content?

ALL GRADES PRIMARY ELEMENTARY MIDDLE MIXED



N = 513, check all that apply

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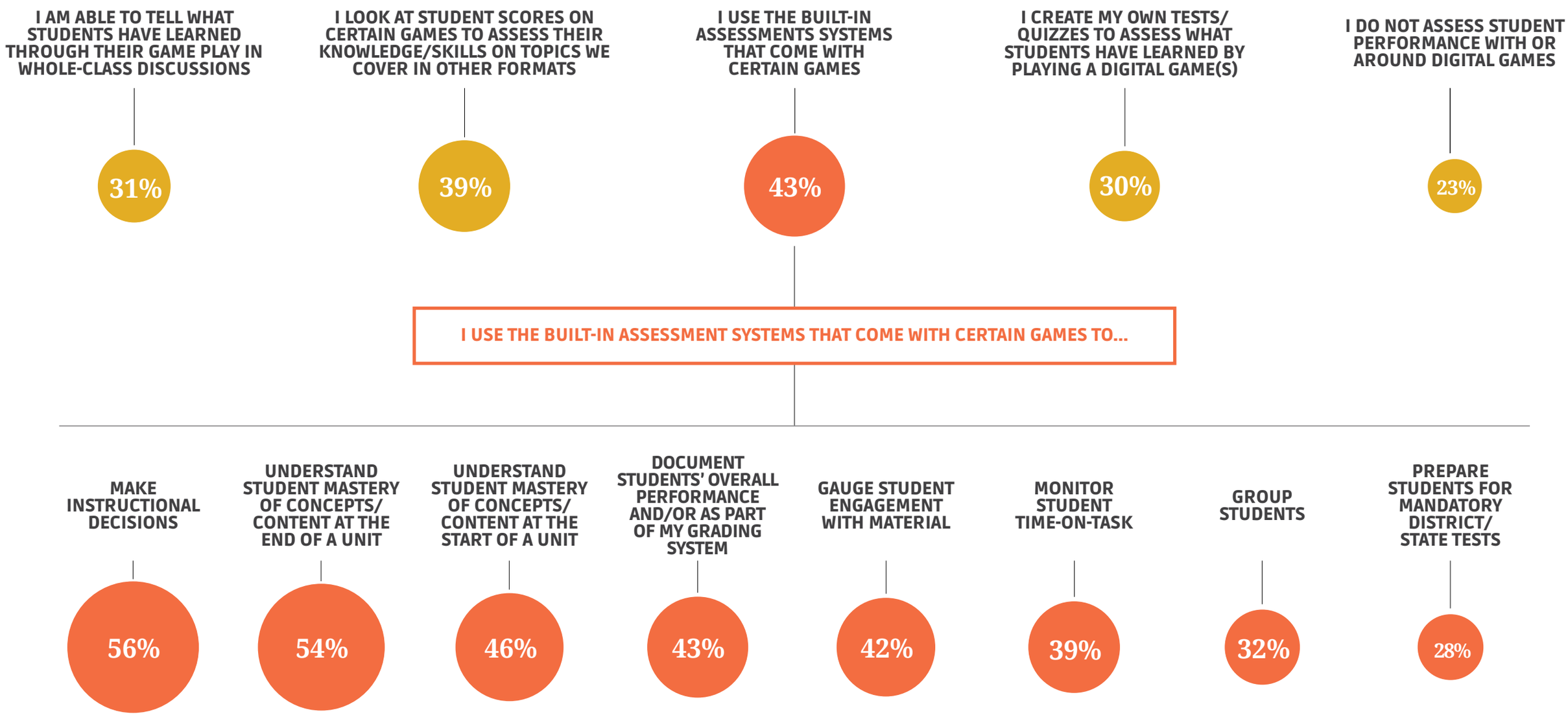
Chart 7

HOW TEACHERS ARE USING DIGITAL GAMES TO ASSESS STUDENT PERFORMANCE

In what ways do you assess student performance with/around digital games?



N = 513, check all that apply

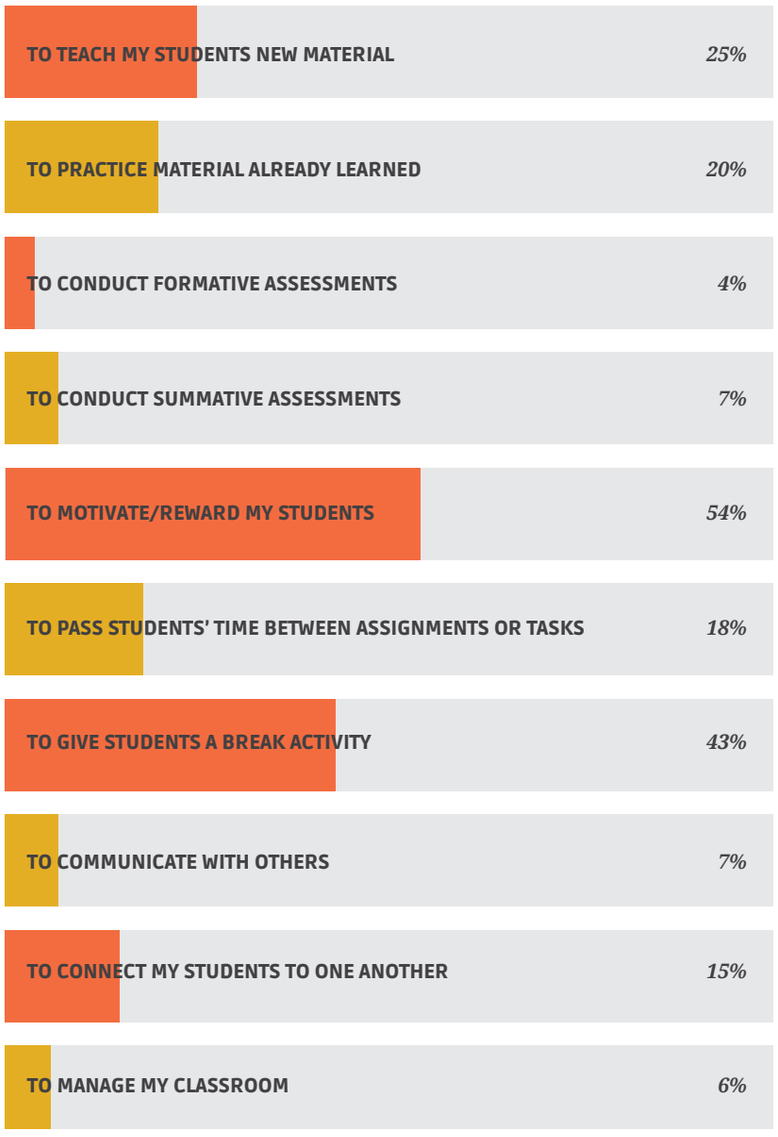


Chart 9
What teachers are primarily using digital game devices for

Based on the responses of the 27% of game-using teachers who have TV console game devices (e.g., Xbox 360, Nintendo Wii, PS3) in their classrooms.

else teachers are using game-enabled platforms for—if not just student gameplay—we presented respondents with a list of devices and asked them to indicate how they primarily use each by selecting no more than three of 11 possible purposes. Chart 8 illustrates across two different views (pp. 23-24) the frequency with which GUTs are using game-enabled platforms to fulfill particular purposes. Notice the extent to which GUTs are using multipurpose platforms like interactive whiteboards and PCs to introduce students to new content, compared to dedicated gaming platforms (i.e., handheld and video game devices), which are more often used for non-curricular activities such as rewards and breaks. Assessment activities are less common across all listed devices, suggesting that teachers are measuring student performance using unlisted means, which may or may not be digital in nature (e.g., paper-based or orally administered tests or quizzes).

The British Education and Technology Agency's (BECTA) 2002 survey found U.K. teachers allowed students to play games on dedicated platforms like Xboxes, Playstations, and GameCubes more often for recreation or reward than for learning purposes (Kirriemuir & McFarlane, 2003). More than a decade later, this still seems to be the case, at least among our American sample of K-8 teachers. Intrigued by this phenomenon, we shared the data displayed in Chart 9 with attendees of the Consortium of School Networking's (CoSN) 2014 national conference to gather their reactions and interpretations. One district technology administrator confirmed the prevalence of teachers using what Kirriemuir and McFarlane (2003) refer to as "pure" games—those not intended for educational purposes—to incentivize students to behave well and finish their in-class assignments. The practice became so common in his district that students came to *expect* gameplay during class time. In some cases, teachers were being pressured to shorten instructional time to make room for the now-expected digital recreation time, inspiring some debate among district staff over allowing digital gameplay at all during school hours. Ruggiero's 2011 survey of 1,704 pre- and in-service teachers documented the pervasiveness of the practice described by this administrator, noting that as a whole, "…the participants of this study felt that games should not be used as the main instructional activity [and] should be used as a reward for getting work done" (Ruggiero, 2013, p. 5).

Chart 8
Purposes by Platform
Page 23

Figure B
Classroom Game Devices
Page 25

CLASSROOM GAMEPLAY DEVICES

The previous section described teachers' *purposes* for using digital games and their *purposes* for using certain digital platforms in instruction. Here we inventory the devices on which students are actually playing digital games in K-8 classrooms. In Chart 2 (p. 16) we saw that more than 90% of K-8 teachers use laptop or desktop computers in the classroom. This may explain why in Figure B we see students playing digital games more often on PCs (72%) than on any other platform, and by quite a large margin. Interactive whiteboards, which 71% of GUTs have access to (see Chart 2), fall in distant second place, with 41% of students playing games on these larger devices, which are essentially interactive projections of PC screens. Tablets follow on the heels of whiteboards, at 39% (57% of GUTs use them; see Chart 2), while every other device trails far behind, including TV gaming consoles, which 27% of GUTs say they use in instruction (see Chart 2), but just 7% report letting their students play. Portable game devices take last place at 6%.

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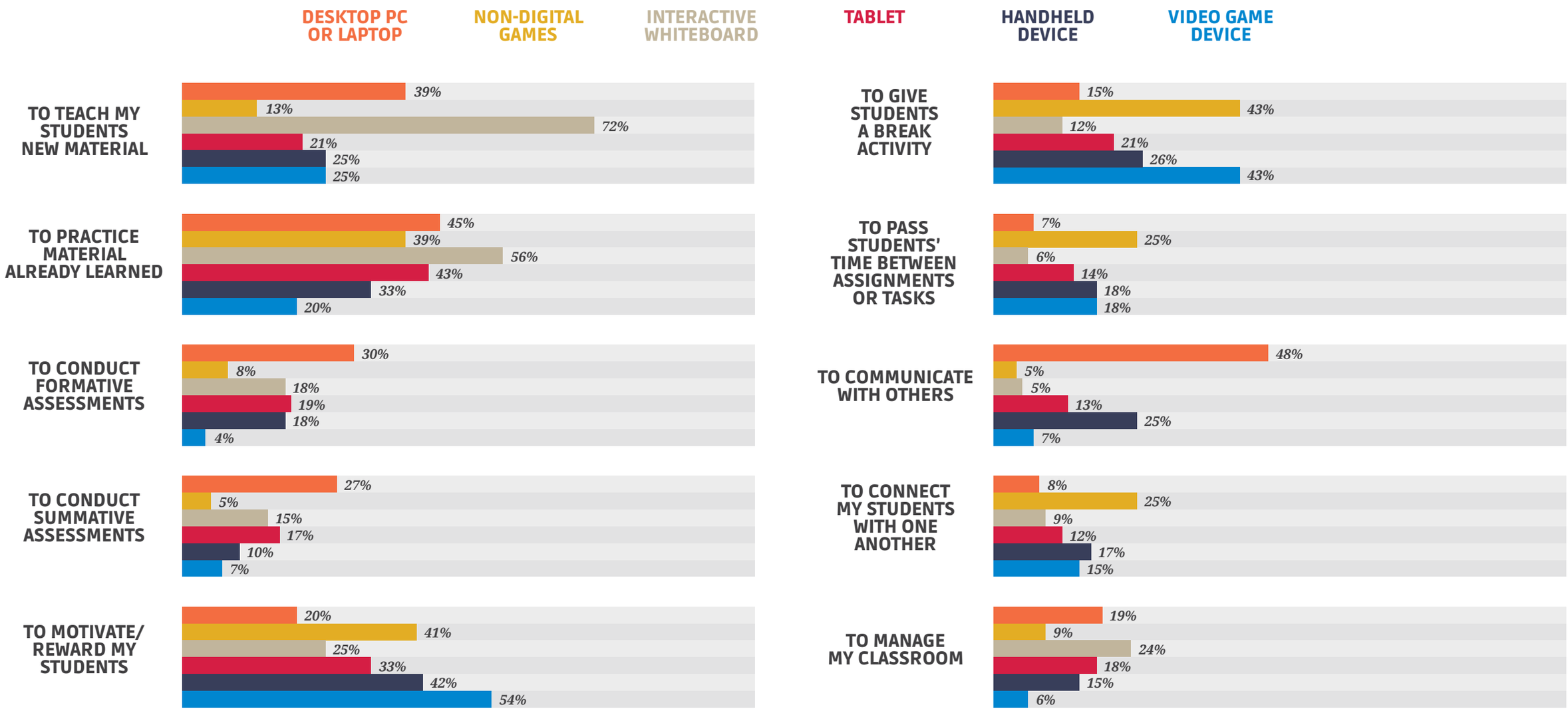
Chart 8 - 1 of 2

PURPOSES BY PLATFORM

What are the primary reasons you use each of the following types of media in your classroom?



N = 513; select up to three reasons for each type of media

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Chart 8 - 2 of 2

PURPOSES BY PLATFORM

What are the primary reasons you use each of the following types of media in your classroom?

TO TEACH MY STUDENTS NEW MATERIAL

TO PRACTICE MATERIAL ALREADY LEARNED

TO CONDUCT FORMATIVE ASSESSMENTS

TO CONDUCT SUMMATIVE ASSESSMENTS

TO MOTIVATE/ REWARD MY STUDENTS

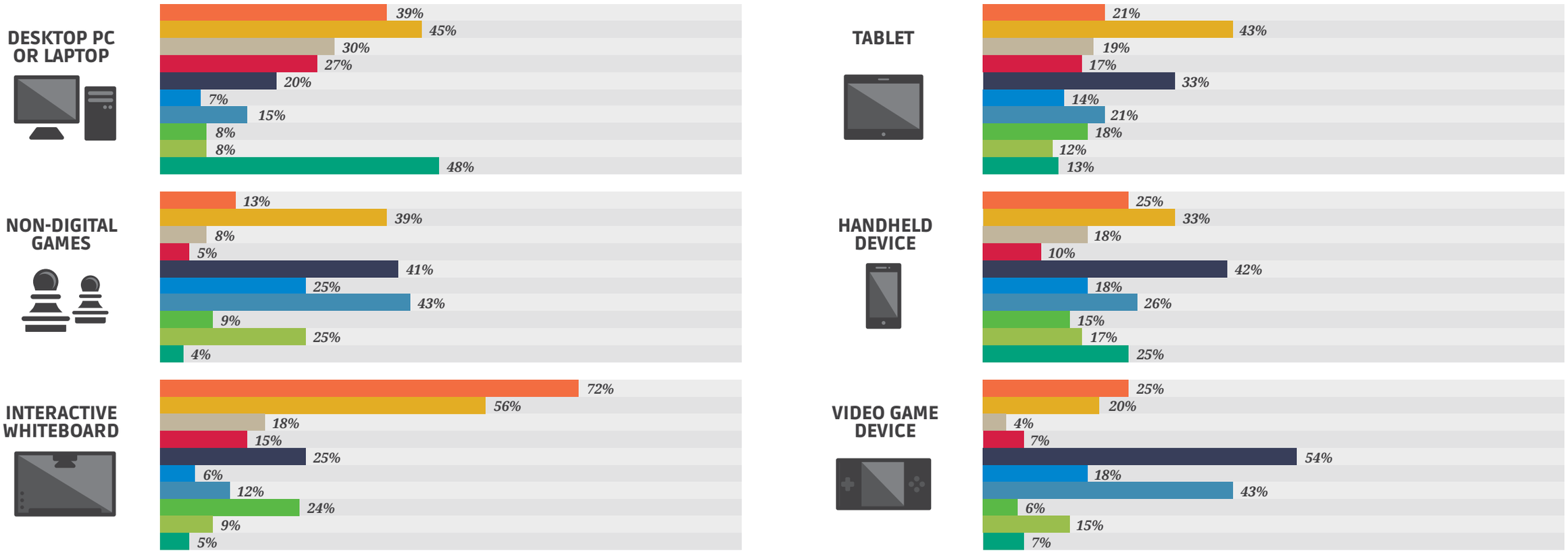
TO PASS STUDENTS' TIME BETWEEN ASSIGNMENTS OR TASKS

TO GIVE STUDENTS A BREAK ACTIVITY

TO MANAGE MY CLASSROOM

TO CONNECT MY STUDENTS WITH ONE ANOTHER

TO COMMUNICATE WITH OTHERS



N = 513; select up to three reasons for each type of media

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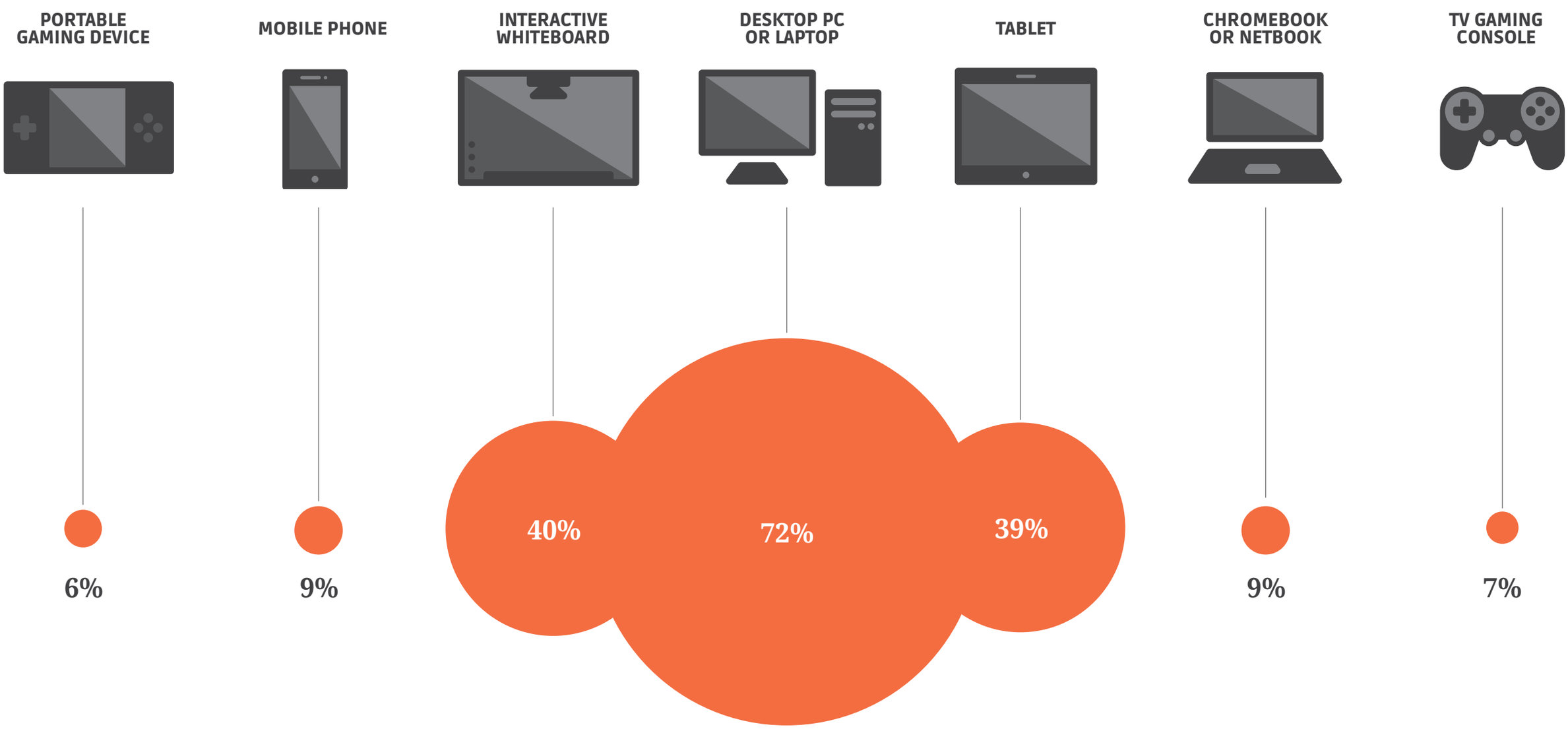
Figure B

CLASSROOM GAME DEVICES

What devices do students typically use to access digital games in your classroom?



N = 513; select aall that apply

Taken together, these data suggest that students' gaming experiences at school are flipped images of their gaming experiences at home, where family members are more likely to play on Nintendo 3DSes, Xbox 360s, and other dedicated gaming platforms than PCs (ESA, 2014). Tablets occupy a middle ground in both settings, as market and utilization research has documented the rise of tablets as popular gaming devices at home, especially in families with children (CGA, 2013; Rideout, 2014; Schneiderman, 2012). These data may shed light on why dedicated gaming platforms are more often used for rewards and breaks, as we saw in Chart 9 (p. 22)—both teachers and students associate console devices with out-of-school play, not learning, and may therefore relegate them to "pure" entertainment in the classroom.

Figure C
Play Configurations
Page 27

Chart 10
In–class Game Frequency
Page 28

STUDENT CONFIGURATIONS

The survey asked teachers how they *typically* have students play games, allowing them to select just two of six options. The greatest proportion of GUTs—30%—reported that their students play alone, and 20% said they play in small groups of three to five. Fewer teachers indicated that their students play as a whole class (17%) or in pairs (14%). However, when tallied, more than half of GUTs (51%) are setting students up to play with fellow classmates. While these groupings may be a factor of student-to-device ratios, video games in general have evolved into quite a social activity over their 20-year history (Granic, Lobel, & Engels, 2014). According to the ESA (2014), 62% of Americans today play games with other people, from siblings duking it out in a *Wii Sports* boxing match, to strangers bartering for extra lives in *Candy Crush Saga*. More than three-quarters of Americans (77%) play sociably for at least an hour per week. In fact, scholars have begun to document the cognitive, social, and emotional benefits of playing video games with other people in both co-located and virtual situations (e.g., Eastin, 2007; Stevens, Satwicz, & McCarthy, 2008; Takeuchi & Stevens, 2011). As one-to-one computing programs make their way into more schools, students may increasingly play solitarily on their own devices, which is not how children are inclined to play in non-school situations (Rideout, 2014). This could, in effect, further differentiate students' gaming experiences at home from their gaming experiences at school, working against a vision of bridging learning experiences across settings.

Fourteen percent of GUTs have their students play digital games between lessons or activities. Note that this includes all platforms, not just dedicated gaming consoles as illustrated in Chart 9, and so this figure is consistent with the data discussed above. The smallest proportion of GUTs—just 5%—said they primarily assign gameplay for homework.

Screen size, the nature of input (e.g., touchscreen vs. keyboard vs. controller), and/or the number of access points together determine the optimal number of individuals that can comfortably play games on a device, either simultaneously or on a turn-taking basis. Figure C allows readers to explore the optimal configurations of student use in light of the types of devices they are most often using in the classroom.

FREQUENCY OF GAMEPLAY IN INSTRUCTION

Over half (55%) of K-8 GUTs say their students play digital games at least weekly (see Chart 10). This includes 9% of teachers whose students play on a daily basis, 23% whose students play two to four days a week, and 22% whose students play once a week. Broken down by grade level, primary (K-3) teachers are significantly more likely than middle school (7-8) teachers to let their students play two to four days per week (29% vs. 10%; $p < .01$), and middle school teachers are more likely than lower grade (K-6) teachers to allow their students to play just once a month (27% vs. 9% and 14%; $\chi^2(18, N = 497) = 39.43$, $p < .01$). These differences may point to (a) the greater flexibility that lower grade teachers have in bringing play-based activities into instructional time, reflecting normative beliefs about the place of play beyond early childhood (Brougère, 1999); (b) the greater availability of "games that double as useful learning resources at this [younger] age," as Futurelab suggests (2009, p. 14); and/or (c) the longer stretches of time lower grade teachers spend with students during the day.

WHAT STUDENTS ARE PLAYING

The term *digital game* elicits different meanings to different people. Online gambling industry execs and moms of toddlers, for instance, are likely to diverge in their conceptions of what counts as a digital game. Even within the population of K-8 teachers, digital games can mean everything from interactive quizzes to first-person shooters. In hopes of capturing the practices and perceptions of a substantial segment of the U.S. K-8 teaching corps, we defined "digital games" for survey respondents quite generously as ones that can be played on dedicated consoles (TV-based or handheld), computers, mobile devices (tablets and phones), and in social media environments (such as Facebook). We did not limit this definition to titles created purely for learning or purely for entertainment purposes, as past surveys have (e.g., 2002 and 2009 BECTA surveys; Futurelab, 2009; Kirriemuir & McFarlane, 2003).

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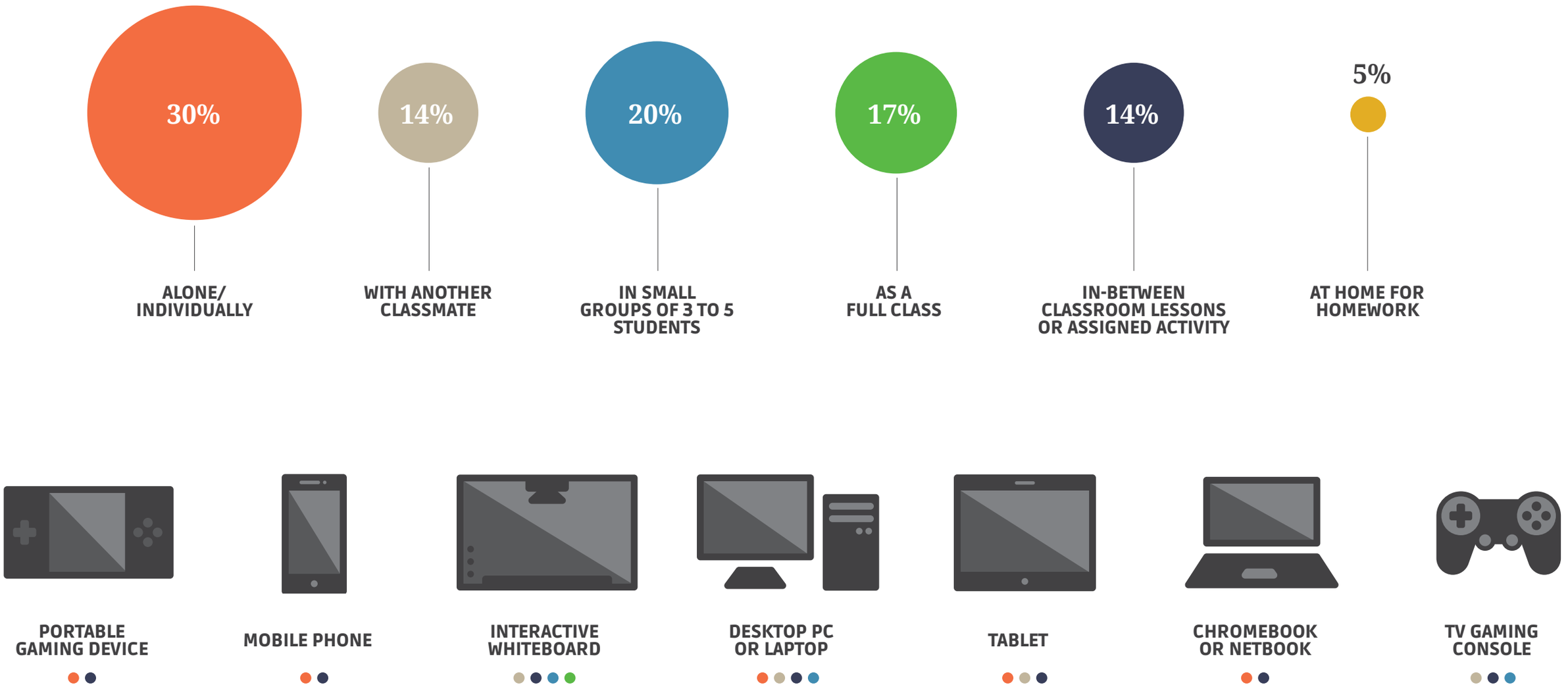
Figure C

PLAY CONFIGURATIONS

Mapping devices to student play configurations



N = 513; select all that apply

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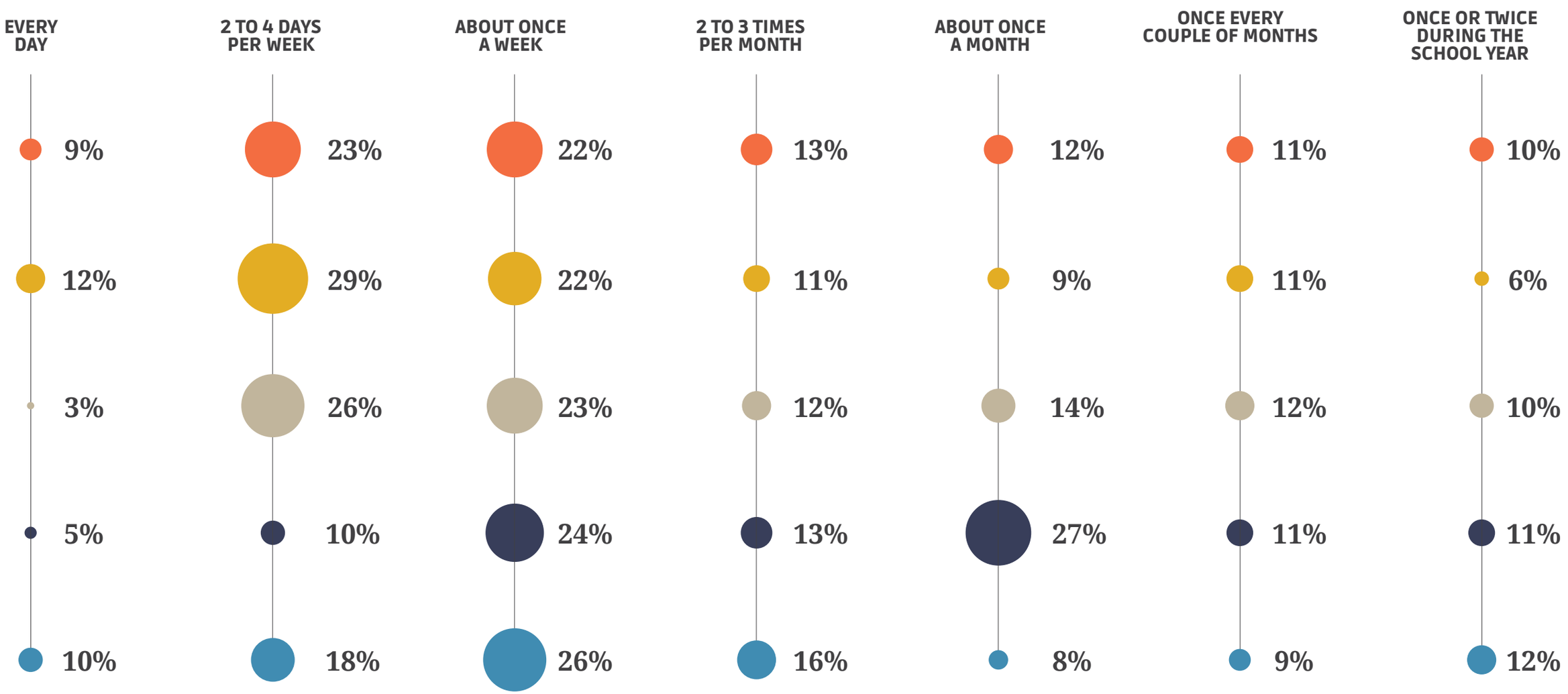
Chart 10

IN-CLASS GAME FREQUENCY

How frequently do your students use digital games in your classroom?



N = 513; check all that apply

However, the present survey did ask teachers about the general nature of the games they use most often with their students. As Chart 11 indicates, 81% of K-8 game-using teachers are using titles created for educational purposes, such as the online suite of games available at BrainPOP, the mobile apps created by PBS KIDS, and the highly immersive 3D multiuser *Atlantis Remixed*. A mere 5% of GUTs say they're using products created for entertainment purposes and typically played at home. Also referred to as commercial off-the-shelf (COTS) games, examples of this second category include *Minecraft*, *Angry Birds*, and *Civilization*. Eight percent of GUTs have their students play a hybrid of the first two options— entertainment games that have been adapted for educational use. *MinecraftEDU* and *SimCityEDU* are common examples. The remaining 7% of teachers indicated that their students play something else. Primary, elementary, and middle school teachers did not differ significantly in these selections.

Chart 11
Classroom Game Types
Page 30

Figure D
Classroom Game Genres
Page 31

Figure E
Classroom Game Titles
Page 32

What's baffling is that in a separate survey question, 45% of GUTs agreed with the statement, "Commercial games not created for educational purposes can be used to teach core curriculum." So why aren't K-8 teachers using games created for general audiences—or even the school-adapted hybrids—more often with students? Does it take too long for students to complete these types of games? Are they harder to align with standards or curriculum (hybrid titles often take care of this for teachers)? Would parents, administrators, or their peers frown upon their use? Do teachers think games are best for delivering content, as opposed to fostering skills that may provide less immediately demonstrable but perhaps deeper benefits in the longer run? Or does it simply come down to the cost of these games and teachers' (nonexistent) budgets? More research is needed to understand what may be keeping teachers from integrating games that their students so enjoy playing at home, despite their favorable impressions of them.

As a follow-up to the game category question, the survey asked teachers which *genres* of digital games their students ever play during class time; respondents could check all that apply. To minimize confusion over genre names, we provided the game titles listed in Figure D as examples. Ninety-one percent of K-8 GUTs use *educational* games, with *trivia* and *puzzle* games trailing far behind at 24% and 23%, respectively. Even fewer teachers marked *student-designed* (14%), *active* (12%), and *simulation* (8%) games. *Action/adventure* and *role playing* games ranked last, with only 6% and 5% of teachers reporting use these genres with students.

Drilling down even deeper, we asked teachers to list up to three titles they use with their students. Of the 513 eligible respondents, 264 listed at least one, for a total of 594 write-in titles (see Appendix A: Write-in Game Titles). The histogram and associated word cloud that comprise Figure E illustrate the popularity of certain games. (Note that titles that were listed just once are excluded from the visualization.) A large majority of the named games have explicit educational aims, such as *Cool Math*, *Starfall*, *PBS KIDS*, *BrainPOP*,

Box 1

THE PROBLEM WITH "EDUCATIONAL GAMES"

What type(s) of digital games do your students play the most during class time?

Four out of five teachers selected "games created for an educational audience and typically used in the classroom." But games with educational purposes can provide vastly different experiences for learners. A growing number of learning games are hitting the market that are arguably as immersive and addictively entertaining as their commercial counterparts. Teams of learning scientists, educators, psychometricians, and game designers are working closely to identify the mechanics that deepen understanding and develop transferable skills in entertainment titles, and applying them to games with curricular objectives and tracking systems designed to facilitate classroom integration. But should games like *Atlantis Remixed* and *Gamestar Mechanic* be grouped with *Math Blaster* under the banner of "educational games?" There is currently not a universally recognized term that distinguishes the former from the latter, and in our failure to make such a distinction to survey respondents on the question depicted in Chart 11, we cannot distinguish which of the 81% of teachers are using titles that immerse, inspire, and grant players true agency over their pathways through the game. While we can try to make this distinction in the next iteration of this survey, this points to a larger problem around nomenclature. Teachers won't know what kinds of educational games to search for if this emerging genre doesn't have a name that is recognized industry-wide.

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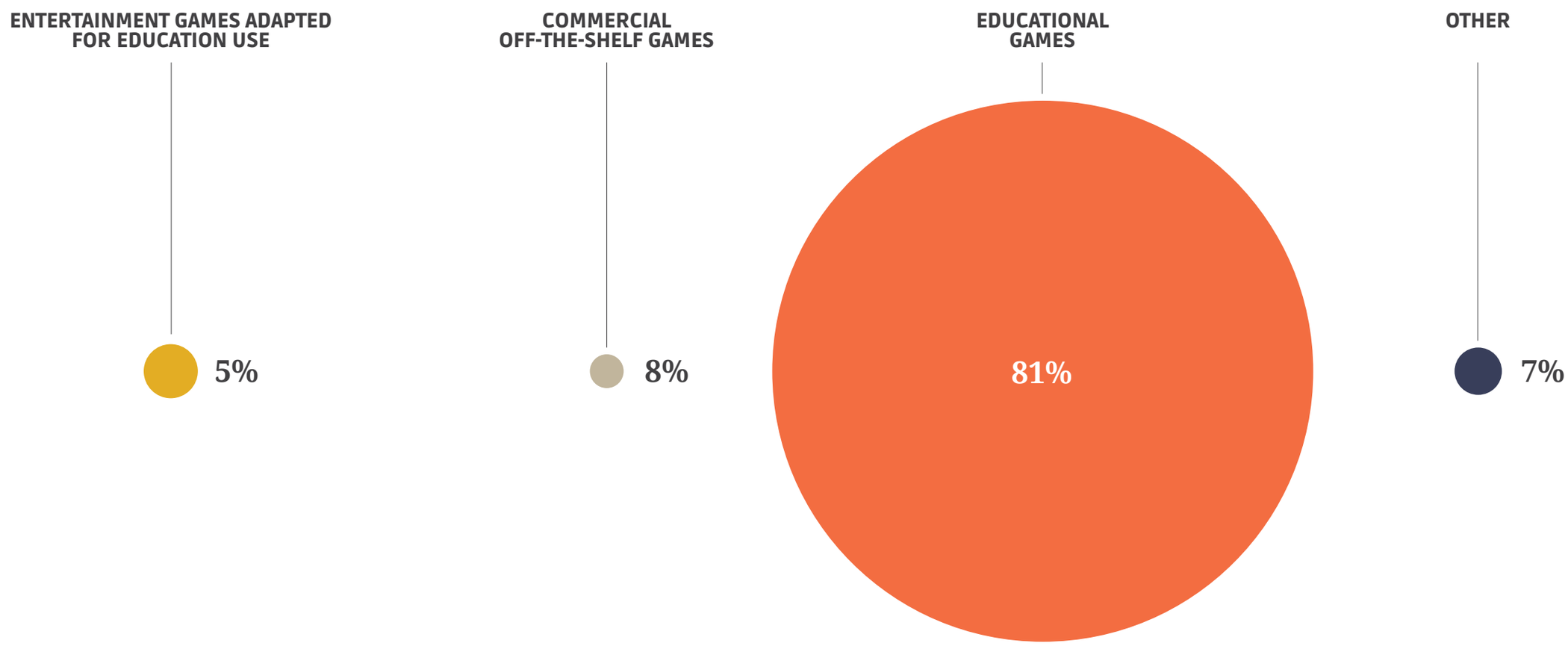
Chart 11

CLASSROOM GAME TYPES

What types of digital games do your students play most during class time?



Examples provided
SimCityEDU, Portal 2, MinecraftEDU

Examples provided
SimCity, Civilization, World of Warcraft

Examples provided
Filament Games, Poptropica, Mangahigh.com, PBS

N = 513; select just one

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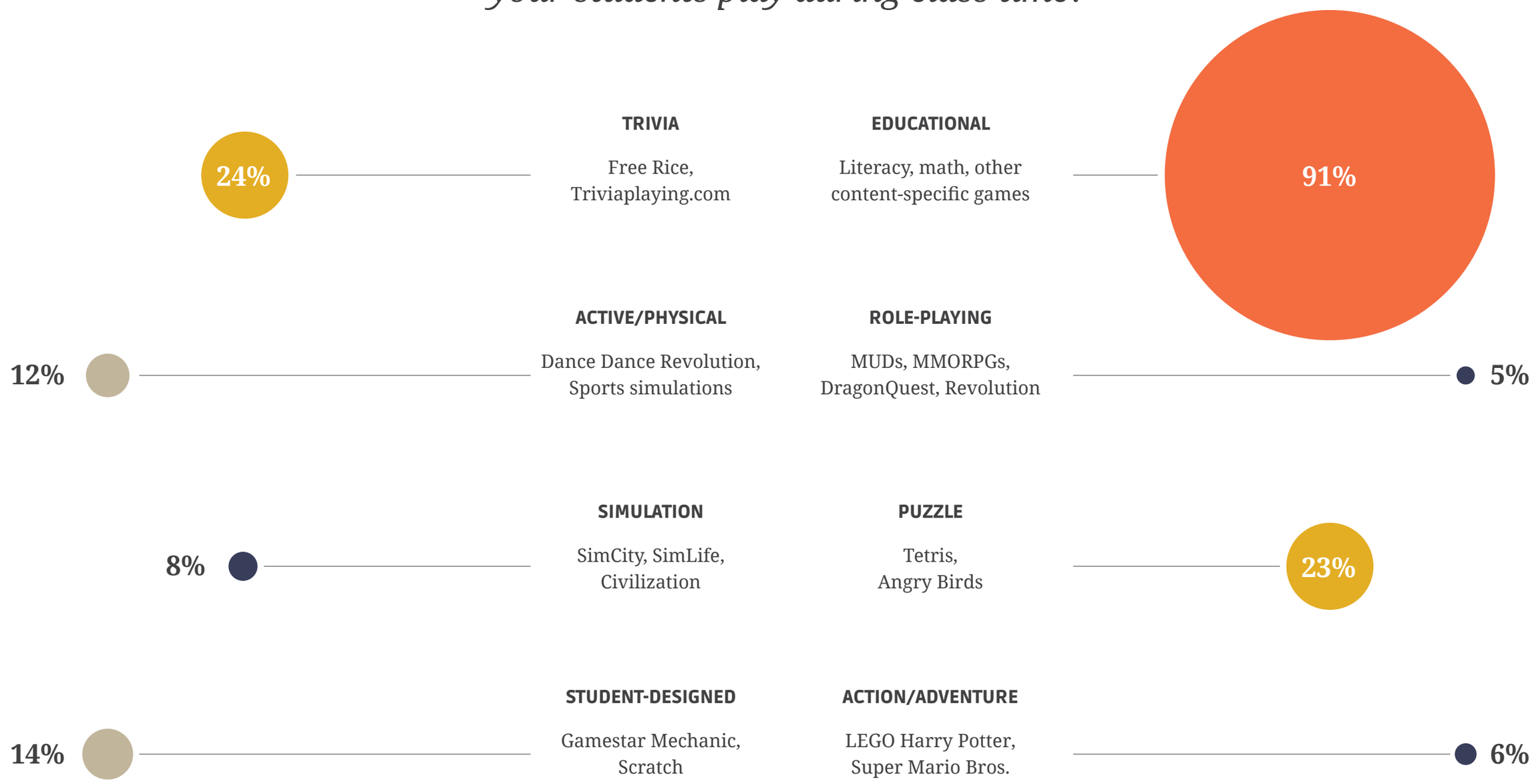
Figure D

CLASSROOM GAME TITLES

What genre(s) of digital games do your students play during class time?



N = 513, check all that apply

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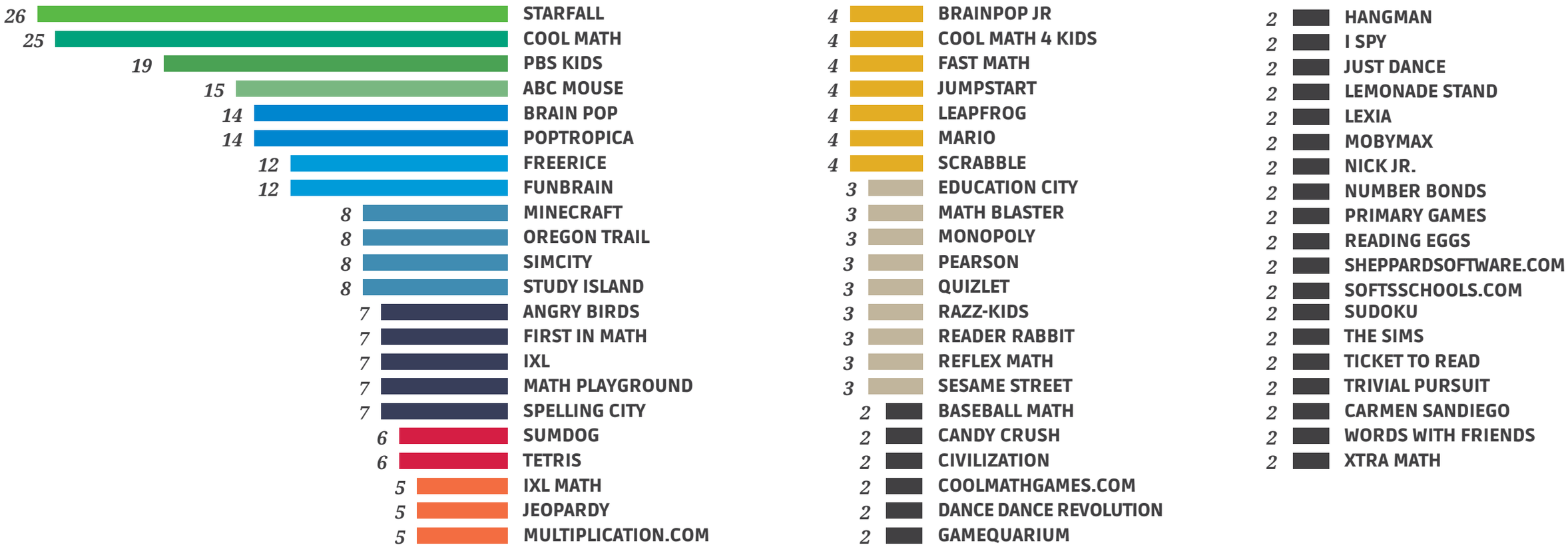
Figure E - 1 of 2

CLASSROOM GAME GENRES

List the titles of up to three digital games you use with your students.



Respondents could list up to three. Only titles listed more than once are included in the visualization

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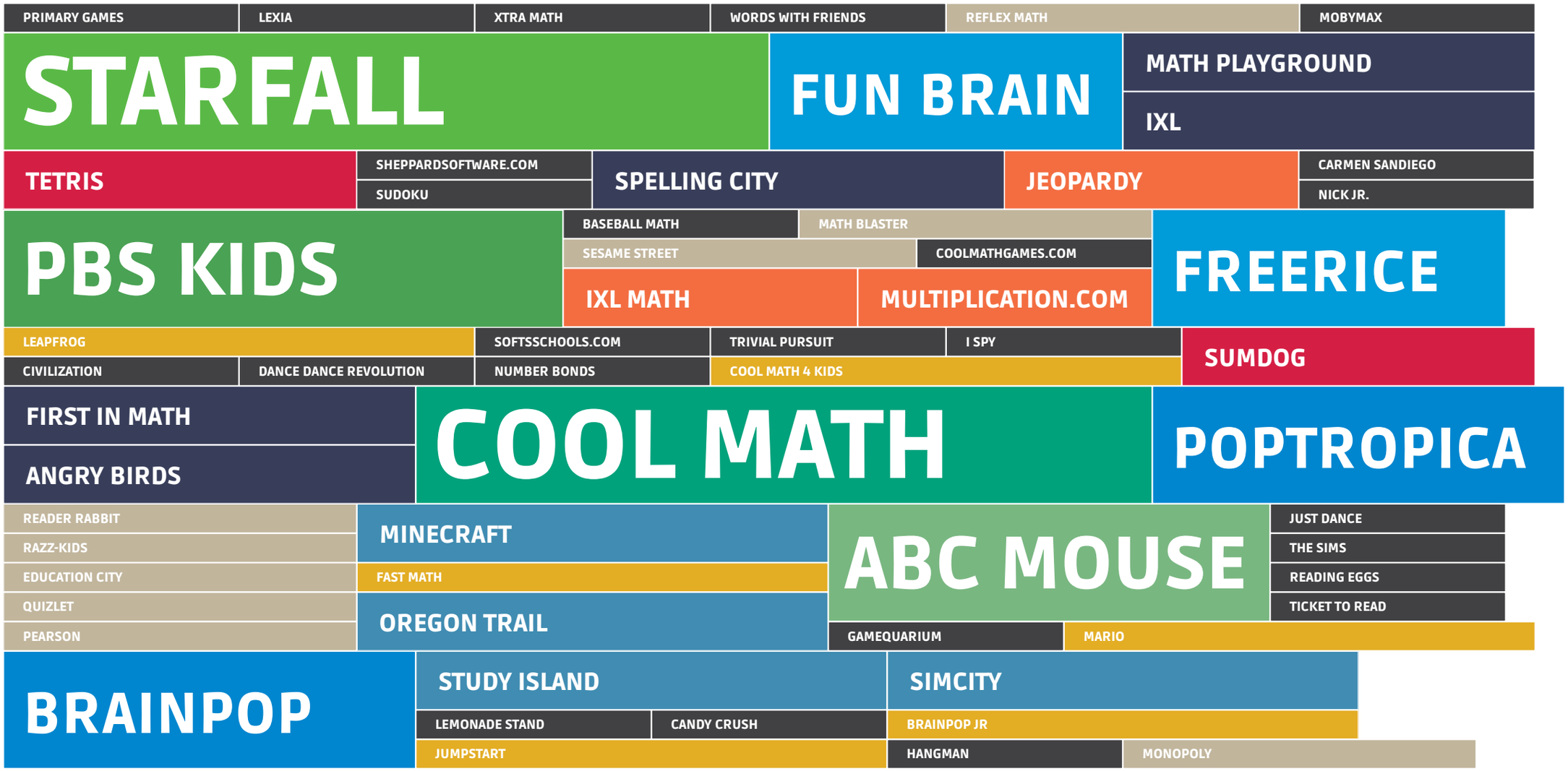
Figure E - 2 of 2

CLASSROOM GAME GENRES

List the titles of up to three digital games you use with your students.



Respondents could list up to three. Only titles listed more than once are included in the visualization

Box 2

WHY GENRE MATTERS

What type(s) of digital games do your students play the most during class time?

A growing body of research suggests that genre matters when it comes to the benefits that entertainment games offer, and to the extent to which they develop skills and knowledge that transfer to real-world situations (Granic et al., 2014). The near absence of *role-playing games* (RPGs) (5%) from K-8 classrooms is worth some discussion, as there is evidence to suggest that RPGs such as *World of Warcraft* improve players' problem solving skills (Adachi & Willoughby, 2013; Steinkuehler & Duncan, 2008).

An even greater number of studies have shown that commercially available *action* games—which 6% of teachers report using with students—improve players' performance on attention, visual acuity, spatial memory and reasoning, mental rotation, and other cognitive and perceptual tasks. Importantly, these improvements transfer to out-of-game contexts and predict higher achievement in STEM domains (see Green and Bavelier's 2012 review and Uttal and colleagues' 2013 meta-analysis). It is worth noting that action games featuring the first-person perspective were primarily used in these studies, as the *shooter* subgenre is notorious for its violent themes (*Call of Duty* is a prime example). This perhaps justifies their low numbers in K-8 classrooms, but the general lack of role-playing and action games appropriate for use by 5–13-year-olds translate into missed opportunities for improving students' cognitive and problem-solving skills.

Puzzle games, which 23% of teachers report using with students, have been less successful in research trials to demonstrate learning effects that extend beyond the game environment (Granic et al., 2014). For instance, Tetris players outperform non-Tetris players on spatial tasks using Tetris-like shapes, but not on other tests of spatial ability (Sims & Mayer, 2002). However, puzzle games have been shown to improve mood and decrease stress (Russoniello, O'Brien, & Parks, 2009), and student emotion, in turn, has been linked to academic motivation, learning strategies, cognitive resources, self-regulation, and academic achievement (Perkun, Goetz, Titz, & Perry, 2002).

To what extent are teachers aware of the benefits and drawbacks of each genre type? Would awareness of such qualities aid them in selecting games for use with their students? Or would logistical considerations—such as the shorter play times required by puzzle games—trump the supposed benefits of certain genres?

FunBrain, and *Poptropica*. However, a number of commercial games were also listed—albeit less frequently—including puzzle (i.e., *Candy Crush*, *Tetris*), trivia (i.e., *Jeopardy*, *Trivial Pursuit*), action/adventure (i.e., *Harry Potter*, *Super Mario Brothers*), active (i.e., *Dance Dance Revolution*, *Just Dance*), simulation (i.e., *Civilization*, *The Sims*), mixed genre games such as *Portal* (action and puzzle), and niche genre games like *League of Legends* (multiplayer online battle arena).

SELECTION CRITERIA

How do teachers go about choosing these titles? Almost half (48%) go by what other teachers say (see Chart 12, next page), and such reports of colleague sharing are consistent with how teachers say they're learning to use games in instruction (refer back to Charts 4, p. 18, and 5, p. 19). Forty-three percent of teachers look for assessment, tracking, or classroom management features in games, which mirrors exactly the 43% of teachers who claim to use the built-in assessment systems that come with certain games (refer back to Chart 7, p. 21). Teachers' personal preferences (42%) play a greater role in their decision making than research claims about the game's educational impact (37%) or even student testimonials (31%). Less than a quarter (24%) of teachers say that cost is a factor—perhaps due to the availability of so many free games—and only 17% consider the game's Entertainment Software Rating Board (ESRB) rating. The lowest-ranked criterion is published game reviews—just 15% of teachers consult reviews when selecting games for classroom use.

WHERE ARE THE IMMERSIVE GAMES?

As noted in the front pages of this report, the highly immersive, highly complex, and highly engaging experiences afforded by certain types of video games don't just improve learning, they can improve the kind of learning that children need to do well in school and life beyond.

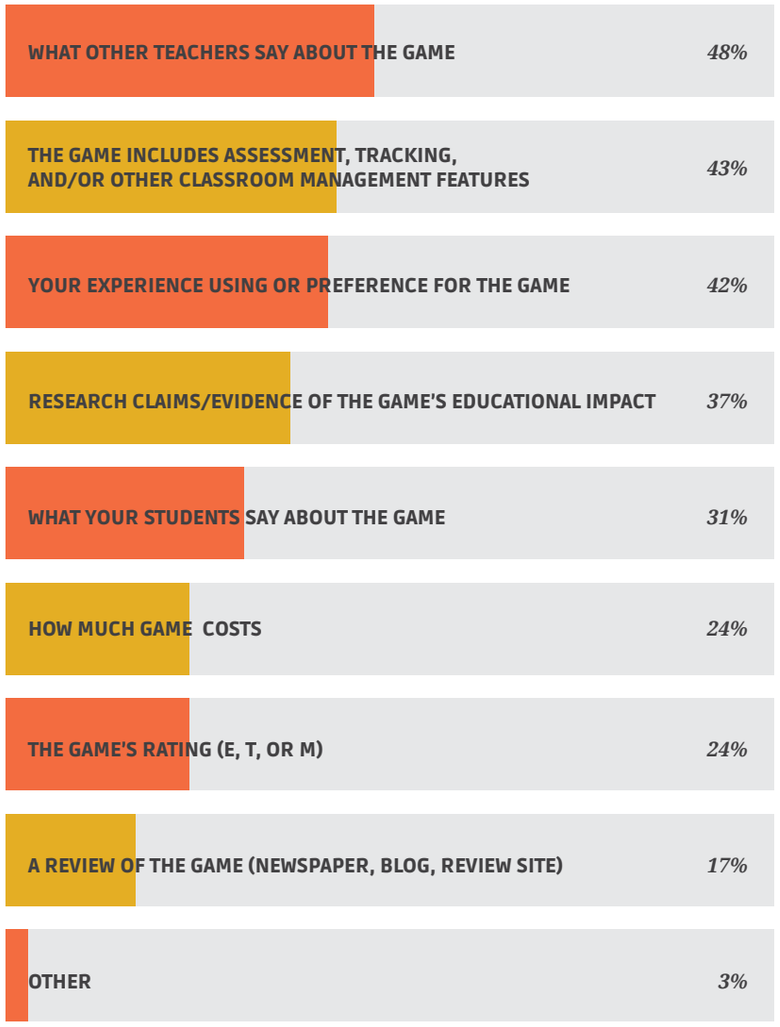


Chart 12
When you select games to use with your students, which of the following influence your decision?

N = 513; respondents were allowed to select up to three criteria

However, as the results just shared indicate, most K-8 students aren't playing these types of games… at least not at school.

At school, some students are playing games like *Angry Birds*, *Minecraft*, and *SimCity*, but most are playing educational mini-games and games embedded in interactive, online lessons, according to teachers' write-in responses. Notably absent from K-8 classrooms are games with curricular objectives that also look, feel, and play like the commercial games kids typically play at home. Given the expanding community of developers creating learning games of this type, we were hoping to see more of them in teachers' survey responses.

We offer two possible explanations for the underrepresentation of immersive games in classrooms. First, they require longer stretches of gameplay and can take several days or even weeks to complete, which make them tough to fit within a class period or lesson unit. This may explain why K-8 teachers report using shorter-form genres like drill-and-practice, trivia, and puzzle games more often than longer-form simulation, action/adventure, and role-playing genres (Richards et al.; 2013). Second, there is still a relative paucity of immersive games that are suitable for use in K-8 settings. For younger students in particular, online lesson systems and drill-and-practice apps are plentiful, while immersive games with educational objectives are not.

Clearly, there are trade-offs involved in a teacher's choice to use certain games over others. The question is whether K-8 teachers are aware of the full range of their choices (including entertainment games adapted for classroom use, which 8% say they use), the potential benefits, and available workarounds to the obvious challenges each present. We will revisit these issues at the conclusion of the report.

PROFILES

ARE THERE CERTAIN TYPES OF GAME-USING TEACHERS?

The 74% of K-8 educators who say they use digital games are just as diverse as the students that they teach, so it behooves us to try to understand GUTs as learners themselves, and where they may fall on the trajectory toward digital game-based *teaching* (DGBT) expertise. To be able to customize tools, programs, and pathways that can more effectively meet the diverse needs of K-8 teachers who want to bring digital games into the classroom, developers, school leaders, trainers, and other stakeholders need clearer images of the individuals they're designing for. This need inspired us to create *profiles* of game-using teachers. Instead of crafting these profiles out of commonplace and immutable demographic variables (e.g., teacher race, age, and gender), they are based upon what we believe to be a more relevant and—since we are interested in supporting teachers' developmental pathways—adaptable set of characteristics.

CREATING THE TEACHER PROFILES

To generate these profiles, we conducted what's called a *cluster analysis*. In short[3], this analytic method involves throwing a select set of variables (particular characteristics gathered on each survey respondent) into a statistical model and seeing what subgroups within the larger population—in this case, K-8 teachers who use games in the classroom—emerge based on their similarities and differences around these variables. While these methods may to the non-statistician seem a bit arcane, if not arbitrary, cluster analyses are an effective way to discover *natural* groupings in the data, so long as the variables selected for use in the analysis have some basis.

3 Refer to Appendix B for a complete explanation of our cluster analysis methods.

		DISPOSITION DIMENSION (INDIVIDUAL FACTORS)			SUPPORT DIMENSION (ENVIRONMENTAL FACTORS)		
Cluster	**N**	**Digital Game Play Frequency** mean on scale of 1–8+	**Digital Game Teach Frequency** mean on scale of 1–7	**Comfort Using Digital Games** mean on scale of 1–4	**Barriers** mean on scale of 1–7+	**Community Support** mean on scale of 0–4	**PD Resources** mean on scale of 0–4+
1	105	1.66[a]	4.17[a]	2.79[a]	2.78[a]	3.03[a]	1.06[a,b]
2	120	6.67[b]	3.60[b]	2.53[b]	3.53[b]	2.43[b]	0.93[b]
3	113	6.71[b]	5.19[c]	3.34[c]	3.65[b]	3.26[c]	3.12[c]
4	175	6.77[b]	5.09[c]	3.32[c]	1.79[c]	3.52[d]	1.20[a]

Table 1
Variables used in the cluster analysis

Cells within a given column that have different superscripts indicate statistically significant differences in cluster means for that variable (e.g., cluster means that carry an "a" superscript are significantly different from those with a "b," but not from each other).

We based our analysis on two dimensions of DGBT-related variables. A *disposition dimension*, as the name implies, expresses an individual's tendency to use games in the classroom and comprises teachers' reports of (a) the frequency with which they play digital games themselves; (b) the frequency with which they use digital games in instruction; and (c) their comfort level using games to teach. The *support dimension* expresses the environmental factors that shape these tendencies and DGBT practices more generally, and includes teachers' reports of (d) the number of barriers they face in using games in the classroom; (e) the support they receive from parents, administrators, and fellow teachers; and (f) the number of sources of ongoing professional development on digital game integration they access.

This combination of variables yielded four similarly sized clusters of teachers. Each cluster holds a set of teachers that are similar to each other and dissimilar from teachers in other clusters, based on their disposition and support dimension scores. Table 1 lists the groups' mean scores for each variable, with superscripts (i.e., a, b, c, d) indicating significant differences between groups on these variables. To illustrate, take a look at the column labeled *Comfort level using digital games*. The teachers in Cluster 1 (C1) are significantly less comfortable using games to teach than the teachers in C2, C3, and C4. The teachers in C3 and C4, meanwhile, report higher levels of comfort than the teachers in C1 and C2, but do not differ from one another on this measure.

To fully appreciate the utility of the cluster analysis, let us now take a look at how the teachers in the four groups differ across more than a single variable. This profile approach will give readers a clearer image of the actual teachers these numbers supposedly represent.

PROFILES OF GAME-USING TEACHERS

PROFILE 1:
THE DABBLERS

PLAYS GAMES
MODERATE

BARRIERS
MODERATE

TEACHES WITH GAMES
LOW-MODERATE

COMMUNITY SUPPORT
MODERATE

COMFORT LEVEL WITH GAMES
MODERATE

PD RESOURCES
LOW-MODERATE

DEFINING CHARACTERISTICS

+ **DISPOSITION**: Play digital games less often than their peers in the other groups and use games to teach several times per month on average. Dabblers report relatively low levels of comfort when using digital games with their students.

+ **SUPPORT:** Face a moderate number of barriers, receive moderate levels of support from parents, administrators, and fellow teachers, and access relatively few professional development resources.

ADDITIONAL CHARACTERISTICS

+ **PRACTICES:** The most conservative of the four profiles in terms of DGBT implementation. Less likely than others to use games to deliver content or assess students. Students in Dabbler classrooms access games far more often on PCs than via game consoles, tablets, or interactive whiteboards.

+ **PERCEPTIONS:** While Dabblers hold lower confidence in the efficacy of digital games to teach 21st century skills than the others, they are still more likely to indicate positive or no changes than negative changes in student behavior and classroom management as a result of DGBT.

+ **NUMBERS:** About one in five (20%) GUTs are of the Dabbler variety, and have spent an average of 15.9 years as classroom teachers—the most veteran of the four profiles

PROFILE 2: THE PLAYERS

PLAYS GAMES
HIGH

BARRIERS
HIGH

TEACHES WITH GAMES
LOWEST

COMMUNITY SUPPORT
LOWEST

COMFORT LEVEL WITH GAMES
LOWEST

PD RESOURCES
LOW

DEFINING CHARACTERISTICS

+ **DISPOSITION**: They're avid gamers, but teach with digital games the least often of the four profiles—just a few times per month. They also report the lowest levels of comfort teaching with games.

+ **SUPPORT:** Face many barriers when using games with students—the highest reported among all groups—and receive the lowest levels of support from parents, administrators, and fellow teachers. They consult few sources for ongoing professional development around DGBT.

ADDITIONAL CHARACTERISTICS

+ **PRACTICES:** Demonstrate concerted efforts in DGBT implementation with moderate rates of device use, genre use, and curricular purposes compared to the other profiles.

+ **PERCEPTIONS:** This is the most likely group to say that games haven't changed student behaviors or content delivery since they started using games.

+ **NUMBERS:** Players account for 23% of K-8 GUTs and have spent 14.5 years teaching, which happens to be the national average for K-8 teachers (Goldring, Gray, & Bitterman, 2013).

PROFILE 3:
THE BARRIER BUSTERS

PLAYS GAMES
HIGH

BARRIERS
HIGH

TEACHES WITH GAMES
HIGH

COMMUNITY SUPPORT
MODERATE

COMFORT LEVEL WITH GAMES
HIGH

PD RESOURCES
HIGHEST

DEFINING CHARACTERISTICS

+ **DISPOSITION**: Digital games are a common pastime for Barrier Busters. They use games with students on at least a weekly basis, and express high levels of comfort employing them in instruction.

+ **SUPPORT:** Despite high disposition scores, teachers in this profile face a high number of barriers. They receive moderate levels of support in terms of DGBT implementation, but take advantage of more PD sources than any other profile.

ADDITIONAL CHARACTERISTICS

+ **PRACTICES:** Provide students with access to the greatest variety of game devices and genres. They also use digital games at significantly higher rates than their fellow GUTs to deliver curricular content and assess students.

+ **PERCEPTIONS:** Perceive DGBT as very effective in developing student core knowledge and 21st century skills. Also more likely than other groups to notice changes in student conflict after introducing games into their teaching—for better *and* for worse.

+ **NUMBERS:** Barrier Busters have, on average, taught for 13.6 years and make up 22% of the game-using teacher population.

PROFILE 4:
THE NATURALS

PLAYS GAMES
HIGH

BARRIERS
LOWEST

TEACHES WITH GAMES
HIGH

COMMUNITY SUPPORT
HIGH

COMFORT LEVEL WITH GAMES
HIGH

PD RESOURCES
LOW-MODERATE

DEFINING CHARACTERISTICS

+ **DISPOSITION**: Naturals score high on the disposition dimension—they play digital games often, teach with them often (at least weekly), and are comfortable leading students in DGBL lessons.

+ **SUPPORT:** Also high scorers on the support dimension, reporting the fewest barriers and the highest levels of support from the school community compared to other GUTs. Naturals access professional development opportunities on a merely moderate basis.

ADDITIONAL CHARACTERISTICS

+ **PRACTICES:** Report a moderately high variety of game device and genre use. Notably, this is the only profile that uses games to deliver core content more often than supplemental content.

+ **PERCEPTIONS:** Hold the highest impressions of the efficacy of DGBT in improving student knowledge, skills, and motivation (albeit not significantly higher than Barrier Busters).

+ **NUMBERS:** Naturals comprise the largest cluster of the four, accounting for 34% of game-using teachers. They've also spent the fewest years teaching, an average of 12.3 years.

HOW TO USE THE PROFILES

What can we learn from these profiles? For starters, they reveal how DGBT dispositions and support are distributed across the broader K-8 game-using teacher population. The largest proportion of GUTs fall into the Natural category (34%), followed by Players (23%), Barrier Busters (22%), and then the Dabblers (21%; see Chart 13). Note that the clusters that emerged from our analyses do not present a neat continuum from least to most; scores on individual variables are, in fact, mixed up across the four profiles in ways that are not immediately intuitive. Barrier Busters, for instance, score as high as the Naturals on frequency of personal game play, frequency of game use in teaching, and comfort using games in instruction, but the two occupy opposite ends of the spectrum when it comes to barriers and PD sources. Additional analyses—namely, comparing the four profiles on responses to other survey items—may help us better understand the complex trajectory of DGBT represented across the four profiles.

Before diving into these deeper analyses, we offer three caveats. First, the profiles do not in-and-of-themselves explain teachers' practices or perceptions around DGBT. Given the nature of the data collected, we cannot determine the direction of relationships that exist among teachers' dispositions to use games with students, support levels around DGBT, and what they actually do with students during class time. In fact it's entirely possible that DGBT practices shape teachers' dispositions to teach with games and how they take advantage of or rally supports around them. It's also possible that these relationships are based on characteristics that we didn't measure in our survey. Second, this is not the only way to cluster teachers. Groups may be formed along a variety of variables, from basic demographic information to the game genres teachers use with students. However, this particular combination of disposition and support-related measures held together strongly compared to others tried, and we believe offers important insights on possible pathways toward DGBT expertise. Finally, given the exploratory nature of our cluster analyses, in subsequent sections we report on differences between profile groups that approach statistical significance ($.05 < p < .09$), as we believe they

Chart 13
Distribution of teacher profiles across the K-8 game-using teacher population

signify important trends worth investigating in future iterations of the survey. Statistically significant differences ($p < .05$) are noted as such.

PROFILE COMPARISONS

Demographics

Our moderately-using and moderately-supported Dabblers have, on average, more years of teaching experience under their belts (average is 15.9 years) than do the Naturals (average is 12.3 years; F (3, 509) = 3.15, $p < .05$). Players (14.5 years) and Barrier Busters (13.6 years), on the other hand, do not differ significantly from any other group on this characteristic. We also compared profiles by teaching position, and found that elementary, middle school, specific subject, and special education teachers are distributed fairly evenly across the four clusters, as are proportions of male to female teachers, and Title 1 (high poverty) to non-Title 1 schools. We were unable to determine whether the groups differed by ethnic makeup due to the low representation of certain ethnic groups in the survey population[4].

Statistical tests indicated that the Dabblers are marginally[5] more likely to teach students who perform below grade level (43.8%) than the Naturals (28.6%). Meanwhile, Naturals are marginally more likely than Players to teach students who perform at or above grade level (59.7% versus 35.8%). The fact that Naturals tend to work with high performing students may explain why they find DGBT less challenging than teachers who tend to work with low-performing students. However, this is a hypothesis that needs testing through additional research.

Chart 14
Device Use by Profile
Page 41

Chart 15
Game Genre by Profile
Page 42

Chart 16
Game Purpose by Profile
Page 43

Practices

Next we report on three DGBT practices—device use, genre use, and curricular purposes of digital games—which together paint a clearer picture of what digital game use looks like in the classrooms of our four prototypical teachers.

The survey asked respondents which *devices* students ever use to access digital games in the classroom. Teachers in all profiles use desktop/laptop computers, notebooks/Chromebooks, and mobile/smartphones to deliver digital-game content about equally. However, as indicated by the superscripts in Chart 14, students in Dabbler classrooms are significantly less likely to play games on interactive whiteboards ($\chi^2(3, N = 513) = 10.27$, $p < .05$), tablets ($\chi^2(3, N = 513) = 18.09$, $p < .001$), and dedicated gaming consoles (i.e., handheld and TV; $\chi^2(3, N = 513) = 21.23$, $p < .001$) than their counterparts in Barrier Buster and Natural classrooms. In fact, Barrier Busters report the highest rates of whiteboard, tablet, and game console use. Apparently, access to hardware is one barrier that the Busters have been able to overcome, or one they never faced to begin with.

The survey also asked teachers which *genres* of digital games students ever play during class time (see Chart 15). No significant differences were detected between the four groups in terms of their use of Active/Physical, Action/Adventure, Educational, or Simulation/Role Playing genres, but Barrier Busters report using Puzzle, Trivia, and Student-designed games (e.g., *Scratch* and *Gamestar Mechanic*) more often than teachers in the other three profiles. Taking both device and genre use into account, Barrier Busters are exposing their students to the widest variety of digital game experiences.

Significantly more Barrier Busters than Dabblers use digital games to deliver local and nationally mandated core content, and trends suggest that Barrier Busters use digital games for these purposes at the highest rates overall. Barrier Busters are also significantly more likely than teachers in the other three groups to use digital games to deliver supplemental content. Notably, this is the only profile in which more than half of teachers report using digital games to deliver local (55%), national (50%), and supplemental (65%) content. As a whole, GUTs aren't using digital games much to assess students, but Busters and Naturals are the most likely to report doing so. On all but one of the curricular purposes listed in Chart 16—i.e., using games to teach supplemental content—Naturals fall in second place (differences between Busters and Naturals on the remaining four purposes are not statistically significant).

Perceptions

How might teachers' perceptions of the effectiveness of DGBL vary between profiles? To answer this question, we first created three *effectiveness scales*, each expressing a respondent's overall impression of the value of digital games in improving student performance in one of three areas: core curriculum, 21st century skills, and engagement/motivation (see Chart 17, p. 45). Across all profiles, teachers are more likely to say that digital games improve student engagement and motivation

4 Statistically speaking, we lacked sufficient power to detect differences between the groups on their ethnic makeup.
5 p values are between 0.05 and 0.09.

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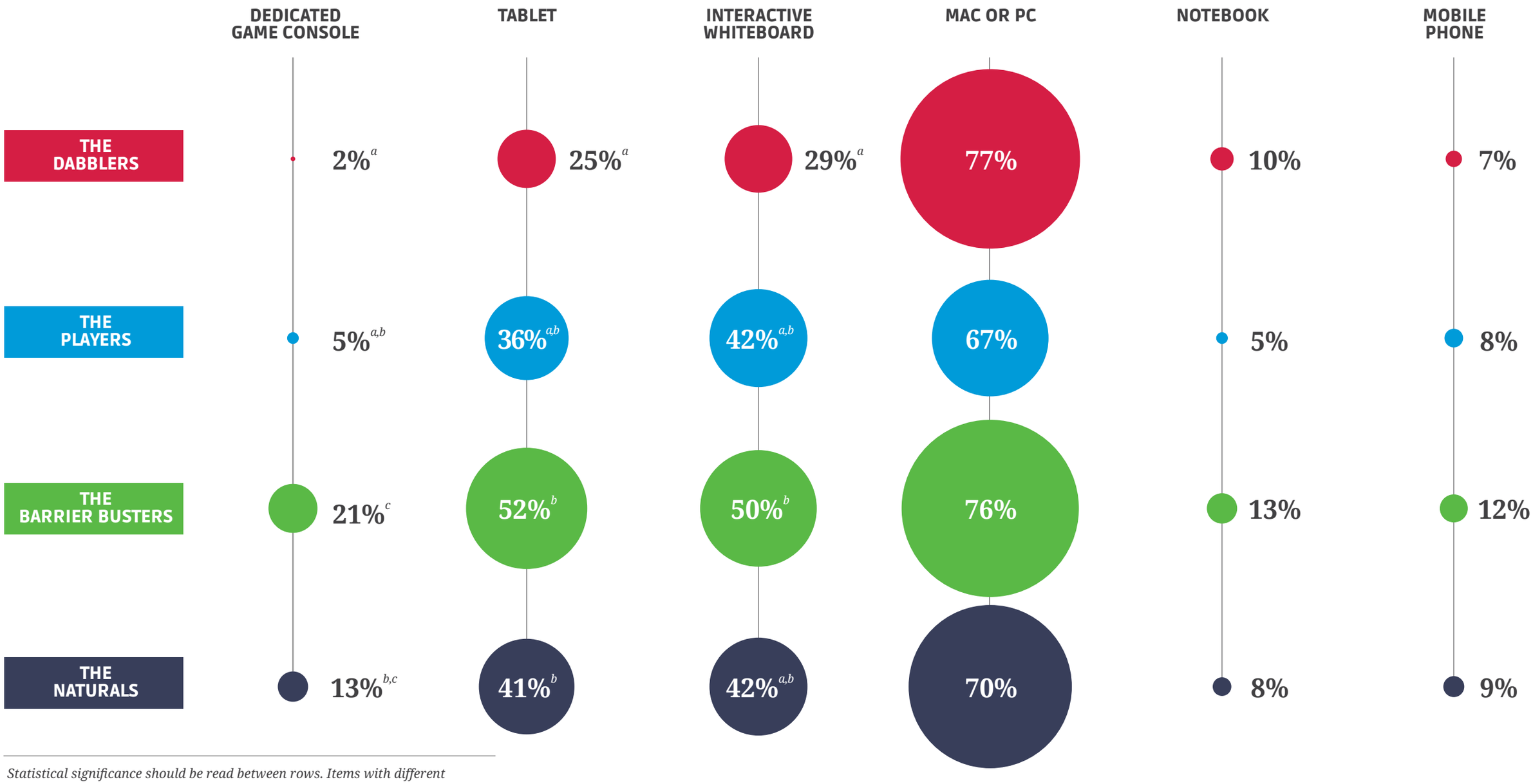
Chart 14

DEVICE USE BY PROFILE

Game device use by teacher profile



Statistical significance should be read between rows. Items with different superscripts differ significantly ($p < .05$). Items that share a common superscript, or don't have a superscript, do not differ significantly.

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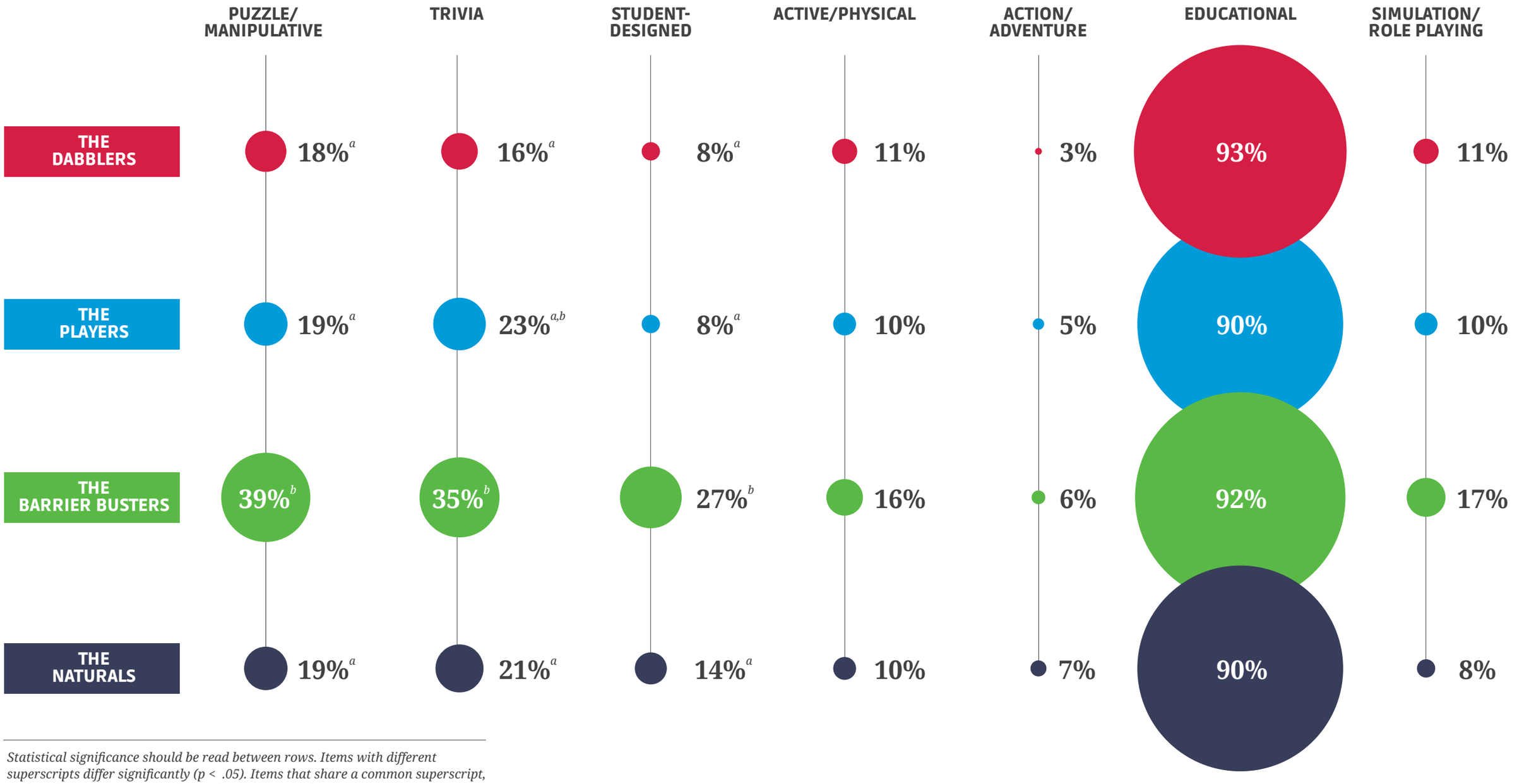
Chart 15

GAME GENRE BY PROFILE

Game genre use by teacher profile



Statistical significance should be read between rows. Items with different superscripts differ significantly ($p < .05$). Items that share a common superscript, or don't have a superscript, do not differ significantly.

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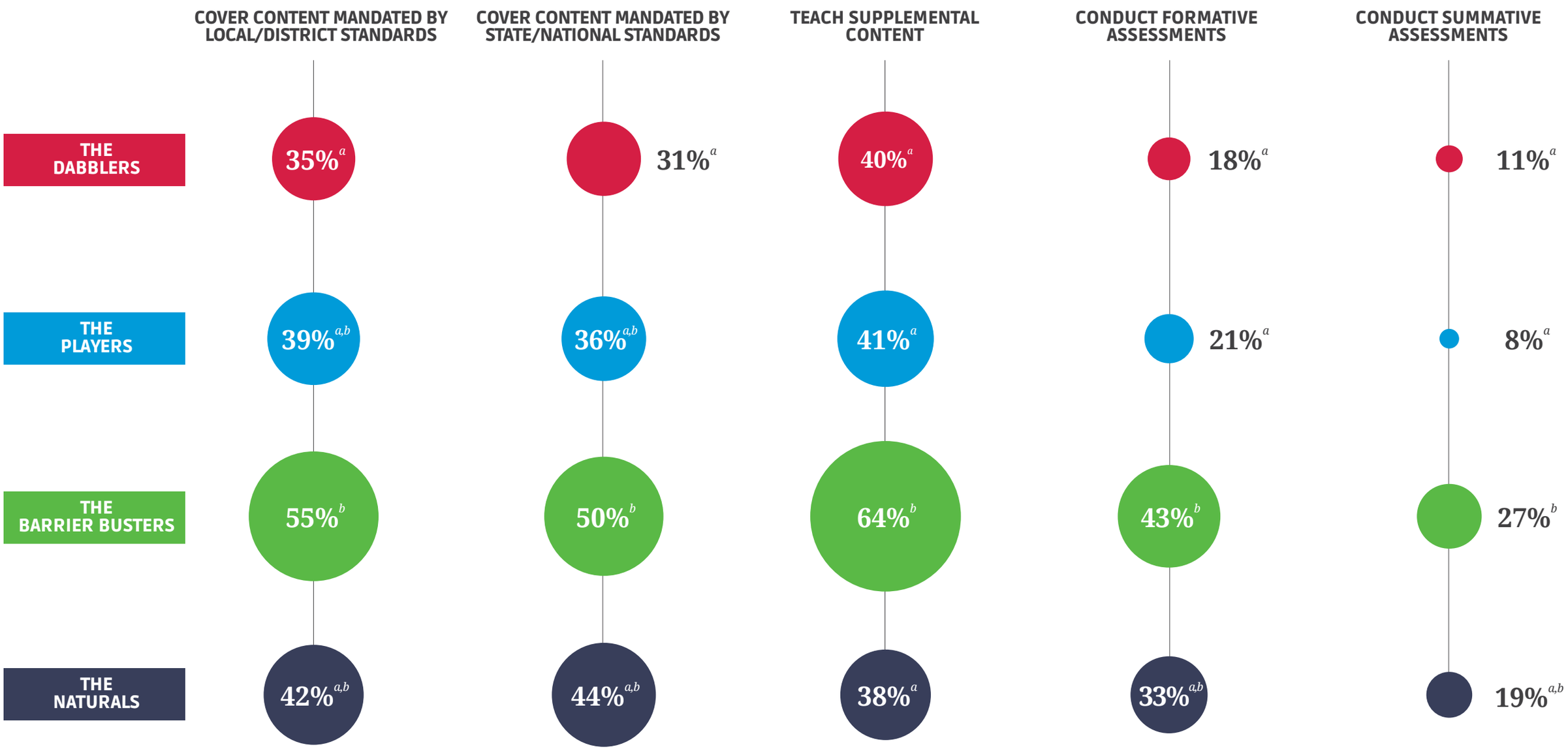
Chart 16

GAME PURPOSE BY PROFILE

Curricular purpose of digital games by teacher profile



Statistical significance should be read between rows. Items with different superscripts differ significantly ($p < .05$). Items that share a common superscript, or don't have a superscript, do not differ significantly.

than core knowledge and 21st century skills, and no differences were detected between the profiles on the engagement/motivation scale. In terms of core curriculum effectiveness, Barrier Busters and Naturals are more likely than Dabblers and Players to believe that digital games are reliable tools for teaching and assessing students and improving performance on standards-aligned assessments (see Chart 17). Naturals are the most likely and Dabblers are the least likely to see the value of digital games in improving students' social skills and problem-solving; Barrier Busters and Players fall between the two on the 21st century skills scale.

Chart 17
Perceptions of DGBL Efficacy
→
Page 45

A separate set of questions probed respondents on the effect they believe digital games may be having on student behaviors and other classroom management issues. As indicated in Chart 18, Barrier Busters and Naturals were more likely than the other two groups to associate increases in student focus and collaboration with classroom game use. In fact, Dabblers and Players were more likely than the others to report *no* changes in these behaviors since integrating games into their teaching. While a majority of teachers across all profiles reported that games have neither increased nor decreased student conflict or instructional delays, Busters and Naturals were more likely to report decreases in these situations than the other two groups. Notably, Players were the most likely to report no changes in any of these situations since integrating games into their teaching.

Chart 18
Observations of Change
→
Page 46

DISCUSSION

As a whole, the range of DGBT experiences represented across the four profiles is not too surprising. But the Barrier Busters really threw us for a loop. Even though they report numerous barriers and only moderate levels of community support around their DGBT practices, these teachers offer students a wide variety of game devices and genres, and use digital games to deliver core and supplemental content at rates on par with the Naturals, which is the profile reporting fewest barriers and most community support. Barrier Busters are also as likely as Naturals to say that digital games are effective teaching and learning tools.

What can explain the paradoxes inherent in the Barrier Buster profile? In the spirit of avoiding statements signifying cause-and-effect relationships, we offer four possible hypotheses:

H1: Barrier Busters face substantial adversity using digital games in the classroom, so they expend substantial ingenuity and effort to make things happen.

H2: Barrier Busters try to do so much with digital games that they run up against challenges that less ambitious teachers may not encounter.

H3: High levels of ongoing professional development help counteract the adversity Barrier Busters face.

H4: The paradox may be explained by some other variable or characteristic that we did not include in the clustering model, or even measure in the survey.

A particular hypothesis may describe the situation for a subset of teachers in this profile, while two or even three may apply to others' situations. Note that hypotheses 1 through 3 assume an exceptionally motivated bunch of teachers, which isn't as obvious—at least through the analyses offered here—with the other three profiles. DGBT may not come very easily to Barrier Busters—especially compared to their Natural counterparts—but in their eyes, students are nevertheless reaping the benefits of classroom-based gameplay. This is why the Barrier Buster profile, above all others, offers hope to DGBL advocates: they illustrate that challenging circumstances surrounding DGBT are not insurmountable.

The Player is an equally compelling profile. Like Barrier Busters, they report numerous obstacles and are not well supported by the school community, but teach with games less frequently and are less comfortable doing so. Perhaps the barriers that Players face have effectively stymied their progress along the same DGBT trajectory that Barrier Busters have managed to travel. On the bright side, Players are—as their name suggests—avid gamers and report providing students with a variety of game-based learning experiences, suggesting an enthusiasm that may help propel them toward DGBT expertise (so long as their trying circumstances don't extinguish this enthusiasm first).

One notable difference between Players and Barrier Busters is that the latter take advantage of numerous PD resources. Could this be the critical link between the two profiles? Might raising awareness of and improving access to these resources help Players achieve the confidence levels needed to optimally teach with digital games? Further research would be required to understand the essential differences between the Players and Barrier Busters, as well as the role that professional development may play in bridging the experiences of these two related profiles.

Another point worth discussing is the connection between the frequency of classroom digital game use and teachers' perceptions of the efficacy of digital

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Chart 17

PERCEPTIONS OF DGBL EFFICACY

Perceptions of DGBL efficacy by teacher profile

THE DABBLERS | **THE PLAYERS** | **THE BARRIER BUSTERS** | **THE NATURALS**

CORE CURRICULUM EFFECTIVENESS (SCALE OF 1-3)

Based on your actual experiences using digital games in your teaching, indicate your level of agreement with the following statements:

+ Digital games are an effective way to teach students core curriculum content.
+ Digital games are an effective way to assess students on core curriculum knowledge and/or skills.
+ Digital games are an effective way to teach content/ concepts.
+ Digital games can help students perform better on standards-aligned assessments.

Q26, items 1, 2, 4 & 6: α = 0.71
On a scale of 1 to 3: M = 2.42 (SD = 0.54)

21ST CENTURY SKILLS EFFECTIVENESS (SCALE OF 1-3)

Based on your actual experiences using digital games in your teaching, indicate your level of agreement with the following statements:

+ Digital games are an effective way to teach social skills.
+ Digital games are an effective way to teach problem-solving skills.

Q26, items 3 & 5; r = 0.26 (p < .001)
On a scale of 1 to 3: M = 2.40 (SD = 0.59)

ENGAGEMENT/MOTIVATION (SCALE OF 1-3)

Based on your actual experiences using digital games in your teaching, indicate your level of agreement with the following statements:

+ Digital games have been effective in increasing my students' engagement.
+ Digital games have been effective in increasing my students' motivation.

Q26, items 10 & 11: r = 0.50 (p < .001)
On a scale from 1 to 3: M = 2.76 (SD = 0.48)

Statistical significance should be read between bars on each scale.. Items with different superscripts differ significantly (p < .05). Items that share a common superscript, or don't have a superscript, do not differ significantly.

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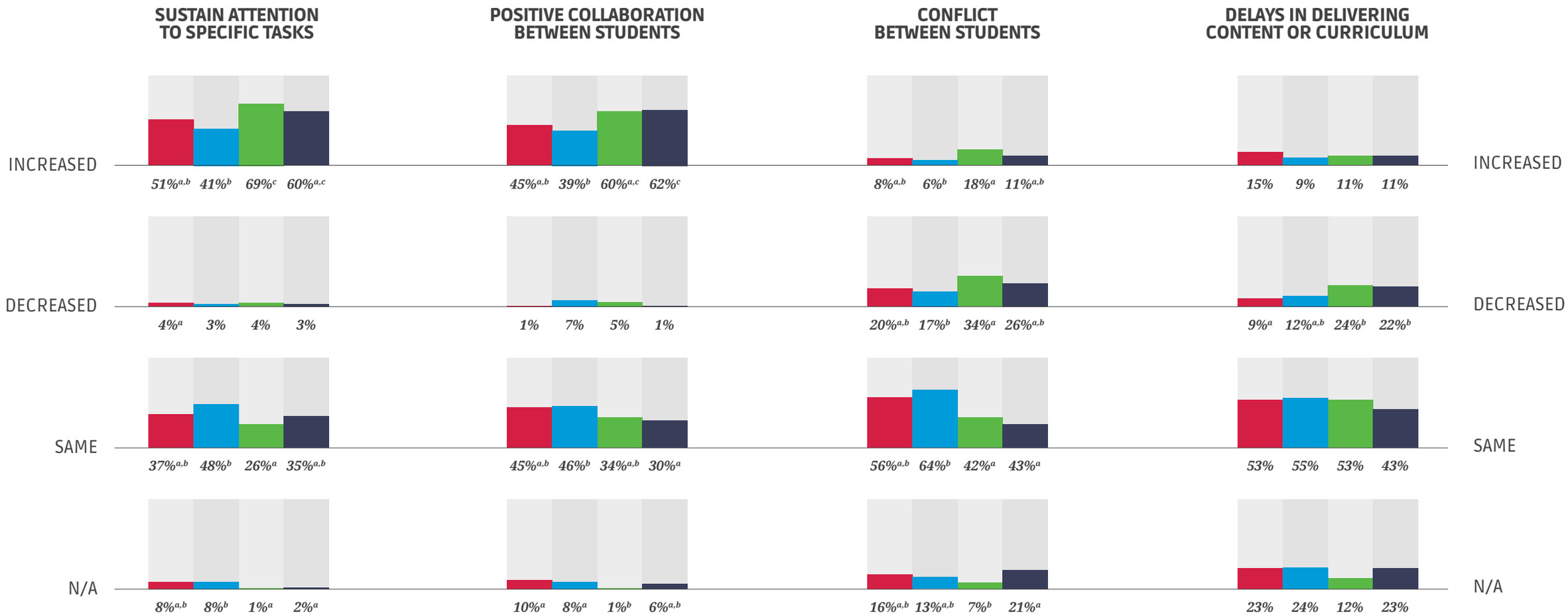
Chart 18

OBSERVATIONS OF CHANGE BY PROFILE

Since integrating digital games into your teaching, what changes, if any, have you observed in any of the following classroom situations?

THE DABBLERS | THE PLAYERS | THE BARRIER BUSTERS | THE NATURALS



Statistical significance should be read between bars in the same chart. Items with different superscripts differ significantly ($p < .05$). Items that share a common superscript, or don't have a superscript, do not differ significantly.

games in student learning. Through our profile comparisons, we found that the teachers who use games with students more regularly (i.e., Barrier Busters and Naturals) also report greater improvement in their core and supplemental skills. Coincidentally, the teachers who use games more regularly also use games to meet a wider range of objectives (to teach core and supplemental content and assess students) and expose students to a wider variety of gaming experiences (genres and devices). What is the nature of the relationships between these variables? Here again we pose a set of hypotheses inspired by these correlations that may be worth testing in future research:

H1: The more often students play, the more they learn.

H2: Teachers' preconceived beliefs that games improve performance are why they use them more frequently with students.

H3: Teachers who don't use games to teach core and/or supplemental content are unable to say whether games have been effective in improving student learning in these areas.

H4: Certain game devices, genres, and/or titles may lead to greater improvements in learning than others.

H3: The correlation may be explained by some other variable or characteristic that we did not include in the clustering model, or even measure in the survey.

Finally, while the Naturals—those high-disposition, high-support dimension GUTs—may elicit the least sympathy or concern from readers, we do worry about the relatively low number of PD resources they report seeking. As the youngest cluster of the bunch (as indicated by average years teaching), one might suspect an overreliance on their game playing experiences to guide their game teaching strategies, which can limit how effectively they use these tools to deliver content (Lei, 2009; Mishra & Koehler, 2006; Schrader et al., 2006). Therefore, as we design training experiences around digital game- based teaching, it's important to not overlook those whom we might assume to be DGBT naturals.

PERCEPTIONS

ARE STUDENTS LEARNING FROM THE DIGITAL GAMES THEY PLAY DURING CLASS TIME?

If so, what are they learning, and which students are learning most? Hundreds of studies involving thousands of students have asked these questions, and collectively, their findings give us confidence that DGBT is a worthwhile pedagogy (see Clark, Tanner-Smith, & Killingworth, 2014). However, it is critical to know what *teachers* believe the answers to these questions to be, as they are key gatekeepers to students' classroom digital gaming experiences. They are the ones who decide whether, how, and when to use digital games with which students. As such, surveying teachers on the above questions may serve as an ecologically valid[6] complement to controlled experimental studies aimed at determining the efficacy of digital game-based teaching and learning. In this section, we share K-8 teachers' observations of their students' learning as well as their experiences using digital games in the classroom.

6 We say "ecologically valid" because the survey captures actual (versus experimental) classroom practice. However, surveys are prone to *social desirability bias* (the tendency of respondents to answer in ways they think others will approve of, which may be inaccurate) as well as under- and overestimation of behaviors, all of which threaten the validity of the method in other ways.

Box 3

PUZZLING PARADOX: MODEST MARKS FOR SCIENCE LEARNING

The fact that only 42% of teachers believe that digital games have improved their students' science learning (see p. 48) is compelling in light of the much-touted potential that these tools have for bringing science to life for learners (NRC, 2011). It furthermore reflects what Rideout (2014) found in her survey of children's use of educational media: only 19% of parents believe their child has learned *a lot* about science from educational media, compared to math (28%) and reading (37%). Rideout posits that parents may hold narrow conceptions of what science is (e.g., beakers in a chemistry lab) to the exclusion of everyday science topics such as weather, health, and animals. But what can explain science's modest ranking compared to its STEM counterparts, math and technology? Is there a paucity of digital games that effectively support children's science learning? Or are the high-quality science games on the market simply evading teachers' notice? Perhaps K-8 teachers are using other media like educational TV/DVDs* to teach science instead, which could explain their inability to comment on the efficacy of digital games in this domain. Or do the modest scores on science merely reflect the emphasis on math and literacy in the lower grades? We invite researchers, developers, and educators to add to and help test this list of hypotheses.

* Educational television shows about science (e.g., *NOVA*, *Scientific American*, *Sid the Science Kid*) have a much longer history in K-12 classrooms than digital games.

Box 4

PUZZLING PARADOX: SOCIAL SKILLS

Digital gameplay is rife with opportunities for student collaboration, both inside the game (e.g., building complex structures together in Minecraft) and around it (e.g., group strategizing, turn-taking). In fact, a body of research has demonstrated that digital gameplay provides optimal opportunities for individuals to develop collaboration, communication, and negotiation skills (Granic, Lobel, & Rutger, 2014; Kirriemuir & McFarlane, 2004; Squire 2003). Yet surveyed teachers report modest improvements in their students' social skills compared to other skillsets (see p. 50). To understand the apparent mismatch between research claims and teachers' observations, we analyzed their social skill improvement ratings by how they set students up to use digital games (see Chart 19a). We found that GUTs whose students play independently are less likely than those whose students play together (in pairs, small groups, as a whole class) to say that digital games are effective/highly effective in improving students' social skills (χ^2 (1, N = 513) = 12.43, p < .001). While this could suggest that the teachers whose students play alone have fewer opportunities to witness the benefits of collaborative gameplay in action, it is also possible that these teachers hold limited notions of the benefits of co-play, which could be why they don't allow students to play together.* Other issues could explain the mismatch, including the fact that many skills listed in the improvement question are regularly assessed through tests, whereas collaboration, communication, and negotiation skills are not. Furthermore, improvements in these skills may show up in settings that teachers are not privy to, such as the playground or at home.

* The survey does not permit us to offer directional claims about the relationship between these two particular variables

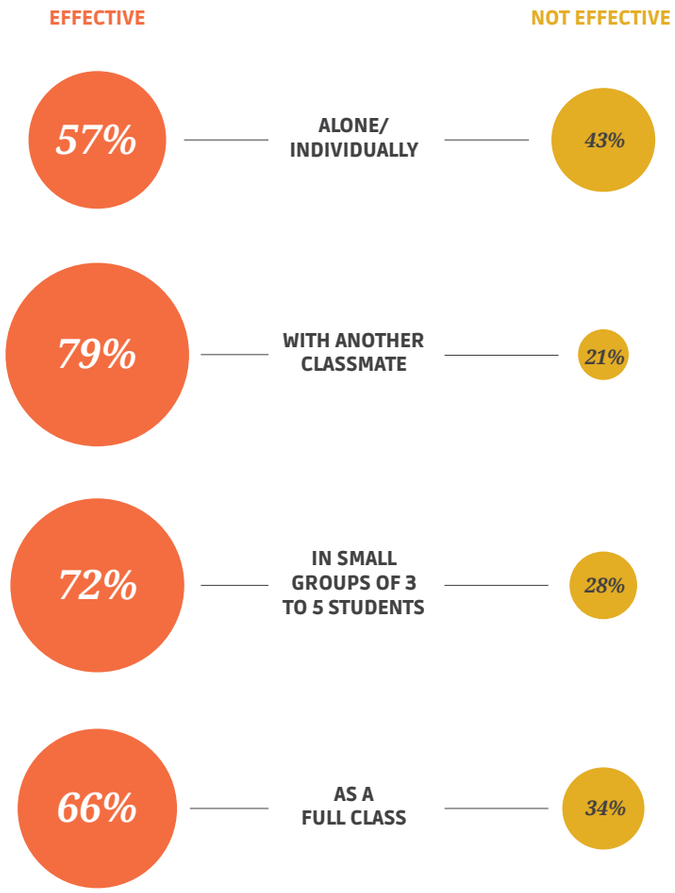


Chart 19a
Teachers' impressions of the efficacy of games in improving social skills by student gameplay configurations

SUBJECT MATTER LEARNING & SKILL DEVELOPMENT

We asked teachers to rate how effective digital games have been in improving student learning in 10 subject and skill areas (see Chart 19b). Mathematics ranked highest, with 71% of GUTs reporting that digital games have been either *effective* or *highly effective* in improving their students' math learning. Computer and Technology Content and Skills ranked in second place, with 65% of GUTs reporting that digital games have improved student learning in this area. On the other end of the scale, only 26% of teachers said that digital games have been *effective/highly effective* at improving students' Art or Culture learning. However, a sizable proportion—42%—was unable to say whether games were effective for teaching Art or Culture at all (they either indicated *not sure* or said this question was *not applicable* to their position). Science ranked between the extremes: 42% percent of GUTs reported that digital games have been *effective/highly effective*, while a quarter (25%) said they've been *slightly effective* in improving student science learning. A full 30% were unable to comment on the efficacy of digital games in improving their students' science learning (*not sure/not applicable*). [See Box 3 (p. 47) for a discussion.]

Chart 19b
Perceptions of Efficacy by Subject
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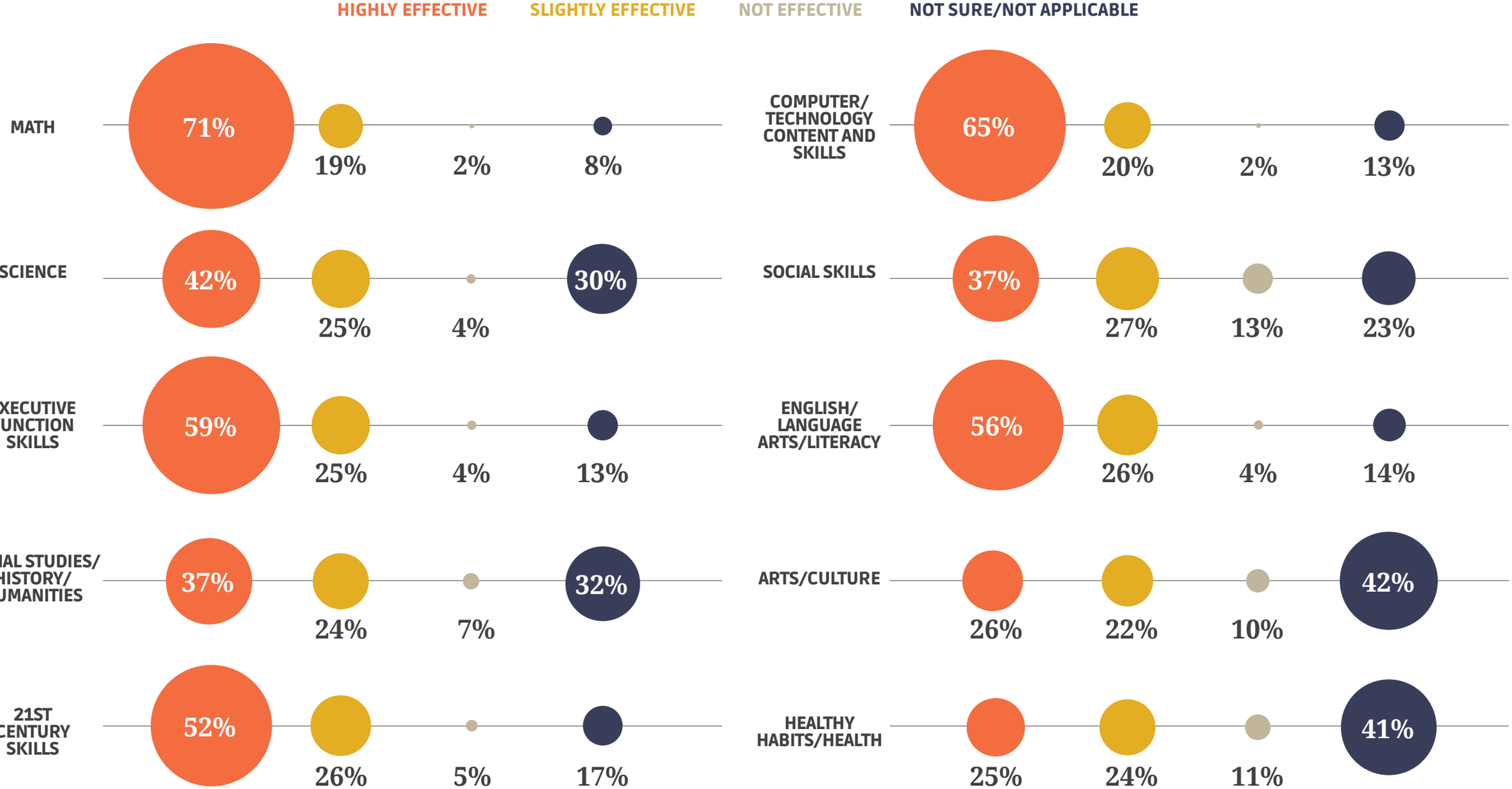
Chart 19b

PERCEPTIONS OF EFFICACY BY SUBJECT

How effective have games been in improving your students' learning?



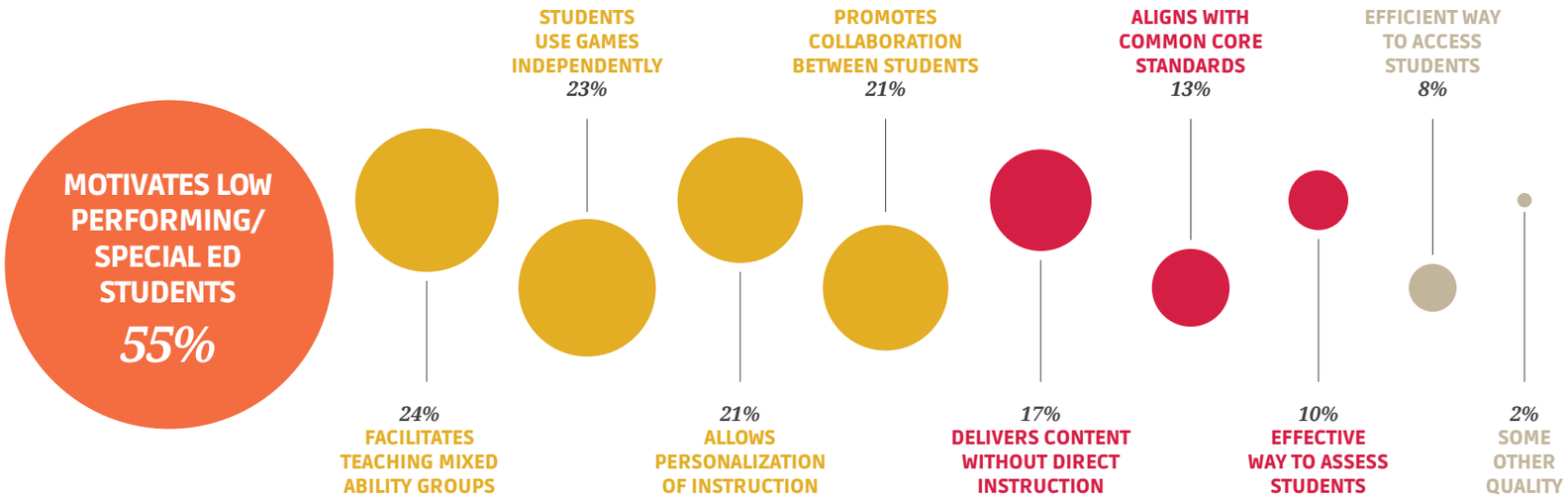


Chart 20
What qualities of games do you find most valuable?

N = 513 ; select up to two

Box 5

PUZZLING PARADOX: CURRICULUM ALIGNMENT

The disparity between teachers' intentions and actual experiences using games to fulfill curricular requirements (see below) may in part be explained by their answers to a separate set of questions, in which 80% of GUTs agreed with the statement, "I wish it were easier to find digital games that align to curriculum standards," and just 39% agreed with the statement, "There are a sufficient variety of digital games that align to curriculum standards." The story being told consistently across our survey data is that teachers are banking on digital games as a means of teaching and assessing students on core content, but in practice, the tools are failing to reach teachers who seek them, and/or failing to deliver on their promises when used.

The survey also asked teachers to consider three sets of domain-general skills as part of this exercise, specifically Social Skills (collaboration, communication, negotiation), 21st-century Skills (systems thinking, perseverance, creative problem solving), and Executive Function Skills (memory, concentration/focus, patience). Executive Function Skills ranked highest of the three, with 59% of GUTs saying that digital games have been *effective/highly effective* in improving these skills, while 52% of teachers feel the same about their students' 21st -century Skills. Only 37% of GUTs reported digital games as being *effective/highly effective* in improving students' Social Skills, while 13% claim games haven't been effective at all, more than any other subject or skillset we queried.

QUALITIES OF DIGITAL GAMES

From a pedagogical perspective, what are digital games good for? Why do teachers use digital games to deliver instruction instead of or in addition to other methods? We generated a list of possible reasons, and invited survey respondents to select the two they value most. Toward the right-hand side of Chart 20, we see that only 10% and 8% of teachers selected *Effective way to assess students* and *Efficient way to assess students*, respectively, even though at least double the proportion reported using games to assess students (refer back to Chart 6, p. 20). Similarly, a mere 13% chose *Aligns with Common Core Standards* even though 41% of teachers claim to use digital games to cover mandated national standards (Chart 6). In other words, despite the popular use of digital games to deliver and assess students on core content, few teachers consider these offerings to be very valuable. [See Box 5 for a discussion.]

At the higher end of the spectrum, more than half (55%) of GUTs chose *Motivates low-performing and/or special needs students*. This figure aligns with teachers' responses to a separate question regarding the types of students they have seen benefit from instruction involving digital games. As Chart 21 illustrates, teachers selected low-performing students most often at 47%, and students with other special needs—including emotional/behavior, cognitive/developmental, and physical issues—

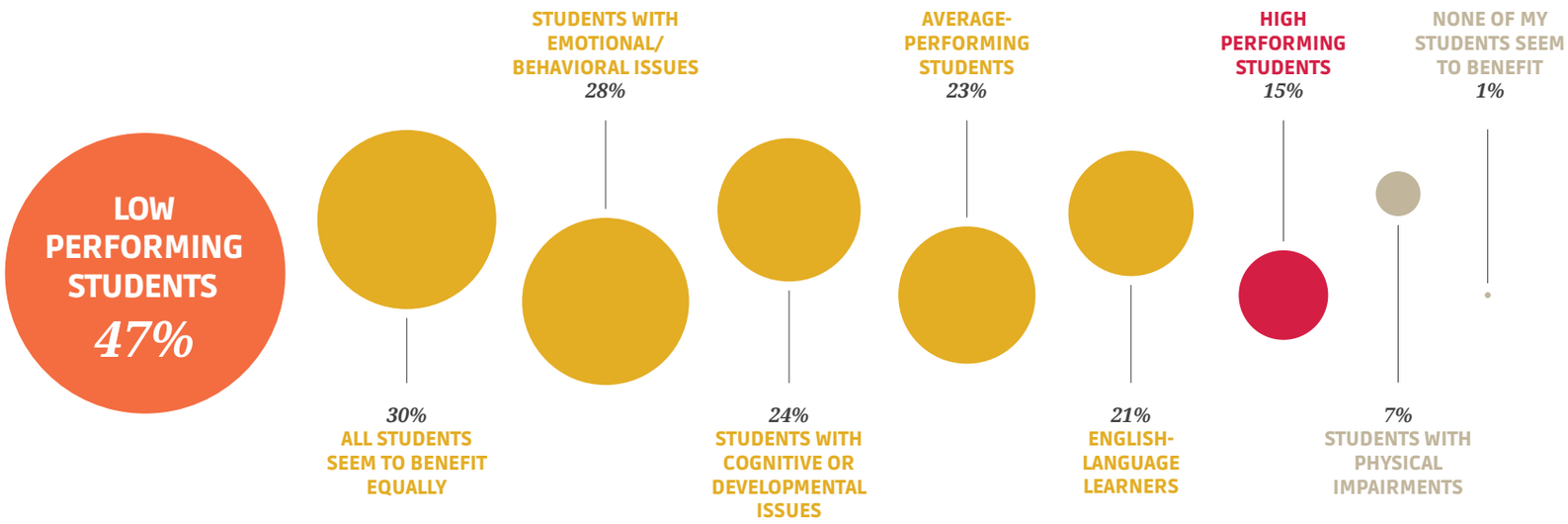


Chart 21
Which of the following types of students, if any, have you seen benefit most from instruction involving digital games?

N = 513; select all that apply

at varying levels of frequency. Thirty percent of teachers believe that all students benefit about equally, and just 1% of GUTs say that none of their students have benefited from instruction involving digital games.

In a follow-up question, we asked teachers to rate their agreement with a set of statements focusing on low-performing students (see Chart 22). Their selections reflect generally positive experiences using digital games with these students to cover content, with 78% and 71% of teachers reporting that their mastery of curricular and extracurricular content have improved as a result of classroom-based gameplay. Teachers are less unanimous on whether it encourages higher attendance among low-performing students, with 58% agreeing, 17% disagreeing, and more than a quarter saying they're not sure. While just about one in five teachers (21%) agree that digital gameplay leads to behavioral issues, 39% agree that too much digital gameplay may explain why these students aren't performing to standard. [See Box 6 for a discussion.]

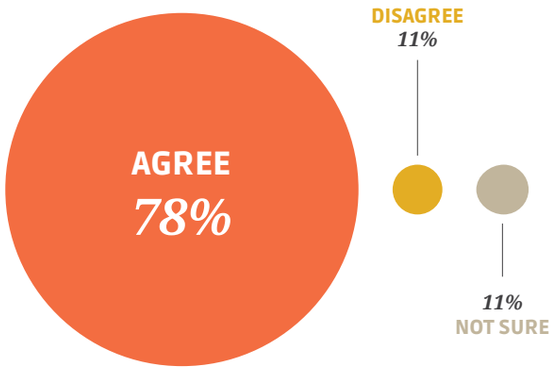
Box 6

PUZZLING PARADOX: DIGITAL GAMES AND ACADEMIC PERFORMANCE

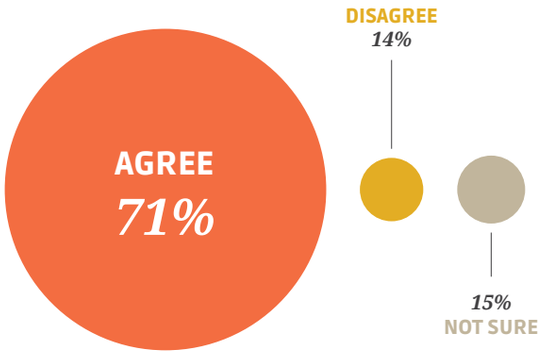
The fact that 39% of teachers believe that too much digital gameplay (see Chart 22, p. 52) may explain why students aren't performing to standard comes close to mirroring findings from Common Sense Media's (2012) survey of K-12 teachers, which found that 42% of teachers think student use of entertainment media hurts their academic performance.

In fact, teachers rated video games to be more detrimental in this regard than any other form of media, including TV, music, and online videos. What can explain the simultaneous enthusiasm and disdain that certain GUTs hold around their students' video gameplay? Perhaps they appreciate what the captivating qualities of digital games can do for learning, but have reason to believe that the time kids spend gaming at home can otherwise be spent doing homework, reading, or getting sufficient sleep.

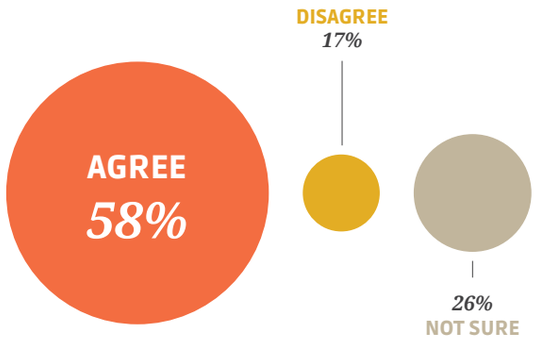
Other teachers may experience situations in their own classrooms similar to one teacher's write-in response to our survey: "Some special ed students get so involved, hyper-focusing, that it upsets their whole day when they have to stop, even to use the bathroom. Also they throw the devices." Here we see how deep engagement can be both a blessing and a curse to teachers.



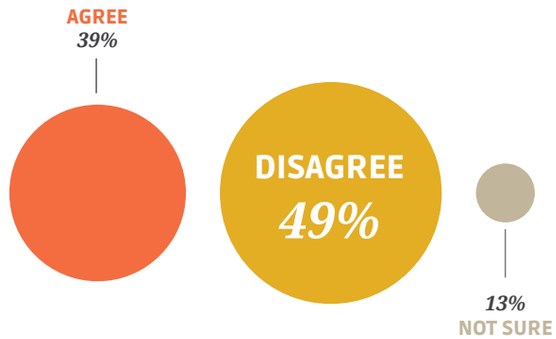
DIGITAL GAMES HAVE IMPROVED STUDENT MASTERY OF CURRICULAR CONTENT/SKILLS (E.G. MATH, LANGUAGE ARTS, SCIENCE, ETC.)



DIGITAL GAMES HAVE IMPROVED STUDENT MASTERY OF EXTRA-CURRICULAR CONTENT/SKILLS (E.G. TECH, COMMUNICATION, CRITICAL THINKING, COLLABORATION)



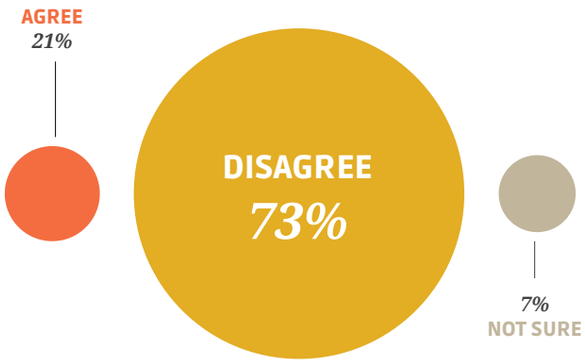
USE OF DIGITAL GAMES IN CLASSROOM INSTRUCTION ENCOURAGES HIGHER ATTENDANCE



TOO MUCH DIGITAL GAME PLAY MAY BE ONE REASON THESE STUDENTS ARE NOT PERFORMING UP TO STANDARD SO I LIMIT THEIR ACCESS IN THE CLASSROOM

Chart 22
In considering your students who are performing below average and their use of games in your classroom, please indicate your level of agreement with the following statements.

N = 513; select all that apply



USE OF DIGITAL GAMES IN THE CLASSROOM OFTEN LEADS TO BEHAVIORAL ISSUES

BARRIERS

What challenges do GUTs face when integrating digital games into their teaching practices? Chart 23 shows that game-using teachers selected *Insufficient time* (46%) and *Cost* (44%) most often, followed by *Lack of technology resources (computers, devices, Internet connection)* (35%) and *Not sure where to find quality games* (31%). One in five says it's hard to find games that fit the school's curriculum, and 14% cite standardized tests as significant barriers. High-stakes test prep may also explain why teachers have so little time.

Chart 23
Greatest Barriers
Page 53

Recall that we administered this survey to 694 teachers, 181 of which—or 26%—do *not* use digital games with students. We sought to discover what NUTs see as challenges or potential challenges to integrating them into their classroom practices, with the aim of narrowing in on the barriers that may be non-starters for the non-users. Chart 23 offers a side-by-side comparison of NUT and GUT responses to the barrier question, illustrating that with just one exception, the two groups hold remarkably similar views. The exception, however, is significant: more NUTs (29%) than GUTs (20%) have difficulty integrating games into instruction (X^2 (1, N = 694) = 5.23, $p < .05$). On the bright side, this particular discrepancy highlights a fixable situation. Pre-service and in-service programs, for instance, can offer more training on how to integrate digital gameplay into instruction. [See Box 7 (p. 54) for a discussion.]

Notably, the GUTs and the NUTs differed on just one of the 12 barriers offered by the survey. But it would be a mistake to assume that curriculum integration is the *only* obstacle that can explain why certain teachers use digital games in their teaching and others do not. The survey

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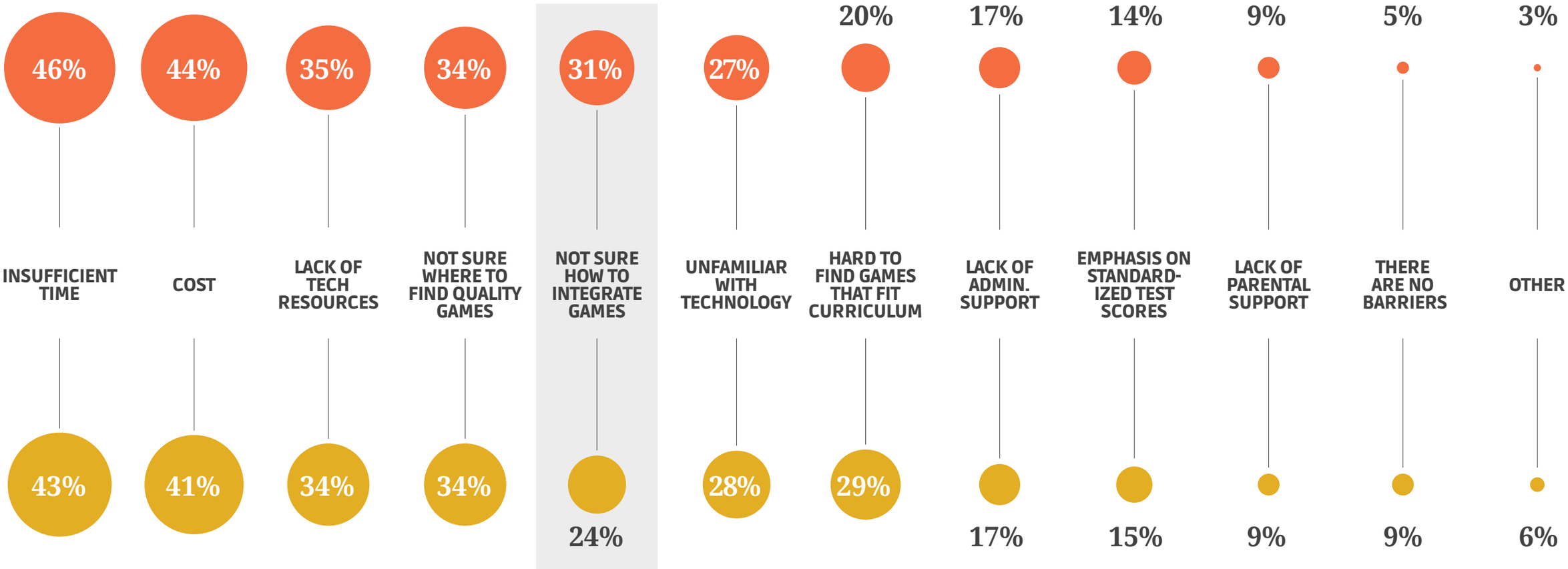
Chart 23

GREATEST BARRIERS

At your school, what are the greatest barriers teachers face in using digital games in the classroom?

GAME-USING TEACHER NON-GAME-USING TEACHERS



N = 513; select all that apply

Box 7

TACKLING THE TIME AND COST BARRIERS

It might be useful to help teachers distinguish the surmountable from the insurmountable barriers, and help shift their thinking about what's truly possible. Are the two most cited barriers, time and cost, as intractable as we might instinctively believe? The 40 minutes (or so) that middle school teachers have with students is hardly ideal for long stretches of interrupted gameplay (Richards, Stebbins, & Moellering, 2013); at least for now, the period structure itself is out of teachers' hands to change. But if games are truly integrated into a lesson, they can help teachers *save* time, according to digital game researcher and former classroom teacher André Denham (personal communication, June 19, 2014). Indeed, teachers needn't devote full class periods to gameplay; with the right games, shorter play sessions can be effectively employed to inspire and/or prime students for non-digital instruction post-gameplay (see Box 8, next section; Arena & Schwartz, 2014; White, 2014). However, teachers can be better informed about available options and workarounds to these time hurdles.

With the emergence of apps marketplaces that offer so much content for free, cost no longer poses quite the challenge that it may have in the pre-app era. But game developers can't afford to give everything away, and justifiably charge customers to access their higher-quality and/or fully featured learning games. Fortunately, emerging account sharing and volume purchase programs* that allow purchasers to use apps class- or school-wide on a single license can further diminish cost barriers. Unfortunately, decisions about volume purchase programs* are often out of individual teachers' hands. According to innovative school leader Sujata Bhatt, "Innovation with games usually happens at the level of the teacher/classroom, while decisions about curriculum and budget happen at school and district levels, where games are less accepted and innovation is scarcer." Greater alignment on a shared DGBT vision across all levels may be a prerequisite to cracking the cost barrier.

* Apple's Volume Purchase Program (VPP) for Education, for example, allows teachers or institutions to purchase apps through the VPP store and use their mobile device management (MDM) solution to assign apps to students over the air. Teachers/institutions can revoke apps and reassign them to other students.

offered respondents a limited set of options in the universe of DGBT-related barriers, and we can be sure that it missed some big ones. Such are the limitations of surveys. The question did, however, offer respondents the option to write in barriers not provided on the list. Table 2 lists all write-in responses, which we have organized into three broader themes: school or district system issues, student issues, and perceptions of value. Many of the barriers listed here represent major omissions from the present survey that will certainly be included in future ones.

Table 2

OTHER BARRIERS (WRITE-IN RESPONSES)

SCHOOL OR DISTRICT ISSUES	STUDENT ISSUES	PERCEPTIONS OF VALUE
TECHNICAL PROBLEMS OR QUALITY + Connection speed + Technical problems on the activity providers' end; servers down, etc. + They don't consistently work!	+ Inattention of students on computer; disabilities affect student ability to control game + Some special ed students get so involved, hyper-focusing, that it upsets their whole day when they have to stop, even to use the bathroom. Also they throw the devices. + Some students struggle with how to use the computers + Students are visually impaired	+ We do not believe in digital games as a learning tool in the classroom. We use a lot of hands-on work in the classroom. Digital games can be used at home. + I teach speech and feel it is a face-to-face subject matter and so do not use video in my class, although I know there are many video products that CAN be used. + Worry about the effect it has on eyesight/student health
BLOCKING + District blocks websites + Games are blocked by MIS + Many sites blocked by administrators		
LIMITED ACCESS + I teach in multiple districts and often do not have access to district computer use + Lack of home internet/computer access + Not all are teaching in a classroom. Equipment not available in many areas where small groups are held. + Many require subscriptions		
LACK OF AUTONOMY + Not being able to find and choose my own games due to tech coordinator making the decisions school wide		

WHAT IT MEANS

Findings from this survey paint a promising picture of digital-game based teaching and learning inside K–8 classsrooms around the U.S.

SYNTHESIS

+ **Digital games have landed in K-8 classrooms.** Nearly three-quarters (74%) of elementary and middle school teachers report using digital games for instruction, and this rate is higher among teachers at Title 1 schools. Four out of five of these game-using teachers say their students play at least on a monthly basis, and 55% say they do so at least weekly. Further, teachers are seeing results, especially those who teach with games more often. *Barrier Busters* and *Naturals*, for instance, are more likely to report that digital gameplay has improved their students' curricular knowledge, focus, and collaboration. A substantial proportion of GUTs also say they're using digital games to deliver content mandated by local (43%) and state/national curriculum standards (41%), and to assess students on supplemental (33%) and core knowledge (29%).

+ **Motivation is still a primary driver of classroom digital game use.** Based on the findings highlighted above, it would seem that educators have progressed beyond a view of games as a way to reward completed work or motivate student learning, as earlier research has documented (e.g., Kirriemuir & McFarlane, 2003; Ruggiero, 2013; Schrader, Zheng, & Young, 2006). But more than half of GUTs (55%) today say they value this quality of digital games, and far more than any other quality offered. Teachers are using dedicated game platforms in particular to motivate and reward students (54%) and for break activities (43%), at about twice the rate they're using these devices to engage students with lesson content. But using games simply to motivate is a lot easier and less time-consuming than using them to teach and assess. "What's troubling about this," according to game researcher Elisabeth Gee, "is the possibility that gaming will be viewed as a dumbed-down learning activity for problem students, rather than as a means of providing richer and more productive learning opportunities for all students" (E. Gee, personal communication, April 3, 2014).

+ **Few teachers are using learning games of the immersive variety**, the kind that lend themselves to deep exploration, complex decision making, and participation in the types of activities that set digital games apart from more didactic forms of instruction. Most teachers instead report using short-form games—either standalone titles (e.g., *Tetris*, *Angry Birds*) or digital repositories that include mini-games or game-like lessons (e.g., Cool Math, Starfall, PBS KIDS). Of course, students can and do learn from shorter-form genres (e.g., Riconscente, 2013), especially if played over multiple sessions, but longer-form games have as a whole performed better in studies of learning efficacy (Clark, et al., 2014). While lack of time (e.g., time needed for high-stakes test prep, time to figure out how to integrate longer games into lesson plans, etc.) is a likely explanation, teachers may also find shorter-form games to be easier to map to curriculum standards (Richards, et al., 2013).

+ **Digital game integration is hard.** Given the proportion of teachers that report using digital games to teach mandated content and assess students on these competencies, K-8 teachers seem optimistic about the role these tools may play in helping them cover the Common Core State Standards. Yet the data suggest integration challenges: four out of five teachers say it's hard to find curriculum-aligned games, and just two out of five believe that a sufficient variety of such games even exist. Meanwhile, only 10% of teachers consider the assessment capabilities of games to be among their most valuable features. Unfortunately, the survey didn't delve into why this might be: Are

game-based assessment features falling short of their promises? Are they too difficult to use? Or are teachers just unprepared to use them effectively?

+ **The problem with discovery.** The previous two points suggest that teachers aren't accessing the titles, pedagogical strategies, and other resources they need to make the most of digital games in their teaching. Perhaps the curriculum integration problem is related to the fact that teachers are learning to teach with digital games via more informal means (i.e., fellow teachers and self teaching) than formal training programs (pre-service and in-service). As a result, teachers may not be getting exposure to the broader range of pedagogical strategies that can enhance and facilitate digital game integration. The discovery problem also extends to game selection: With designations as broad as "educational games," "math games," "literacy games," and so on, how can teachers know, as they browse and search the catalogs, which titles will best fit students' interests, align with standards, units, and lesson plans, fill available class time, and fit their tight (or nonexistent) budgets? In the absence of finer-grained labels to distinguish learning games from one another, teachers can't know what's available and therefore what's possible.

RECOMMENDATIONS

Certain institutional factors, such as high-stakes testing and the partitioned structure of the school day (especially in middle school), will need to change before immersive games can have a real presence in K-8 classrooms (Richards et al., 2013). As policymakers and school leaders continue their valiant work on these longer-term solutions, we propose some action items that can more immediately address the discovery and professional development problems highlighted above.

+ **Establish an industry-wide framework for describing and evaluating educational games**—because teachers can't know exactly what they should look for if there's no name for it! As a number before us have similarly proposed,[1] game developers, distributors, review sites/services, and educators should together (a) come up with common nomenclature around learning game sub-categories, and then (b) use this taxonomy to label, market, and review them. Breaking down the massive "educational/learning game" genre into a manageable number of sub-genres ought to make the search and discovery process less overwhelming and more illuminating for teachers. The taxonomy should embed a framework for easily evaluating games along obvious characteristics such as grade, subject, platform, price, and curriculum standards alignment; Common Sense Media's Graphite platform employs one worth building upon. The taxonomy should also highlight not-so-obvious dimensions that teachers should equally consider in their selections, including time to completion, timescale, and open-endedness—qualities proposed by Squire (2008) in his framework for evaluating games—as well as 21st-century skill alignment, assessment capabilities, and research evidence (i.e., whether the game's learning impact has been scientifically measured). We recommend going beyond the simple adaptation of existing commercial genre names (e.g., puzzle, action games)—as many who have attempted this task before have done—and creating meaningful new terms. In our recommendation, developers would agree to label their products according to the taxonomy, and distributors (e.g. app stores and digital repositories) and game review sites would use these common terms and framework to organize the search and discovery process for teachers.

+ **Elevate awareness of alternative means of integrating games into instruction.** More than a decade ago, when scholars first began inspiring us with their visions for digital game-based learning, they certainly weren't writing about drill-and-practice games. Yet this is what so many K-8 teachers are still using with students today. Until teachers and students are freed from organizational constraints that prohibit longer stretches of student gameplay, there are ways of situating play sessions in relation to the broader lesson plan that can free teachers to use a wider variety of games. For instance, Arena and Schwartz (2014) propose the use of shorter-form games to prime students to be receptive to more didactic methods of instruction following their play (see Box 8). In this way, games can play an integrated and essential—rather than supplemental—role in a lesson without taking up too much class time. Similarly, teachers can adopt a flipped model of instruction, whereby students play longer-form games for homework and spend class time discussing key lessons. Professional development programs and resources can help promote these strategies among teachers.

+ **Invest in the creation of innovative integration models for classroom digital gameplay.** Are there additional models similar in spirit to those mentioned above (priming, flipped classrooms) that can help teachers get around the institutional, curricular, financial, cultural, and other hurdles to DGBT implementation? We encourage foundations, government agencies, angel funders, and venture capital firms to invest in R&D on solutions that can strike the optimal balance between classroom/curriculum integration,

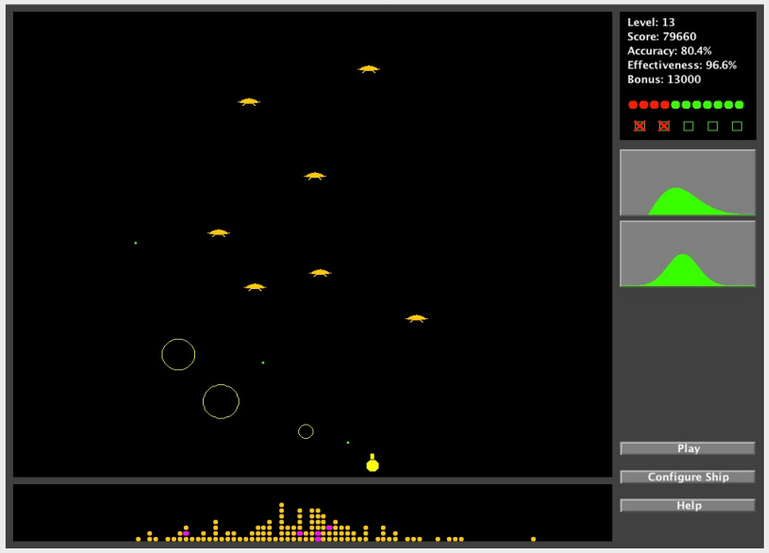
1 For example, Frazer, Argles, and Wills, 2008; Liu and Lin, 2009; Richards et al., 2013; Wilson et al., 2009. See in particular Richards, Stebbins, and Moellering's (2013) longer argument for the creation of a learning game taxonomy. The recommendation proposed here extends earlier proposals by suggesting a framework that will aid teachers in the discovery process.

Box 8

DIGITAL GAMES AND PREPERATION FOR FUTURE LEARNING

Researchers Dylan Arena and Daniel Schwartz argue that digital games for academic use needn't be stand-alone learning exercises (Arena & Schwartz, 2014; Schwartz & Arena, 2013). They've come up with a happy medium between the immersive learning games that students enjoy playing but that eat up a lot of class time, and the drill-and-practice games that have garnered the well-worn but well-deserved analogy to chocolate-covered broccoli. Teachers should use digital games, they argue, to provide students with the compelling and relevant *experiences* that can prepare them for later learning from the more formal *explanations* delivered via text, lectures, or discussions. As such, digital games should be conceived as part of a larger ecology of learning that encompasses both informal and formal learning experiences (Arena & Schwartz, 2014).

To illustrate their point, Arena and Schwartz conducted an experiment with 83 community college students using a digital game on statistical probability distributions. About two-thirds of the students (N = 56) played *Stats Invaders!*—a variation of the classic video game *Space Invaders*—in which alien ships descend in the physical arrangement of specific probability distributions (e.g., normal distribution). The game doesn't offer overt explanations of statistical concepts; rather, like any good game, it's visual, there's feedback, players think and act quickly, and it's fun. The remaining third of students did not play the game (control group).



Screen shot of Stats Invaders!

Alien ships descend in the physical arrangement of specific probability distributions (e.g., normal distribution). Players save Earth from alien attack by tuning a bomb to resemble the shape of the alien fleet configuration, a task that sensitizes students' recognition of certain distribution patterns.

Before you guess what happened, there's one more twist: half of the students in both the game and control conditions were also given a two-page passage explaining statistical distribution concepts using more formal terms, which game condition students read after playing *Stats Invaders!* All 83 students in the study took a 10-item posttest that covered statistical distribution concepts included in the passage.

Students who played the game and then read the passage outperformed students that just played the game (and did not read the passage) *and* students that just read the passage (but did not play the game). Interacting with the game helped students build intuitions about statistical distributions that, in turn, helped them learn more from the passage. Arena and Schwartz note that if they hadn't given students the passage to read after playing *Stats Invaders!*, what they learned through gameplay would have gone undetected (as the posttest scores of the gameplay minus passage students indicate). This experiment illustrates a method for determining whether a digital game can provide effective experiential learning, also known as a *preparation for future learning* (PFL) assessment (Schwartz & Arena, 2013).

What does this have to do with digital gameplay in K-8 classrooms? We believe the implications of this experiment extend far beyond college-age students and statistical distributions. As Arena & Schwartz (2014) summarize:

> *...the research demonstrates that even without having instructional content that maps directly onto curricular standards, games can prepare students to learn in more formal environments, such as school. Game environments can provide experience, and formal environments can provide explanations. This clarification should be useful for creating learning games, because it can help them focus on what games do well, rather than trying to make games into a standalone solution for learning.*

fun/engagement, and learning efficacy, and encourage researcher-developer-educator teams to investigate and invent in the space that lies somewhere in between immersive, entertainment games and educational drill-and-practice titles.

+ **Provide universal technology training for pre-service teachers.** Just 8% of K-8 teachers report receiving pre-service training on digital game integration. This reflects the general lack of technology training that pre-professional programs offer new teachers, especially early childhood (K-3) educators (Barron et al., 2011; Daugherty, Dossani, Johnson, & Oguz, 2014). As mentioned above (The problem with discovery), teachers without formal training aren't being exposed to the broader range of pedagogical strategies that can enhance and facilitate digital game integration. We therefore urge policymakers to allocate funds to states and school districts to set up partnerships with universities and other teacher certification programs to offer adequate technology and DGBT training for the future teachers of young children.

+ **Create and promote online training resources.** According to the survey, in-service teachers rely on colleagues and mentors most for DGBT professional learning and advice. While we would never underestimate the value of trusted real-life networks, we believe these networks—which are prone to the perpetuation of folk pedagogies[2] around game-based learning—can be strengthened if linked to a pipeline of the latest evidence-based information. A number of excellent teacher-facing DGBL websites that serve these purposes already exist (e.g., Educade, Edutopia, Education Arcade, edWeb, and BrainPOP Educators), but a minority of K-8 teachers say they're using them. This means that we need to (a) do more to promote these online resources, and (b) identify how they can more effectively address teachers' pedagogical questions as well as their lifestyles, learning styles, and organizational constraints. Massive open online courses (MOOCs) offer a promising and convenient way to deliver in-service teachers DGBT training opportunities that may not be locally available. According to Sujata Bhatt, MOOCs could be particularly appealing if certification counted toward salary points in teachers' pay scales, and if local educational agencies recognized them as valid pathways for professional development and growth.

+ **Conduct follow-up research and share widely with stakeholders.** As an exploratory exercise, the teacher profiles we created highlight interesting relationships between teachers' *dispositions* to use digital games in their teaching and the *supports* they experience around their DGBT practices. However, given the limitations of our survey data, we were unable to establish the direction of these relationships and the relationships also observed between teaching practices and student learning. To refine these profiles into truly useful tools for product and program design, we need to conduct additional survey and complementary case study research that will allow us to verify their authenticity. Another issue surfaced in our profile analyses was the relationship between lower levels of support and lower valuations of student learning among certain teachers (i.e., *Players*). It would therefore be useful to conduct a similar survey with principals, technology administrators, superintendents, and other district-level employees as a way of surfacing their perspectives on digital game-based teaching and learning. Doing so could shed light on the support problem. Finally, teachers and administrators alike should be better informed of the findings from this and other DGBL research. The more all stakeholders know about each other's practices and perceptions, the easier it'll be to establish a shared vision and align decision-making across classroom, school, and district levels.

FINAL THOUGHTS

Findings from this survey paint a promising picture of digital game-based teaching and learning inside K-8 classrooms around the U.S. But as a research methodology, surveys have their limitations (e.g., respondents may misinterpret questions and terms, respondents may over- or underestimate behaviors, response options may not capture the universe of possible answers, etc.) and can only show us what's going on at a particular moment in history. Conducting another survey that asks the same set of questions a few years from now could tell us what progress the field will have made in the interim. But progress toward what? More teachers using digital games to meet CCSS requirements and more reports of student learning as a result of their gameplay? Less disillusionment with game-based assessment systems and fewer reported hurdles to curriculum integration? What, exactly, is the ultimate win state? As McGonigal (2011) points out, not all games are winnable. Some, like the highly addictive *Tetris*, are essentially unwinnable, but we play for the "simple purpose of continuing to play a good game." Perhaps this research can be thought of as a feedback panel for this *infinite* game that so many stakeholders are playing. Game developers, hardware manufacturers, policymakers, funders and investors, school leaders, PD providers, and teachers themselves will keep striving to level up digital game-based teaching and learning experiences as long as there is a good game to play.

2 Folk pedagogies, a term coined by Jerome Bruner (1996), are instructional methods that teachers devise based on their own intuitive assumptions about how children learn. These assumptions may or may not align with modern scientific understandings, or benefit students' learning. Professional training can help teachers overcome these assumptions.

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APPENDIX A: WRITE-IN GAME TITLES

A
A-Z Reading
A Plus Learning
AAAmath.com
ABC Mouse
ABC Say It
ABC Tracer
ABCgames.com
ABCya.com
ABS Magic Phonics
Absolute Value and Opposites Competition
Acuity
AdaptedMind
Agriball
Alphabet Zoo
Angry Birds
Aplusmath Flash Cards
Assassins Creed
Aztec Take Away

B
Bad Piggies
Baseball Math
Baseball Multiplication
Battleship
BBC Games
Big Brainz
Big Fish Games
Big Universe
Bigiqkids.com Spelling and Vocabulary
Bitesize
Bloons
Bloxorz
Bluster
Boggle
Bookworm
Brain Quest
BrainPOP
BrainPOP Jr.
Bugs and Bubbles
Buzzed

C
Candy Crush
Car Race
Cartoon
Cell Website Simulations
Changemaker
Chooseitmaker
Civilization
Class Room Guides
Classroom Jeopardy
Clifford Thinking Skills
Clue
Cluefinders
Compass Learning
Compass Odyssey
Cone Crazy
Connected
Cookie Doodle
Cool Math
Cool Math 4 Kids
Coolmath-Games.com
Cranium
Crossword Puzzles
Crush the Castle
Curious George

D
Dance Dance Revolution
Dancemat
Destination Math
Digimath
Discover Kids
Dog Bone
Dora
Dream Box
Duolingo

E
Earobics
Ed City
Edge Lore
Edgewater
Edmodo
Edu
Education City
Education Games
Edusmart
Electric Company on PBSKids
ESLgamesplus.com Interactive Language Games
Esuite Math Interactive Games
Everyday Math Games
Everyday Mathematics
Eye Train

F
Fact Dash
Fast Math
Financial Football
First in Math
Flashmaster
Flonga
Fonix
Foss Website Simulations
Freerice
Fruit Shoot
Fun Brain Jr.
Fun Brain
Fungames

G
Gamequarium
GenX
George
Gizmos
Glogster
Google Eyes
Grammar Gorillas

H
Hand-Eye Coordination Games
Hangman
Harry Potter
Hay Day
Hear Builder Auditory Memory
Hear It, Say It, Learn It
Help Kidz Learn
Holiday Hangman
Homemade Games by Me
Hooda Math
Howthemarketworks.com

I
I-Ready
I Spy
Ice Cream Shoppe
Ice Ice Baby
IDC
IDK
Illustrative Mathematics
Integer Football
iSequence
Istation
Ixl
Ixl Math

J
Jacobs' Lessons
Jeopardy
Jet
Jih
Jiji Math
Jump Start
Jump Start First Grade
Jumple!
Jurassic Park Builder
Just Dance

K
Kakooma
KenKen.com
Keyboarding
Kid Zone
Kindergarten Math

L
Lady Bug
League of Legends
LeapFrog
LeapFrog Letter Factory
Learn with Homer
Learning.com
Learning Chinese Adventure
Learning Games for Kids
Learning Heroes
Learning to Read
Learning Upgrade (Reading and Math)
LEGO's Rescue Heroes
Lemonade Stand
Letris
Letter School
Lexia
Life

Literacy Games
Literacycenter
Little Writer
Lizard Point - Geography
Lumosity
Lure of the Labyrinth

M

M&M Math
Mario Bros
Mario Party
Math 101
Math activities designed by Pearson Math
Math Attack
Math Baseball
Math Blaster
Math City
Math Dojo
Math Facts
Math Facts in a Flash
Math for the Brain
Math Fun
Math Games
Math Hoops
Math Mania
Math Ninja
Math Playground
Math Pop
Math Tools
Math Your Way
Math Zoo
Mathematics
Mathletics
Maths Games
Memory Games
Mickey Mouse Playhouse
Mind Math
Mind Point Quiz Show
Minecraft
Mobymax
Money
Monkey Math
Monopoly
Mosaic
Mr. Nussbaum
Ms. Spider
Multiple
Multiplication.com
Mymath

N

Nick Jr.
Number Bonds
Number Top It

O

Online Assessment
Online Quiz Games
Order of Operations Competition
Oregon Trail

P

Panda Pop
PBS Games relating to Clifford
PBS History for Kids
PBS Kids
PBS Math
Pearson
Pemdas Blaster
Physics Games
Pizza Time
PM Readers
Pop It
Poptropica
Population Game Creative Learning Exchange
Portal
Primary Games
Prime and Composite Fruit Shoot
Promethean Planet
Punctuation Paintball
Puzzle Jigjag
Puzzles

Q

Quia
Quizlet

R

Race Cars/Horses
Razz-Kids
Reader Rabbit
Reading Blaster
Reading Eggs
Reading Sequencing
Reflex Math
Rhyming Bee
Richard Scarry Busy Town
Roblox
Role Playing

S

Scholastic.com
Scrabble
Sesame Street
Shelved
Sheppardsoftware.com
Sight Words for Reading App
Sim Education
SimCity
SimCityEdu
Simplex Phonics
Slater Farms
Smarts
Smarty Ants
Softsschools.com
Solving Word Problems Competition
Spacey Math
Speed Games
Spell Out
Spelling City
Spelling Magic
Splash Kindergarten
Splash Math
Sponge Bob
Spotlight
ST Math
Star Math
Star Reading
Star Wars
Starfall
Stem
Stemscopes
Study Island
Success Maker
Sudoku
Sumdog

T

Teach with Portals
Ten Marks
Tetris
Text Twist
The Elder Scrolls
The Game of Life
The Sims
Think Thru Math
Thomas
Tic Tac Toe
Ticket to Read
Time
Tracing the Alphabet
Treasures' Connected
Trivia
Trivial Pursuit
Twister Dance
Type 2 Learn
Typing Games

U

V

Virtual Families
Virtual Manipulatives App
Vocab

W

Wheel of Fortune
Where in the USA Is Carmen Sandiego?
Where in the World Is Carmen Sandiego?
Wii Fit
Wonders
Wooords
Word Puzzle
Word Whomp
Words with Friends
WTF Games

X

Xtra Math

Y

Z

Zombie Grammar Force
Zondle
Zoo Burst

APPENDIX B: CLUSTER ANALYSIS METHODS

Clustering is a class of techniques used to classify cases into groups that are relatively homogeneous within themselves and heterogeneous between each other, on the basis of a defined set of variables. (Timm, 2002)

The cluster analysis used to determine teacher profiles included six variables, broken conceptually into two dimensions: *disposition* and *support*. The specific variables by dimension include:

DIMENSION 1: Disposition variables

+ Frequency of digital gameplay (original 8-point scale)
+ Frequency of digital game use in teaching (original 7-point scale)
+ Teacher's comfort level with games (original 4-point scale)

DIMENSION 2: Support variables

+ Number of reported barriers to using games to teach (original 7-point scale)
+ Scale of support from parents, administrators, and colleagues (original 8-point scale)
+ Number of sources of ongoing professional development about games (original 5-point scale)

Given the nature of the variables, only game-using teachers (GUTs) were included in these analyses. Because outliers can unduly influence cluster configurations, we first pulled in the most dramatic outliers by collapsing response categories that contained very few responses. We then standardized all variables due to varying response scales (though their means in all tables are in the original, unstandardized metrics for clearer interpretation). Next, we ran a *k-means* cluster analysis, which determines group classification by maximizing the similarity of cases within clusters (i.e., smallest possible mean differences on the variables in the equation) and minimizing the similarity of cases between clusters. Because k-means require setting the number of clusters *a priori*, we assessed several cluster configurations, from three- up to six-group solutions. The four-group cluster solution was determined to be optimal based on SPSS iteration statistics, significance statistics for each variable's contribution to the clustering, and assessments of within- and between-group similarities.

We verified stability of the four-cluster solution by conducting cluster analyses on random subsamples of the data and then checking them against the clusters designated by the analysis with the full data set. This process indicated fairly strong stability—only 8% to 12% of cases were misidentified using this procedure.

Table 1 lists the means of the variables included in the analysis by cluster, and includes indications of which means are significantly different.

		DISPOSITION DIMENSION (INDIVIDUAL FACTORS)			SUPPORT DIMENSION (ENVIRONMENTAL FACTORS)		
Cluster	**N**	**Digital Game Play Frequency** mean on scale of 1–8+	**Digital Game Teach Frequency** mean on scale of 1–7	**Comfort Using Digital Games** mean on scale of 1–4	**Barriers** mean on scale of 1–7+	**Community Support** mean on scale of 0–4	**PD Resources** mean on scale of 0–4+
1	105	1.66[a]	4.17[a]	2.79[a]	2.78[a]	3.03[a]	1.06[a,b]
2	120	6.67[b]	3.60[b]	2.53[b]	3.53[b]	2.43[b]	0.93[b]
3	113	6.71[b]	5.19[c]	3.34[c]	3.65[b]	3.26[c]	3.12[c]
4	175	6.77[b]	5.09[c]	3.32[c]	1.79[c]	3.52[d]	1.20[a]

Table 1
Variables used in the cluster analysis

Cells within a given column that have different superscripts indicate statistically significant differences in cluster means for that variable (e.g., cluster means that carry an "a" superscript are significantly different from those with a "b," but not from each other).

References

Timm, N. H. (2002). *Applied multivariate analysis*. New York: Springer.

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With generous support from the Bill & Melinda Gates Foundation, the Joan Ganz Cooney Center convenes the Games and Learning Publishing Council (GLPC), a multi-sector alliance of field leaders and key investors in game-based learning. The GLPC aims to understand the market dynamics and areas of innovation within the game-based education field. It is doing so by promoting innovations that are ready for scaling within the GBL field; developing and disseminating analytical tools, briefs, and reports to help "raise the sector"; and engaging policymakers, developers, and inventors to wisely deploy digital games to advance Common Core knowledge and 21st-century skills.

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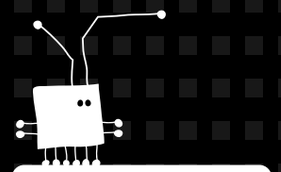

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