Digital Learning Objects’ Potential to Support Early Learning

A Report to the Ready To Learn Initiative

Education Development Center / SRI International
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About EDC/CCT

Education Development Center, Inc. is a global nonprofit organization that develops, delivers, and evaluates innovative programs to address urgent challenges in education, health, and economic development. EDC manages more than 300 projects in 35 countries. For more than 30 years, EDC’s Center for Children and Technology has been at the forefront of creating and researching new ways to foster learning and improve teaching through the development and thoughtful implementation of new educational technologies.

About SRI/CTL

SRI International is an independent, nonprofit research institute conducting client-sponsored research and development for government agencies, commercial businesses, foundations, and other organizations. SRI’s Center for Technology in Learning (CTL) evaluates large-scale technology innovations, designs assessments that enhance teaching and learning, develops tools to help students master complex ideas, builds online communities of learners, and offers strategic learning consulting services.

Principal Investigators

Shelley Pasnik sp@edc.org
Carlin Llorente carlin.llorent@sri.com

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Through classroom observations, interviews, and focus groups of teachers serving children in preschool and early elementary classrooms (K–2nd) researchers found that:

- Early childhood educators are comfortable integrating literacy and math learning materials from multiple sources into their lessons, and all study teachers were excited about the idea of enriching classroom activities using computer activities and video viewings.

- Teachers thought interactives and videos had the potential to keep children interested, focused, and engaged while supporting learning in a range of activity settings. Teachers expressed that learning in a variety settings could help children develop the versatility they will need to be excellent “21st-Century Learners.”

- Teachers believed digital learning objects could help them tailor instruction to better serve individual students, including those with special needs and those who may benefit from extra challenges.

- Teachers indicated that certain characteristics would increase the utility of digital learning objects in the classroom setting. Some of these characteristics include: an initial focus on discrete skills, having simple interfaces and easy navigation, including short introductions and clear goals, offering precise and progressive feedback, and the ability to self-adjust the difficulty of a game for individual children.

- In selecting between various digital learning materials, teachers indicated a preference for resources that align with common themes (like animals), and that come with additional supports. Teachers also favor resources that are searchable by topic, age, standard, and skill-level.

- Teachers were interested in how digital learning objects could help them to monitor student progress. This is especially true when the content of the digital learning objects is closely aligned with common standards, such as the Common Core or Head Start Early Learning Framework.

- Technical challenges such as a lack of availability of hardware and up-to-date software may limit the ability to integrate digital learning objects into classrooms. It will be important moving forward to work within the existing infrastructure available, making it as easy as possible to use digital learning objects across platforms and formats, and finding simple, creative ways to distribute these products to teachers who may not have continuous Internet connectivity in the classroom by a small number of creative teachers who bring their personal devices to school.
I. Context for the Study
The Ready To Learn initiative is funded by the U. S. Department of Education to bring engaging and high-quality media to young children who may be at risk for academic difficulties due to economic and social disadvantages. The initiative aims to deliver early mathematics and literacy resources on new and emerging digital platforms, such as tablet computers, interactive whiteboards, and smartphones, as well as by better-established technologies, such as computers, video displays, and gaming consoles. The initiative aims to create learning experiences that can leverage the unique capabilities of these various technology platforms.

II. Study Overview
As external summative evaluators of Ready To Learn, Education Development Center, Inc. (EDC) and SRI International (SRI) will conduct four context studies during the first two years of the initiative (2011 and 2012). EDC/SRI conducted the first three of these context studies during the spring and summer of 2011, including the Digital Learning Objects Study. This study investigates how teachers used literacy and math digital learning objects, most of which were originally designed for use in home and other informal environments, in formal learning environments such as prekindergarten (PK) and early-elementary (K–2) classrooms. Public media producers had developed many of these digital learning objects to reinforce learning and provide opportunities to practice early literacy and math concepts and skills (e.g., matching letters and sounds or sorting geometric shapes).

III. Methods and Sample
This study included the following data collection activities: focus groups with teachers before and after introducing select digital learning objects; observations of teachers integrating digital learning objects into classroom practice between focus-group meetings (if teachers had the opportunity to use objects with students); and telephone interviews if teachers did not have the opportunity to use objects with students. We also collected inventories from participating teachers to survey overall technology use as well as digital learning object use during the study period.

Eighteen teachers participated in the study—eight prekindergarten teachers and ten K–2 teachers—with three to five teachers participating in each of the four sets of focus groups. Most teachers were teaching during summer data collection and were able to use the digital learning objects in their classrooms after participating in an initial focus group.

Digital learning objects were available to participating teachers via Web links, including the IOWA DLL website and the PBS LearningMedia website. Although additional digital learning objects were available to teachers via these websites, the 25 exemplar digital learning objects were the focus of this study.
IV. Findings: Teachers’ Responses to PBS Digital Learning Objects

All study teachers held the view that technology, including digital learning objects, can support teaching and benefit children’s learning. Most teachers reported that media and technology were good supplements to existing instructional activities and could play an important role in preparing children to be “21st-Century Learners.” Additionally, some study teachers found that integrating digital learning objects into their classroom practice could help them meet new accountability standards regarding the use of technology in the classroom.

Teachers identified several advantages to and considerations about using public media-produced digital learning objects in their classrooms, each of them noted below.

Digital learning objects fit with existing teacher practices and routines:

- Interactives and videos can keep children interested, focused, and engaged in the classroom.
- Interactives and videos can support learning in a range of activity settings.
- Digital learning objects can help teachers tailor instruction to better serve individual children.
- Digital learning objects can help prepare children to be “21st-Century Learners,” whether in school or in another setting.

Teachers indicated that certain design characteristics may increase digital learning object utility in the classroom; these include the following:

- initially focus on discrete skills
- self-adjust the difficulty of a game for individual children
- offer precise, progressive feedback
- have simple interfaces and easy navigation
- include short introductions and clear goals
- feature ethnically and socially diverse groups of characters and settings
- resist the “click everything” strategy
- are relatively short, unless there is support for interactivity
- support math, literacy, and social emotional learning, but want options for other subjects, too
- offer multiple supports to help dual-language learners and other learners
- allow progress monitoring and support current accountability practices

Some external factors are likely to influence the integration of digital learning objects into classroom practice:

- Teachers prefer resources that are identified by theme and that come with additional supports.
- Teachers favor resources that are searchable by topic, age, standard, and skill-level.

Technical challenges also may constrain digital learning object integration into classrooms:

- Availability of hardware and up-to-date software can be limited.
- Many classrooms have unreliable or no access to the Internet.
V. Recommendations for PBS Learning Media

The preschool and early-elementary school teachers who participated in this research found, on the whole, that interactives and videos contained within PBS LearningMedia could be worthwhile complements to their current teaching. At the same time, teachers made multiple suggestions about how to ensure that these objects are relevant and useful to educators and the children they teach.

Below are our recommendations to PBS LearningMedia based on all data collected during the study:

- Make it easy for teachers to search resources by topic, child's age, and skill level.
- Develop suites of materials around themes or commonly taught concepts or skills.
- Provide teachers with built-in supports for using digital learning objects, such as videos with built-in pause points and discussion prompts.
- Provide teachers with external supports for using digital learning objects, such as lesson plans and ideas from other teachers on using short videos to introduce important ideas. Align digital learning objects to common standards such as the Common Core or Head Start Early Learning Framework.
- Feature digital learning objects that support progress monitoring and accountability practices.
- Feature interactives that have clear, inspiring goals children can work toward.
- Provide content-specific, scaffolded responses to a child's efforts as well as hints that prompt her to consider why a second or third choice may move her closer to the desired answer.
- Make purposeful exploration and learning more appealing than random clicking, and more fun than getting the wrong answer.
- Keep in mind that some of children's strongest responses to public media games and activities build from their relationships with characters; use these characters to promote learning, not compete with or distract from it. Just as TV producers had to learn to place the learning on the plot line, the same is true for how instructional designers must emphasize game mechanics and the potent use of character and decision points.
- Feature videos and interactives that focus on discrete skills and build toward comprehensive skills.
- Include interactives that provide precise, strong guidance on performance as well as additional supports in multiple formats such as repeatable written and spoken instructions.
- Feature interactives that respond to the child’s performance by making the next task easier or more difficult and that allow teachers to change these settings based on their observations of a child’s progress.
- Ensure many videos and interactives explicitly support math, literacy, and social emotional learning.
- Look for opportunities to embed positive models of social emotional skills, like listening or taking turns with peers, into digital learning objects even when social emotional learning is not the focus of the video or interactive.
• Offer resources on other important content domains such as art, science, and social studies.

• Whenever possible, feature digital learning objects that represent the full range of ethnic and social diversity of contemporary schools.

• Offer short, self-contained videos (less than two minutes long), and provide support for interacting during and around video viewing.

• Make sure that digital learning object interfaces are easy to navigate, minimizing the use of multiple browser tabs or pop-up windows.

• Minimize the amount and length of introductory material a child must view before she can begin a game or video.

• Keep in the foreground universal design principles and visual and auditory cues that support and draw in dual-language learners.

• Make it as easy as possible to use digital learning objects across platforms and formats, keeping in mind that most preschool and early-elementary classrooms have desktop computers as their principal—and frequently only—technology.

• Find creative and simple ways to distribute digital learning objects to teachers who may not have continuous Internet connectivity in the classroom.
As evaluators of the U. S. Department of Education’s Ready to Learn initiative, Education Development Center (EDC) and SRI International conducted this study of how prekindergarten and early-elementary grade (K–2) teachers might use individual PBS LearningMedia resources—video clips and interactive games—in their teaching. The Corporation for Public Broadcasting and the Public Broadcasting Service (PBS) have long records of supporting, developing, and delivering video and interactive gaming experiences that offer children the opportunity to practice literacy and math skills by watching and interacting with characters from public media programs. Based on recent findings from Grunwald Associates documenting that many upper elementary, middle, and high-school teachers are eager to use digital learning objects to enhance their teaching, public media decision-makers wanted to understand how digital learning objects included in PBS LearningMedia could be beneficial to teachers working with young children (aged 2–8) in low-income communities.

In the study, we investigated how teachers used literacy and math digital learning objects—most of which were originally designed for use in home and other informal environments—in formal learning environments such as prekindergarten (PK) and early-elementary (K–2) classrooms. Public media producers had developed many of these digital learning objects to reinforce learning and provide opportunities to practice early literacy and math concepts and skills (e.g., matching letters and sounds or sorting geometric shapes).

During an initial focus-group session, researchers asked teachers to describe the ways they use media and technology in their classrooms and introduced them to a set of literacy and math digital learning objects. We then asked them to use these digital learning objects in their teaching, as they deemed appropriate and useful. Our team observed teachers in action and invited them to reflect on their experiences during a second focus-group session. Teachers in the study were actively looking for innovative ways to engage children, particularly those who require additional support and increased practice with basic skills or those who would benefit from more challenging work. We found that teachers were able to elaborate on how the affordances of the digital learning objects support the learning needs of children they teach, and also were able to articulate what aspects of digital learning objects made them effective tools to support learning in classroom settings.

We observed teachers incorporating select digital learning objects into various classroom activities, and heard them discuss ways the digital learning objects fit into their regular classroom activities and instructional practices, particularly for supporting in-class lessons, introducing or reviewing concepts, and providing opportunities for practice of specific skills. Teachers identified specific characteristics or features of digital learning objects they found most important when considering the potential for classroom use.

While the study asked teachers only about individual digital learning objects and how they might be used, nearly all teachers were eager to share their insights about ways in which external factors (how resources...
are curated, what supports are provided to facilitate their use, and how resources support various elements of the Common Core) might influence the degree to which they incorporate materials from PBS LearningMedia into their classrooms.

I. Methodology

This section includes the research questions that guided our study, as well as brief descriptions of the teachers who participated in the research, data collection, and analysis.

Research Questions

Two questions guided the exploration of digital learning objects currently available from PBS LearningMedia.

1. What kinds of mathematics and literacy digital learning objects do prekindergarten and early-elementary teachers find best integrate with current and near-future classroom practices?
   - What specific design elements (format, length, content) matter to teachers?
   - How do (or could) digital learning objects fit into current classroom practices?

2. What are guiding design principles or characteristics of digital learning objects that increase the likelihood of their use in classroom environments?

To answer our research questions we conducted:

- Focus groups with teachers before and after introducing select digital learning objects;
- Observations of teachers integrating digital learning objects into classroom practice between focus-group meetings (if teachers had the opportunity to use objects with students); and
- Telephone interviews if teachers did not have the opportunity to use objects with students.

We also collected inventories from participating teachers to survey overall technology use as well as digital learning object use during the study period.

Data-Collection Procedures

Researchers worked with four focus-group cohorts during the study period, two cohorts in New York City and two in the San Francisco Bay area. At each location, one cohort was composed of prekindergarten teachers and the other of K–2 teachers.

For each cohort, we conducted an initial focus group to understand teachers’ current use of media and technology and to introduce the selected set of digital learning objects. We then asked teachers to use these digital learning objects in their classrooms, if they could, and, if they could not (for example, if they were on summer vacation), to try out the digital learning objects at home. Our team conducted classroom
observations and phone interviews during this time. Finally, once teachers had used the digital learning objects in their classroom, we conducted a follow-up focus group to discuss teachers’ experiences.

Focus groups were designed to

- Examine how teachers use or might use technology and media for instruction
- Discuss the appropriateness of the selected digital learning objects for the children taught by participants with respect to length, content, and type (video or interactive game/activity)
- Identify points of entry for integration of the digital learning objects into classroom instruction
- Identify successful classroom uses of digital learning objects
- Gather suggestions as to how the digital learning objects might be extended or enhanced for further use in the classroom

Observations were designed to

- Observe teachers’ use of digital learning objects with children in classroom settings
- Identify how digital learning objects are integrated into ongoing instruction
- Observe children’s use of digital learning objects during typical classroom activities
- Identify points of entry for digital learning object use

Interviews were designed to

- Elicit responses from teachers about how they viewed digital learning objects within the context of their teaching instructional goals and children's needs.

During the first focus-group session, we engaged teachers in conversation about their current technology and media use, as well as potential uses of digital learning objects. We introduced teachers to several exemplar digital learning objects and gave participants an opportunity to explore other digital resources on their own. Finally, we asked teachers to assess the appropriateness of the digital learning objects for the children they teach and to consider ways in which they might integrate them into their daily practice.

Teachers also completed the Technology Use Inventory during the first focus-group session, indicating which types of technology were available to them in their classrooms. As a follow-up to the first focus-group session, available teachers were observed using digital learning objects of their choice with children in their classrooms or were interviewed via phone to discuss and reflect on the digital learning objects they reviewed. During the second focus-group session, participants completed the Digital Learning Object Use Inventory, discussed as a group the digital learning objects they had used, and offered points of potential entry by discussing how or what would be needed to integrate digital learning objects into their existing classroom instruction.

Focus-group facilitators used a structured protocol for each of the focus groups. Facilitators co-developed the protocols and provided ideas for prompts and questioning prior to data collection. A standardized protocol was used for telephone interviews, and observers were provided with a structured observation protocol to conduct their observations. Researchers took notes during each of the focus groups and all sessions were audio recorded and transcribed. All instruments and procedures were reviewed and approved by EDC’s Institutional Review Board.
Sample

Eighteen teachers participated in the study—eight prekindergarten teachers and ten K–2 teachers—with three to five teachers participating in each of the four sets of focus groups. We recruited participants for the digital learning object study by (1) leveraging existing relationships with prekindergarten centers and teachers who participated in our 2009 Ready to Learn study and (2) leveraging professional connections at local universities and with mentor teachers in local K–2 classrooms. Most teachers were teaching during summer data collection and were able to use the digital learning objects in their classrooms after participating in an initial focus group.

All study teachers reported a moderate to high level of confidence working with technology in general, and with computers in particular. Additional characteristics of participating focus group teachers and the children in their care include the following:

- At least 50% of the children were from Ready To Learn’s target communities.
- Approximately 60% of the children were dual-language learners.
- Teacher experience levels ranged from 2 to 28 years of teaching.
- Prekindergarten classrooms generally had a lead teacher, one to two aides, and a parent volunteer in partial or full-day programs.
- K–2 teachers on the West Coast were working in summer enrichment programs sponsored by local school districts. K–2 teachers on the East Coast were not teaching this summer.

Teachers reported a range of technology available to them in their classrooms and schools. In particular, 11 out of the 18 teachers reported at least one working computer in the classroom for children’s use. All participating teachers had access to cassette players, and nearly all had access to televisions and DVDs/VCRs. A few teachers reported using interactive whiteboards, iPads/Android tablets, and smartphones in the classroom. See Appendix A for a complete list of available technology.

Selection of Digital Learning Objects

In order to optimize what we could learn about the potential of PBS’s digital learning objects to support early math and literacy learning, we worked closely with PBS to identify exemplar public media resources freely available online. This process was challenging because the study took place before and during the public release of PBS LearningMedia. Digital learning objects were available to participating teachers via Web links, including the IOWA DLL website and the PBS LearningMedia website. Although additional digital learning objects were available to teachers via these websites, the 25 exemplar digital learning objects were the focus of this study. (See Appendix B for the list of exemplar digital learning objects.)

After PBS staff identified potential exemplar digital learning objects, our research team, including researchers with expertise in literacy and mathematics, systematically reviewed and rated digital learning objects to ensure they addressed key math and literacy skills for PK and K–2 children. We rated each digital learning object on the following dimensions: interface, developmental appropriateness, and content. From the original list of nearly 50 digital learning objects and our own review of various PBS websites, we identified 25 exemplar digital learning objects across age ranges (PK–2nd grade) and content (literacy and math).
II. Analysis

We conducted a systematic review of all of the data we collected during the course of the study to identify common themes, constraints, and suggestions for integrating digital learning objects into formal classroom instruction in mathematics and literacy. We reviewed transcripts from each of the focus groups and consulted notes from each focus group to support the interpretation of findings drawn from the transcripts. We reviewed information from the Technology Use Inventories and Digital Learning Object Use Inventories to better understand the background and context for focus-group findings. Additionally, we reviewed observation protocols and telephone interviews to confirm and elaborate on information discussed during the focus groups.
Findings

All study teachers held the view that technology, including digital learning objects, can support teaching and benefit children’s learning. Most teachers felt that media and technology were good supplements to existing instructional activities and could play an important role in preparing children to be “21st-Century Learners.” Additionally, some study teachers found that integrating digital learning objects into their classroom practice could help them meet new accountability standards regarding the use of technology in the classroom.

Teachers identified several advantages to using public-media–produced digital learning objects in their classrooms, discussed in detail below. First, we describe how digital learning objects fit into existing teacher practices and the specific areas of teaching and learning teachers described as being the best supported by the digital learning objects. Second, we address characteristics that might increase digital learning object utility in the classroom. Third, we discuss external factors likely to influence the integration of digital learning objects into classroom practice, and fourth, we highlight technical challenges that may constrain digital learning object integration.

I. Digital Learning Objects Fit with Existing Teaching Practices and Routines

Study teachers were able to imagine a variety of ways in which digital learning objects—both videos and interactives—could be used across content domains. As one seasoned prekindergarten teacher said, “I guess … we’re used to integrating a lot of stuff together, so it’s not going to be hard for us [to find a way to use materials like these digital learning objects].

**Interactives and videos can keep children interested, focused, and engaged in the classroom.**

All study teachers were excited to integrate computer activities and video viewing into classroom activities. Teachers believe digital learning objects can provide a novel way for children to engage with critical content and practice important skills. They also noted that engagement is highest when children are able to mimic a public-media characters’ actions or words in videos and manipulate the mouse/touch the screen to engage with familiar characters on screen.

**Example:**
K–2 teachers, in general, liked the concept of and the content covered in the video *Two Vowels Go Walking*; however, many noted the experience could be enhanced by adding “… interactive [components or prompts such as] ‘Let’s go over the words that we learned today’ or ‘… Say [the words] with me,’ etc.”
Interactsives and videos can support learning in a range of activity settings.

Teachers reported the potential for and were observed integrating digital learning objects into various activities including circle time, center time, and whole-class instruction to support curricular needs and entire class and interactive games as a way to provide specific exposure or practice to individual children. As such, teachers were especially interested in digital learning objects that reflect skills that they frequently address in their classrooms.

**Examples:**
After viewing *Curious George Treasure Maps*, a second-grade teacher elaborated on how much she enjoyed the video. “I really like the treasure maps, just because ... no matter what grade I teach or what group of kids I have, I always start with maps ... because they live in New York City and maps are so important. ... I just liked it because it would be an extension of [my in-class work].” Another teacher also agreed with the utility of the video to address a familiar concept to children, and felt it could be used as an introduction to a lesson or during a mid-point on a larger lesson about maps.

A prekindergarten teacher integrated a digital learning object to support a sorting lesson. She began by modeling the sorting activity in *Oscar’s Trash Sort* with her laptop during circle time. She held the screen up for children to see and then asked questions as she sorted trash on the screen. She then modeled in-person sorting of items in the classroom; throughout the activity she elicited responses from children to sort tools (e.g., pegs, nails) from circus-related items (giraffes with glittery hats, an elephant). During free-choice time, children had the option to use *Oscar’s Trash Sort* at the desktop classroom computer or sort items on a table into tools and circus-related categories.

Digital learning objects can help teachers tailor instruction to better serve individual children.

Most teachers appreciated interactive digital learning objects that allowed children to revisit activities and practice skills in a setting where they receive immediate, helpful feedback. They considered digital learning objects especially beneficial to children who needed additional support and to those who were able to engage with more advanced material.

**Examples:**
Teachers cited the “vocabulary review” in *Truman’s Word Show* from *Martha Speaks* as an excellent way for prekindergarten children to practice vocabulary, to learn the meaning of new words, or to deepen understanding of existing vocabulary through brief or extended practice, depending on the child’s needs.

Teachers also identified *Number Sense* from *Cyberchase* as a helpful resource to challenge K–2 children who have already mastered patterns in a single category.

Digital learning objects can help prepare children to be “21st-Century Learners,” whether in school or in another setting.

By using digital learning objects in the classroom, study teachers felt they were providing opportunities for all children, regardless of their access to technology and media outside of school, to use digital technologies in
ways that help build 21st-century skills. Teachers identified digital learning objects as useful tools children can use to learn particular academic skills, as well as to learn and refine various fine motor skills necessary to successfully engage with technology.

**Example:**
During observations in prekindergarten classrooms, we saw children with limited computer skills who were using the touch-screen function for the first time in an attempt to be successful at *Oscar’s Trash Sort*. The “click–drag–click” motion provided children an opportunity to practice moving objects on the screen. As one prekindergarten teacher noted during our focus group, “Even if it’s just a finger and they move it, they still need that.”

Another K–2 teacher stated, “Everything we do in teaching … has to meet ten purposes all at one time. So it would be great if the technology did the same. So it might want to be teaching a certain skill, but at the same time look like something else that a child would need to do for computer competency, like logging in, navigating a website, typing.”

Teachers also said that digital learning objects can play an important role in enhancing home-school connections by reinforcing learning that is taking place at home during school time and by providing tools for parents to participate and support in-class learning.

**Example:**
By providing parents with easy access to targeted digital learning objects for use at home, such as *Storybook Creator* from *Super WHY!*, teachers said they are able to involve parents in reinforcing skills learned in school. Digital learning objects that feature familiar characters from home viewing, such as Super Why and Princess Presto, have the potential to link classroom learning to home learning.

## II. Digital Learning Object Characteristics that Appeal to PK–2 Teachers

While enthusiastic about the potential use of digital learning objects in the classroom, teachers also identified features that could increase the utility of the digital learning objects in preschool and early-elementary classrooms. Teachers identified several characteristics that they considered when evaluating whether and how to integrate digital learning objects into their classroom activities.

**Teachers favor interactives that initially focus on discrete skills.**

Many digital learning objects, including those selected for this study, focus on multiple skills. Teachers found that digital learning objects are more useful if they allow a child to focus on one particular content-based skill at a time and culminate with the integration of all skills as they are mastered and the game progresses. DLOs can additionally focus on skills such as learning to use the mouse, but again should focus on only one of these skills at a time, building toward complexity as skills are mastered.
Example:
K–2 teachers discussed the need for discrete skill practice. For instance, when viewing Crack Hacker’s Safe, one teacher suggested games should include several activities of varying degrees of difficulty. She suggested a counting game could first require children to work with numbers 1 through 10, then through 50, and finally through 100, instead of beginning with three-digit numbers automatically.

Teachers prefer interactives that self-adjust the difficulty of a game for individual children, when they aren’t able to do it themselves.

Teachers want digital learning objects to automatically adjust to a child’s performance in order to promote independent use and increase the length of time children can engage with a given digital learning object. Also, teachers want to be able to customize a child’s experience, setting the initial difficulty level or target skill (e.g., sorting by shape only). Study teachers felt this would give them confidence that the digital learning objects were aligned with their instructional goals and curricular standards, as well as with children’s skill levels.

Examples:
K–2 teachers believed Number Sense by Cyberchase was difficult for children to follow. They expressed an interest in the overall concept of patterning, but they felt “there’s a lot of steps [required].” One kindergarten teacher said, “It seems like ... you’d want it to be like one thing. What’s the number, or what’s the color?”

Prekindergarten teachers also expressed a desire for more control over the content of digital learning objects. For instance one PK teacher suggested, “What would be really neat is if, on Oscar’s Trash Sort, you could tell it to just do colors. So we’re working on colors this week, and it’s only going to give you color ones. Or just shapes. Okay, so today it’s colors and shapes, because we’ve been working on colors and shapes. So now you can mix it. Once children are able to successfully sort by these individual categories, they will be ready for the challenge of multiple sorting categories and a more complex sorting activity.”

Teachers favor interactives that offer precise, progressive feedback.

Teachers believed some of the strongest interactives were those that allowed children to be as independent as possible when practicing a skill. For children to use these digital learning objects without intensive teacher guidance, they want interactives to provide relevant and task-specific feedback that helps children progress through an activity. Responses such as “that’s not right” or “try again” do not offer children support on how to improve their performance. Teachers suggested feedback should be supportive (e.g., acknowledge children’s effort) and should also guide children on how to improve performance (e.g., providing substantive hints).

Example:
Teachers were concerned that feedback such as “correct” or “incorrect” does not provide enough guidance for children about how to make better and more informed choices, once they have already chosen an incorrect response during a game or activity. Although Oscar’s Trash Sort eventually highlights the shelf where the player is to place the object, K–2 teachers expressed a desire for more specific feedback. One teacher, for instance, highlighted that it is important for games to “Explain why it was wrong. So if [the prompt] says ‘Find the circle’ and [children] click on the square, [the next prompt should be something like] ‘Oh, that’s a square, look for the circle ...’” This same teacher explained that, “Otherwise ... the kids who are getting it wrong don’t know why they’re getting it wrong.”
Teachers also noticed that the feedback provided when children select an incorrect response in some interactive games was more entertaining than the feedback provided when they selected a correct response. This prompted some children to purposely and repeatedly select incorrect responses.

**Example:**
During an observation, some children using Big Bird’s Letters pressed all of the keys on the keyboard. The goal of the game was to press on a letter and see an object beginning with the letter pressed. Children quickly realized that when they pressed a non-letter, Big Bird appeared on screen. The classroom teacher reflected on the experience during the focus group. “My kids in my classroom are … just interested in what they could touch, and what was going to do what. When Big Bird came on, they were just like, all over. … I noticed they were more interested in the reaction they got, rather than, like, the letters … they were more interested in, ‘Oh, when I do this, when I do that, it changes.’ ”

Finally, teachers explained that feedback that was appropriately integrated into the game visually and spatially would better support children’s learning and performance.

**Example:**
Teachers of first- and second-grade children cited the feedback mechanism in Crack Hacker’s Safe and Number Sense tied to Cyberchase (small text boxes appear on top of the main screen) as an example of something with which their children struggle. Teachers explained, “... the text was kind of small [and the] vocabulary was difficult.”

**Teachers gravitate toward interaction with simple interfaces and easy navigation.**

Teachers prefer interactives that make navigation easy for children and teachers, even those with limited technology skills and experience. A teacher- and child-friendly interface would include an entry system into—and an exit system out of—each interactive that is simple, quick, easy to use, and “kiosk-like,” allowing children to focus on the target interactive rather than on how to get around the display of the larger game environment.

Because many teachers want children to use computers independently, they favor interactives with fewer images, icons, and audio elements surrounding the various interactives, as well as those that limit the number of windows that a child can open at once, to decrease distraction from the target interactive.

**Example:**
During our observations, there were multiple times when we observed children opening more than one interactive at a time, either accidentally because of imprecise mouse movements or intentionally as they became bored with a game. This resulted in multiple games running at the same time, exposing children to the audio for two or more games at once. In this situation, it is nearly impossible for children to discern the directions and feedback from any one game, which can lead to disengagement and confusion about game play. One K–1 teacher felt that, “... in terms of the actual format of the screen, the sidebar ... is too much.” Another K–1 teacher described her own difficulty with the interface by explaining, “[It was] visually distracting.” She said, “I found myself looking over there like, ‘What’s that?’”

Teachers note that an elegant way to exit games that provides closure and a feeling of accomplishment would also enhance navigation.
Example:
During our observations, we noticed that the only way to end Oscar’s Trash Sort is to close the window, which could happen at any point in gameplay. There was no way to indicate a final round, or an exiting of the game environment. Children and teachers found this to be an unsatisfying completion to the activity. As one prekindergarten teacher described it, “If it is a continuous process for a long time, it’s going to be hard to pull out a kid. The only way we could do that is ... to turn the timer. Okay ... your turn is done, so give other kids a chance. But then ... they may not get the feeling of fulfillment, because they didn’t finish the whole thing.”

Teachers favor interactives with short introductions and clear goals.

Teachers preferred interactives that minimize introductions and extra character talk. Teachers reported children have only 5–10 minutes on the computer several times a week, and maximizing their engagement on key content/skills is therefore crucial.

Example:
Both Super Grover’s in the Nick of Rhyme and Cookie Monster’s Alphabet Soup have long introductions that children must listen to each time they take a turn. As one first-grade teacher described from her notes on the digital learning objects, “[Cookie Monster] Talks too much. The [children lost] patience with Cookie Monster.”

Comparing the digital learning objects in this study to software available in their classrooms, teachers indicated that they preferred interactives in which there was an overarching goal for each individual game. Teachers believed children would be more engaged by having a display of progress, and perhaps an end goal for each digital learning object.

Example:
One first-grade teacher noted that while playing Oscar’s Trash Sort on her own she finished four or five rounds but noticed, “… he keeps going, ‘Oh, here’s more garbage’ and then more stuff comes out.” She explained she kept asking herself, “When am I done?” She felt her children would get antsy with so many rounds and no clear indication of when the game ends.

Teachers prefer videos and interactives that feature ethnically and socially diverse groups of characters and settings.

Because teachers in our focus groups work with diverse groups of children, they were most interested in digital learning objects that include scenarios and languages familiar to their students. They felt the relatability of the characters would resonate with children who are not necessarily used to seeing characters of their race, ethnicity, or language background represented in media.

Example:
Second-grade teachers commented positively on the diversity of the people represented in the Subtraction video from Sesame Street. They explained that it not only reminded them of their own experiences but also how children might think about non-diverse characters. One teacher said, “... If I grow up looking at TV shows and everybody on TV was not my skin color ... I’m going to stop paying attention.” Another teacher made a similar comment about the importance of settings. “… [A]nd even the setting ... kids just want to see other children in the same setting as them ... and learning and doing the same things that they’re doing.”
Teachers favor interactives that resist the “click everything” strategy.

Study teachers prefer interactives that reduce the likelihood that correct responses are given at random or simply by clicking through options.

**Example:**
Teachers reported that children in their classrooms learned they could advance through *Measuring Up* by simply clicking from left to right until they found the correct answer. Likewise, during our observations of prekindergarten classrooms, we witnessed children clicking at random or in a pattern until they found the correct answer. As one prekindergarten teacher described, “[Children] liked *Clifford Measuring Up*, but I noticed there was one kid in particular who wouldn’t listen [to] ‘Which one’s the shortest?’ He would just be picking one, because he [thought], ‘If I just click all of them, one of them [is bound to be] the answer.’ ” Another prekindergarten teacher described a similar situation in her classroom, where one of her children “… noticed that he’d click it, and it would go, ‘No, that’s wrong,’ so he’d click another one, [and it would go] ‘No, that’s wrong’ again, so he’d click another one and it would go ‘Oh, that’s yes’ [this time].” This teacher thought the child thought to himself, “Okay, so I’m not going to listen to the whole thing, I’m just going to start clicking and it’s going to tell me yes or no.”

Teachers favor shorter videos, unless there is support for interactivity.

Teachers expressed a preference for shorter videos, indicating that they were better suited for classroom use, particularly those under two minutes for prekindergarten children. Teachers reported longer videos could be useful if they were able to plan accordingly. Teachers wanted video activities that promote or invite interaction by asking children to respond to or mimic character behavior. Teachers felt this would improve the quality and educational value of the videos.

**Example:**
One prekindergarten teacher, when asked to elaborate on how she could use videos in her classroom, responded, “I guess it depends on the age of the kids, ’cause the younger they are … the easier for them to get bored or restless. They can only stay, like, in a video, a clip … for 2 to 5 minutes. … If we show it to them, it only, I think, lasts for 2–3 minutes, is good for them. But if you show them a clip longer than that, they get restless … they have to be interacting … with what the video is doing …”

Teachers favor videos and interactives that support math, literacy, and social emotional learning, but want options for other subjects, too.

Teachers expressed a preference for math- and literacy-focused digital learning objects because they consider these domains crucial to academic success. At the same time, they expressed an interest in seeing digital learning objects for other subject areas. For example, teachers want digital learning objects tied to science, especially ones geared directly to individual grades (not spanning multiple grades). In addition, K–2 teachers expressed interest in content- and grade-specific social studies videos and interactives, and prekindergarten teachers expressed interest in seeing digital learning objects addressing basic art concepts, such as identifying primary colors and blending colors.

**Example:**
Teachers noted a lack of science resources, especially in prekindergarten. As one teacher said, “I mean, honestly, in my opinion, I’ve been here 9½ years, and I think science is the one where
we’re always lacking.” Teachers also expressed a desire for more relevant science content in K–2 grades. One teacher in particular said, “And for ... plants and vegetation, stuff like that. So if I look at the science book and it’s so dry and boring ... [and think,] ‘my kids are Dominican, this has nothing to do with them,’ then I’ll start looking up things [that are] more relatable.”

Teachers, especially prekindergarten teachers, also are interested in digital learning objects that address social emotional skill development, whether it is embedded with content digital learning objects (e.g., math digital learning objects) in a way similar to traditional Sesame Street programming or created by individual digital learning objects that specifically address these crucial skills. Teachers were concerned about the limited socialization that occurs when young children, especially prekindergarten children, use the computer, and elaborated on how the digital learning objects might address this area.

**Example:**
One prekindergarten teacher said, “The majority of our kids, when they come to my class, this is their first experience. And so really we want to focus on the socialization, but if they’re already going to the computer, they’re not socializing, because they’re generally there by themselves.” Another said, “The socio-emotional is talking about how you interact with other people, emotions, identifying your emotions, and so exactly with the Sesame Street characters, well, why is Oscar the Grouch? What makes him grouchy, and how does that make you feel when somebody is that way, acts that way to you ...

**Teachers favor interactives with multiple supports, which help dual-language learners as well as other students.**

Teachers noted the steady increase of dual-language learners in their classrooms and identified as a priority additional accommodations that would allow dual-language learners to participate fully with digital learning objects. Teachers expressed a desire for text presented in digital learning objects to be simple and printed in standard, easy-to-read fonts. They suggested that digital learning objects allow children to replay all instructions and written feedback as needed. Additionally, they suggested graphical images could be used to supplement written or spoken text, in a manner similar to visual dictionaries. Teachers also suggested that, where possible, options to view text or hear spoken instructions in Spanish (and other languages) should be provided in order to make digital learning objects beneficial for children who are learning to speak English as a second language.

**Examples:**
Many teachers have children for whom English was not their first language, in particular children who speak Spanish at home. One K–2 teacher suggested providing a language option for teachers and children such that, “Pop-up boxes could have their messages played in Spanish, or the directions could be in English or in Spanish.”

Prekindergarten teachers also discussed how language skill could be a barrier or an asset to playing the games. One teacher described her experience using the interactives in her prekindergarten classroom and said, “I think language makes a difference, too. If somebody’s English is better, they’re going to understand it easier, but all of our kids are second-language learners, with the exception of maybe one percent.”

**Teachers favor interactives and videos that allow progress monitoring and support current accountability practices.**

In light of current accountability practices, teachers identified specific supports they feel are important to foster the integration of digital learning objects into their regular classroom practice. For example, teachers believe
that digital learning objects that provide assistance with accountability and progress monitoring would be extremely useful.

**Examples:**
Teachers indicated that tracking children’s progress in digital learning object activities could allow them to meet accountability requirements and make decisions regarding the need for differentiated instruction. One second-grade teacher explained, “After [a child played] the game ... [she could print a report] to put in [her] data binder.”

K–2 teachers further elaborated on the need for accountability. One teacher said, “Realistically, though, if you’re marketing this to schools ... they have to be data-driven. There has to be a part where it’s data driven, because ... the principals say, ‘Where’s the data part to it?’ ”

### III. Broader Considerations that Shape Use of Specific Digital Learning Objects

While our research, interview, and focus-group questions concentrated on the features of particular digital learning objects, teachers also had a lot to say about how external factors influence which digital learning objects can be integrated into current teaching practices. They highlighted a desire for additional curricular supports around skill- or theme-related digital learning objects.

**Teachers favor resources that are identified by theme, and that come with additional supports.**

Both prekindergarten and K–2 teachers frequently teach lessons around themes such as “insects” or “seeds,” or skills such as “sorting” or “counting.” Many said they would like the Family Literacy Bags currently available via PBS LearningMedia to include more digital learning objects, more hands-on activities, and additional resources, including links, to share with parents.

**Example:**
One prekindergarten teacher described how themes drive the content of her classroom lessons and therefore, when she looks for additional supports on the Internet, she searches by themes. She said it would be good if she could, “Type in ‘pre-K lesson plan’ [and] go [search by] themes.”

The K–2 teachers described the importance of additional supports in the classroom to make use of the digital learning objects. Specifically, one teacher summed up the sentiments of many with her response, “Lesson plans, too. Some teachers want extensions on, you know, lesson plans and websites ... . We’re talking what’s good for the kids, but also what’s good for the teacher.” A second-grade teacher also suggested, “Video [examples of other teachers] using [the digital learning objects] in their class.”

**Teachers favor resources that are searchable by topic, age, standard, and skill-level.**

Given that planning lessons requires substantial amounts of time and effort, teachers expressed a desire for a resource that allows them to easily and quickly find needed or relevant digital learning objects. This includes organizing digital learning objects in an intuitive way for teachers of younger children and providing an easy
and focused way to search for specific digital learning objects. Teachers voiced this desire in a variety of ways.

**Example:**
One K–2 teacher said she likes “[websites] that say: What grade do you want? What standard are you looking for? ...” while another one mentioned she would like “… different ways [to] search [by] a specific topic.”

Teachers expressed a wish that all resources on the PBS LearningMedia site be tagged by a specific target grade level—not large grade bands—and by target skill level, as well as which theme or topic they cover. Teachers also want clear information regarding the standards, such as Common Core, to which the digital learning objects are related. Teachers said that such tagging would allow them to quickly find resources that fit their curricular needs.

**Example:**
Given the pressure K–2 teachers face to meet standards and have children succeed in standardized tests, many teachers were interested in having digital learning objects that were “… aligned with the Common Core standards.” As one second-grade teacher said, “… if the standard is there, that just saves us so much time and makes it so much easier [to know which digital learning objects to use].”

Finally, many schools have e-boards where teachers can post lesson ideas, share materials, and offer suggestions to teachers requesting assistance with difficult lessons or topics. Teachers said that the PBS LearningMedia website might be a good place to access a bulletin board or comment area where teachers could post information about digital learning object use and read others’ comments on the digital learning objects, including suggestions for use and ideas for expansion or integration into existing curricula.

**Example:**
One second-grade teacher described her experience with an internal district e-board to explain how digital learning objects could serve the same purpose. She asked, “Why reinvent [the lesson]? Really, why? You can just, like, go there and see lessons that have been done on the smartboard or PowerPoints that have been done.”

### IV. Use of Digital Learning Objects in the Context of Limited Infrastructure

The challenge of using technology in classroom settings was a recurring theme for teachers. Lack of hardware, software, and Internet accessibility all hinder teachers’ ability to use the digital learning objects in their classrooms.

**Availability of hardware and up-to-date software can be limited.**

Teachers typically reported having one working computer for children’s access in a classroom, with limited access to computers outside of classrooms. However, even teachers who had working computers in their classrooms frequently reported that the computers were old, slow, and had antiquated software that would not support current digital learning objects. Access to televisions and VCR/DVD players was more common.
Classrooms have limited or no access to the Internet.

Teachers reported that, even when they do have computers for child use, most do not have access to the Internet, while others have limited and unreliable access to the Internet for students. Furthermore, teachers with reliable Internet access noted that school districts often have firewalls that prevent sites, including PBS, from being accessed due to the slow district or school process of having websites approved for school use. Many teachers believed that accessing digital learning objects via the Internet is not something children, especially prekindergarten children, can do at school, especially on their own. Teachers suggest that digital learning objects be accessible via pre-packaged DVD/CDs, or through a mechanism by which teachers can download versions from home and install them on their classroom computers via flash drive or CD/DVD.
Future Considerations

The preschool and early-elementary school teachers who participated in this research found, on the whole, that interactives and videos contained within PBS LearningMedia could be worthwhile complements to their current teaching. Teachers expressed ways in which digital learning objects could help them reach and engage children who may be struggling, while also offering opportunities to young learners ready for a new challenge. Teachers reported that, based on their experience using sample digital learning objects, they could envision using videos and interactives in a variety of classroom settings and that, by interacting with these media resources, children could develop 21st-century learning skills. At the same time, while imagining how digital learning objects might be integrated into their daily routines and education goals, teachers made multiple suggestions about how to ensure that these objects are relevant and useful to educators and the children they teach. We have arranged these recommendations and considerations in order to help producers contributing to PBS LearningMedia continue the work of developing new digital resources.

Challenge: Ease of Access

Teachers are busy professionals who make use of resources that are tagged and organized in a way that makes finding and using them as efficient as possible.

What PBS LearningMedia Can Do

- Make it easy for teachers to search resources by topic, child’s age, and skill level.
- Develop suites of materials around themes or commonly taught concepts or skills.
- Provide teachers with built-in supports for using digital learning objects, such as videos with built-in pause points and discussion prompts.
- Provide teachers with external supports for using digital learning objects, such as lesson plans and ideas from other teachers on using short videos to introduce important ideas.

Challenge: Alignment with Educational Goals

Teachers need all resources they use in their classrooms to align with their teaching and assessment goals.

What PBS LearningMedia Can Do

- Align digital learning objects to common standards such as the Common Core or Head Start Early Learning Framework.
- Feature digital learning objects that support progress monitoring and accountability practices.
- Feature interactives that have clear, inspiring goals children can work toward.
• Provide content-specific, scaffolded responses to a child’s efforts as well as hints that prompt her to consider why a second or third choice may move her closer to the desired answer.

• Make purposeful exploration and learning more appealing than random clicking, and more fun than getting the wrong answer.

• Keep in mind that some of children’s strongest responses to public media games and activities build from their relationships with characters; use these characters to promote learning, not compete with or distract from it. Just as TV producers had to learn to place the learning on the plot line, the same is true for how instructional designers must emphasize game mechanics and the potent use of character and decision points.

• Feature videos and interactives that focus on discrete skills and build toward comprehensive skills. Include interactives that provide precise, strong guidance on performance as well as additional supports in multiple formats such as repeatable written and spoken instructions. Feature interactives that respond to the child’s performance by making the next task easier or more difficult and that allow teachers to change these settings based on their observations of a child’s progress.

Challenge: Content

Teachers are keen to have a variety of resources to support learning in core areas, as well as other content and social emotional domains.

What PBS LearningMedia Can Do

• Ensure many videos and interactives explicitly support math, literacy, and social emotional learning.

• Look for opportunities to embed positive models of social emotional skills, like listening or taking turns with peers, into digital learning objects even when social emotional learning is not the focus of the video or interactive.

• Offer resources on other important content domains such as art, science, and social studies. Whenever possible, feature digital learning objects that represent the full range of ethnic and social diversity of contemporary schools.

Challenge: Clear Design and Easy-to-Follow Functionality

Teachers are thoughtful and particular about the resources they use in their classrooms. They look for resources that will fit well with their instructional practices, are easy to use, and provide the right amount of support to help children from diverse backgrounds learn.

What PBS LearningMedia Can Do

• Offer short, self-contained videos (less than two minutes long), and provide support for interacting during and around video viewing.

• Make sure that digital learning object interfaces are easy to navigate, minimizing the use of multiple browser tabs or pop-up windows.
• Minimize the amount and length of introductory material a child must view before she can begin a
game or video.
• Keep in the foreground universal design principles and visual and auditory cues that support and
draw in dual-language learners.

Challenge: Infrastructure

Although technology is common in many preschool and early-elementary school classrooms, it often is not
the most updated or the best available. Additionally, most classrooms do not have access to the Internet.

What PBS LearningMedia Can Do

• Make it as easy as possible to use digital learning objects across platforms and formats, keeping in mind
that most preschool and early-elementary classrooms have desktop computers as their principal—and
frequently only—technology.
• Find creative and simple ways to distribute digital learning objects to teachers who may not have
continuous Internet connectivity in the classroom.
Appendix A: Technology Availability

Teachers reported full or shared access to:

- At least one working desktop or laptop for teacher use only (16 PK/K–2 teachers)
- At least one working desktop or laptop for child use (either shared with teachers or strictly for child use) (11 PK/K–2 teachers)
- Working televisions and DVDs/VCRs (17 PK/K–2 teachers). Cassette players (all teachers)
- Digital cameras (14 PK/K–2 teachers)

Additional access to technology included:

- Interactive whiteboard (4 K–2 teachers)
- iPads or Android tablets (3 PK/K–2 teachers)
- Personal smartphones (3 PK/K–2 teachers)
### Appendix B:
25 Exemplar Digital Learning Objects

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<th>CONTENT</th>
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<th>SERIES OR PROGRAM TITLE</th>
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