Third Graders' Use of Digital Tools Designed for Multimodal Communication in Project-based Science

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Abstract: This short paper describes a study conducted in the context of a larger design-based research project focused on investigating the integration of science, English language arts, and mathematics in elementary grades project-based learning (PBL). This study focuses on one third-grade unit (*How can we help the birds that live around here grow up and thrive?*), in which student groups developed and presented digital, multimodal artifacts, using a suite of digital tools. We asked: (1) What did third-graders' digital artifacts reveal about their use of multiple modes to communicate information? (2) How did students describe their modal use as they shared their digital artifacts? Findings suggest that third-graders were strategic and flexible in their modal selection and use. In sharing presentations, there was variability in students' descriptions of multimodal features and rationale for modal use.

Keywords: Multimodal literacy, instructional design, learning technologies, project-based learning

Introduction and purpose

Designers of Project-based Learning (PBL) environments and curriculum have been theorizing important roles for technology in PBL for more than two decades (Blumenfeld et al., 1991). The 2017 NMC Horizon Report (Freeman, Adams Becker, Cummins, Davis, & Hall Giesinger, 2017) identified deeper learning approaches, such as PBL, as driving the adoption of educational technology, and predicted that these approaches will have long-term impacts on technology planning and decision-making in K-12 education during the coming years. While implementation literature frequently cites technology tools as integral for supporting inquiry and scaffolding learning, we know very little about how elementary-grade learners use technology tools to create artifacts in the context of PBL (Condliffe, Visher, Bangser, Drohojowska, & Saco, 2016).

This study is part of a larger, design-based research project focused on investigating the integration of science, English language arts (ELA), and mathematics in elementary grades PBL, called Multiple Literacies in Project-based Learning (MLs). In addition to iterative curriculum design, we have been engaged in the iterative design of a suite of digital tools (e.g., Collabrify Writer, Collabrify Flipbook), which play a key role in learners' self-expression, reflection, and collaboration. This study's focus on the use of digital tools in an elementary classroom is consistent with the International Conference of the Learning Sciences' 2018 focus on *exploring learning in real-world settings and understanding how learning may be facilitated with technology*. This study focuses on one third-grade project-based unit (*How can we help the birds that live around here grow up and thrive?*), in which students participated in an "ornithology lab" (OL) that culminated in students developing and presenting digital, multimodal artifacts. In this context, we ask: (1) What did third-graders' digital OL artifacts reveal about their use of multiple modes – image, video, and writing – to communicate information? (2) How did students describe their modal use as they shared their digital artifacts with the class?

The Common Core State Standards for ELA support the integration of multimodal reading and writing in K-12 classrooms (CCSS 2010). However, there is little research evidence to guide elementary-teachers' use of digital, multimodal literacies with their students, as most research on multimodal literacy has been conducted at the secondary level (Smith, 2013). In one exception, Dalton et al. (2015) investigated fifth-graders' digital retellings of folktales, composed in a scaffolded PowerPoint environment. Researchers found that all students' retellings included both written and visual information. Furthermore, student interviews revealed intentionality regarding design choices and an awareness of how different modes work together. While this research is promising, we know little about elementary students' use of digital tools to compose multimodal writing, especially in the context of communicating disciplinary knowledge in PBL.

Theoretical perspectives

Learner-Centered Design (LCD) is an approach to software design, focused on tailoring software specifically for student use (Soloway, Guzdial, & Hay, 1994). LCD draws upon ideas of user-centered design, but also addresses

the specific needs of learners: (a) how they will learn to use the software tools, (b) how the software will support learners' motivation, (c) how to design for diverse learners, and (d) how to account for learner growth. The design of the Collabrify Tools, featured in this study, is guided by these principles.

Both LCD and PBL are grounded in social constructivist theories of teaching and learning. Based on these perspectives, students actively construct knowledge by working together to solve problems and by manipulating and using ideas, a variety of information sources, and cognitive tools (Brown, Collins, & Duguid, 1989; Palincsar, 1998). The tenets of social constructivist theory also suggest that learners benefit from software that scaffolds the construction of artifacts, creates opportunities for collaboration and communicating with others, and includes supports for reflecting on constructed artifacts (Soloway et al., 1994).

Finally, this study focuses on third-graders use of multiple modes and sources of information (e.g., firsthand observations, print and digital text, videos, images) to create digital, multimodal artifacts using researcher-designed technology tools. Multimodal perspectives on literacy assume that people use many representational resources or modes (images, audio, video) to make meaning and that different modes have affordances and constraints for representing and communicating ideas, which influence sense-making (Jewitt, 2008).

Methods, data sources, and instructional context

This study took place in one third-grade classroom with 32 students in a K-5 elementary school in the Midwest United States. On state achievement measures, only 20% of students demonstrated proficiency in ELA. The teacher is an experienced third-grade teacher, and a second-year *Multiple Literacies in Project-based learning* (MLs) participant and user of Collabrify Tools.

The instructional context of the study is one MLs PBL unit of instruction, framed by the driving question: *How can we help the birds around here grow up and thrive?* In the unit, students learned about birds that live in their community, structure-function relationships, physical and behavioral traits, and how traits interact with birds' habitats. As part of the unit, students engaged in an "ornithology lab" (OL), which culminated in the development and presentation of digital, multimodal artifacts to communicate information about a student-selected local bird. Students created the digital artifacts using the suite of Collabrify Tools. The digital applications with which students worked on Chromebooks included: (a) Lesson Launcher (used to support navigation of the digital tools, see Figure 1), (b) WeRead (an e-reader), (c) Collabrify Writer (a multimodal writing tool, in which students enter their own drawings, photographs, videos, and animations, or conduct online searches for images and videos), and (d) Collabrify Flipbook (a drawing and animation tool). Collabrify Writer, the primary tool considered in this study, has the affordance that the user can easily incorporate text, images, and video in a single document, in contrast with other word processing tools. The apps are labeled "Collabrify" because they are designed to support synchronous collaboration among learners.

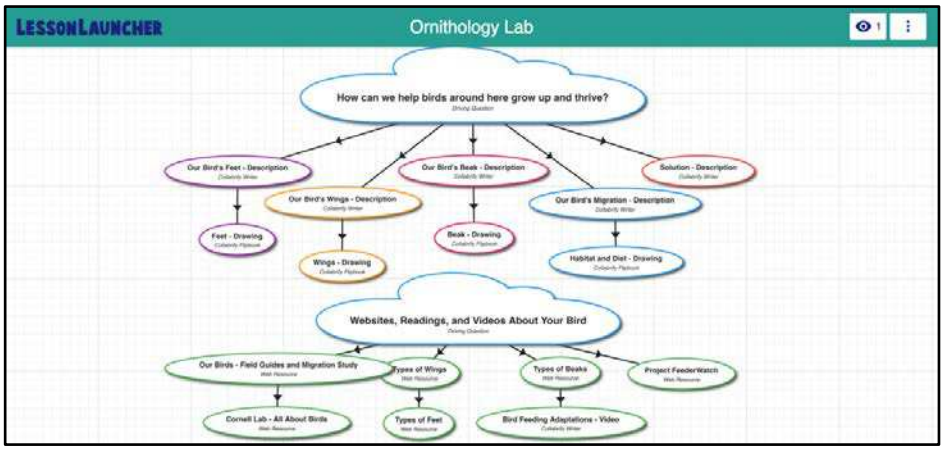

Figure 1. Screenshot of the Ornithology Lab Lesson Launcher.

For the OL, students used multiple print and digital multimodal resources (e.g., field guides, tables, charts, videos, audio, etc.) in order to engage in the work of ornithologists: classifying and describing their bird's physical (feet, wings, beak) and behavioral (migration) traits, and planning and designing solutions to help local birds survive and thrive in their community. Similar to Dalton et al.'s (2015) work with fifth-graders, we

hypothesized that providing a basic structure for third-grade students' digital, multimodal writing within the Collabrify Writer files would support the third-graders to focus on core science ideas in their writing, and alert them to their modal options. For instance, in addition to written prompts that focused on the content of the entries (e.g., Describe your bird's beak.), we embedded prompts within students' Collabrify Writer files that alerted them to options for incorporating multimodal features: (a) take new photos or insert video, (b) select existing photos or videos, or (c) add YouTube video. In addition, students could choose to embed additional multimodal features at any other point within their digital artifacts.

Data sources for this study included student pairs' digital artifacts (e.g., Lesson Launcher, Collabrify Writer, and Collabrify Flipbook files) and field notes, as well as transcribed video/audio recordings of students' presentations of their digital artifacts in class. One goal of this study was to describe the range and frequency of the third-graders' use of modes in their digital writing. We created a modal-use coding system that included the set of modes available to students: writing, image, animation, and video. We analyzed 14 sets of OL artifacts (all entries within 14 groups' Lesson Launcher files) using the four code categories. We then expanded these categories to include subcategories that emerged from the data set (e.g., YouTube videos, own videos, Google Images, etc.). We were also interested in the extent to which students' modal selections were relevant to the written information in their artifacts. Thus, we developed a rubric to assign a score to each image, video, or animation included. A total of 3 points was possible for each multimodal feature: 0 – no feature included; 1 – feature not relevant (e.g., image of a different bird than described) or purely decorative (e.g., "The End"); 2 – feature relevant but not specific (e.g., image of focal bird, but not reflective of description); 3 – feature relevant and specific (e.g., image of focal bird and reflective of written description).

Another goal of this study was to determine whether and how students described their artifacts' multimodal features and modal use as they shared their OL artifacts with their peers. For each presentation, students selected and projected one or more Collabrify files using a SMART Board. First, we viewed and transcribed video recordings of students' OL presentations (8 groups volunteered to present). We read each transcript line-by-line and wrote open-ended analytic memos, and then engaged in open and axial coding (Corbin & Strauss, 2008) specific to modes (e.g., writing, image, video) as well as codes that emerged from the data, such as whether presenters described multimodal features with or without prompting, and how students explained their rationale for including certain multimodal features.

Findings

In response to our first research question, we found that all 14 groups incorporated a variety of multimodal features within their OL presentations: all groups included text; 8 groups included at least one YouTube video; 1 group recorded and included their own video; 10 groups created drawings and 4 of those groups combined their drawings with other modes; 3 groups created animations; 11 groups captured and included their own photographs; all groups completed Google searches for, selected, and embedded images; and 1 group captured and included a screenshot. Also, analyses suggest that the majority of the multimodal features included in groups' presentations received a score of 3 (relevant and specific). For example, of the 102 Google Images included across presentations, 66% received a score of 3 (67 images), 23% received a score of 2 (23 images), and 12% received a score of 1 (12 images). Of the images receiving a score of 1, the majority were purely decorative. These findings suggest that students were strategic (i.e., purposefully choosing multimodal features) and selective (i.e., choosing relevant features that were responsive to embedded prompts and illustrative of their written entries) in the incorporation of multimodal features.

While scaffolds were included to prompt students to incorporate multimodal features (e.g., images, videos, photographs) at specific points in their presentations, all 14 groups included more multimodal features than were prompted for, suggesting that students went beyond the scaffolds in their selection and inclusion of multimodal features. Further, while not all groups used every modal option available to them, all groups *did* include multiple types of multimodal features in their OL presentations, demonstrating flexibility in modal use.

In response to our second research question, analyses of groups' oral presentations revealed variability in the ways in which students incorporated and addressed their modal use when sharing their OL presentations. While some groups did not point out or describe multimodal features as they presented, without prompting from the teacher or other students, other groups independently pointed out and described embedded multimodal features as they shared their presentations with the class. When YouTube videos were included, some groups engaged their peers in viewing and discussing video excerpts. Analyses of groups' oral presentations sometimes revealed students' rationale for including specific multimodal features. Some groups independently described this rationale. On other occasions, the teacher or student audience members prompted groups to explain why they included certain multimodal features in presentations (e.g., Student: "Why'd you wanna [sic] choose those pictures?").

Finally, groups provided a variety of explanations for incorporating specific multimodal features, including that the multimodal features (a) illustrated ideas in their written description (e.g., "We chose this picture because we thought it was going on its migration path and it stopped to get some food."), (b) looked cool (e.g., "…we liked the picture and it looked cool."), or (c) that they were unsure why they included the feature (e.g., "I don't know why...").

Significance

This work is significant because, as Lemke (2004) urged, students need to be able to interpret, analyze, and produce multiple modes of representation in service of communicating disciplinary knowledge. The research literature tells us very little about how to support young students, in particular, to learn to interpret and generate multimodal texts. This study provides evidence that, even in the elementary grades, learners can be supported to strategically and flexibly select, use, and combine multiple modes of representation to communicate disciplinary knowledge. This work also has the potential to inform the design of technology tools that may scaffold students' development of digital, multimodal compositions.

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