Virtual Learning Experiences: A Pilot Study of Technology Integration and Creative Production

Doris B Chin, dbchin@stanford.edu
Rachel C Wolf, rcwolf@stanford.edu
Stanford Graduate School of Education, Stanford, CA, USA

Abstract
This paper presents a pilot study of a project-based learning curriculum using innovative digital technology for creative production. The technology is a platform that allows users to both engage with and create their own interactive and immersive virtual learning experiences (VLEs). The study was implemented with two veteran teachers and their middle-school students during a two month-long climate science project. As a final project, students created VLEs summarizing their learning. Measures include student surveys and teacher interviews, both administered at the end of the study. Survey data indicate that the students enjoyed the technology and felt they learned both from creating their own VLEs, as well as exploring the VLEs of their peers. Interviews with the teachers revealed that they valued the technology for its ease of use and affordances for creativity and collaboration for their students. More importantly, their reflections illuminated how they adapted their pedagogical moves in response to student progress to scaffold the creative process. This included smaller, introductory projects, instructional framing, concrete examples, self-selected teams, and guiding rubrics.

Introduction
In this paper, we present a pilot study of project-based learning using digital technology for creative production in the classroom. We describe the learning context, project details, and technology. We also summarize the student and teacher perspectives gleaned from survey and interview data. We conclude by highlighting particularly interesting pedagogical moves and teacher reflections on creative production with the technology on student learning.

Theoretical Framing
Project-based learning (PBL) is a well-known and well-researched framework for active learning (c.f., Krajcik & Czerniak, 2018; Kokotsaki, Menzies, & Wiggins, 2016; Krajcik & Blumenfeld, 2006; Barron et al., 1998; Blumenfeld et al., 1991). Based in constructivism, PBL experiences are grounded in creative projects that encourage deep knowledge development, application, and reflection. One of the critical elements that sets PBL apart from other forms of instruction is the focus on a final product, one which is created through peer collaboration or iterated on using peer feedback. There is a wealth of empirical evidence showing the benefits of PBL on learner understanding, agency, and motivation (e.g., Larmer, Mergendoller, & Boss, 2015; Geier et al., 2008; Gültekin, 200;). In practice, many questions (and constraints!) arise for teachers when they implement PBL in their classrooms; they must balance the novelty and draw of "learning by doing" with meaningful reflection and learning of the target objectives.

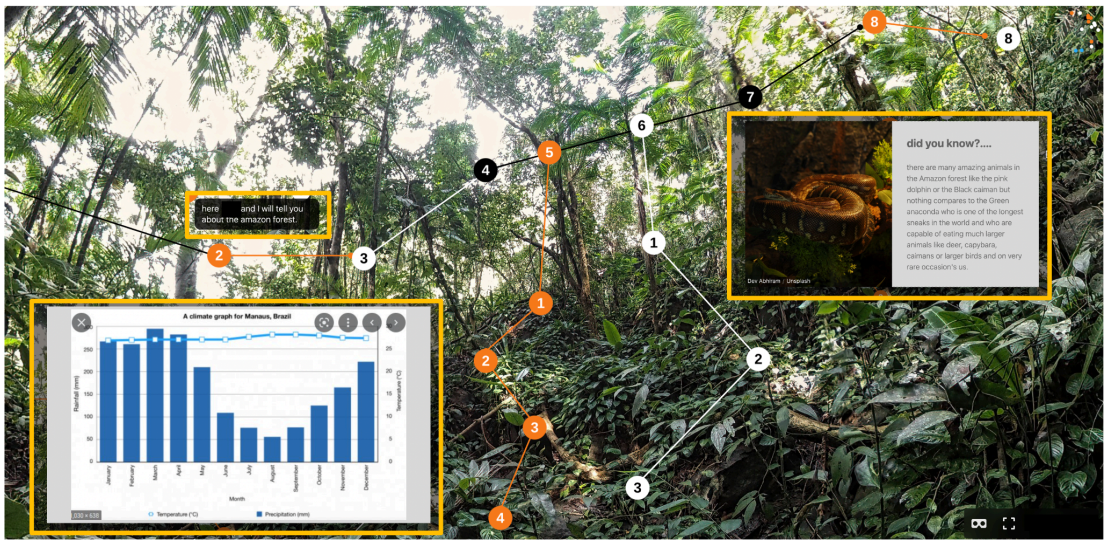
Another learner-driven framework relevant to the projects discussed here and often integrated into PBL is creative production (Ito, et al., 2013). Although digital media and creative production have their roots in informal learning environments, they have been gaining traction as vehicles for learning in the classroom. The continual advancement of digital technologies has opened up new avenues for young people to learn as they explore ways to edit, remix, and create "imaginative and expressive forms… shaped by (their) individual choices and available media." (Ito, et al., 2013).

Virtual Learning Experiences: Creative Production in Action!

Immersive, interactive multimedia editing platforms, such as ThingLink and 360schools, offer users the opportunity to not only engage with someone else's creation, but to act as creative producers themselves. Depending on the software, virtual learning experiences (authors' nomenclature for these products when used in the educational space; VLEs) can be created individually or collaboratively, and can be viewed on a web browser or using virtual reality technology such as Google cardboard.

Use of these technologies across learning contexts is rife for study. How collaboration, knowledge sharing, and instructional framing impact the student experience and learning are just a few of the many questions to explore. The cases described here focus on classroom implementations of VLEs using ThingLink. This platform was chosen because of its affordances for student agency and collaboration in learner-driven instruction. As creators, students must choose a base image, then research and choose *what* media to include (e.g., photos, websites, articles) and then *how* and *where* to embed it in the base image. The collaborative features of ThingLink make it a natural choice for group work, as it supports several mechanisms by which students can work together. See Figure 1 for a screenshot of an example student-created product.

Figure 1. Screenshot of a final student-created VLE biome project. This team chose to guide fellow students through the biome by color-coding and numbering the icons that users can explore. Inset elements boxed in yellow are sample media embedded in three of the icons.



Learning Contexts and Measures

VLEs were infused into a PBL experience around climate science and data literacy, centered around the early springtime phenomena of red oak budding and bird migration. The study involved two veteran, middle-school teachers, each with 20+ years of experience (but little to no experience with VLE technologies). Ms. A's all-subjects class consisted of a small group of 11 5th-8th grade students; Ms. B carried out the project with her two 6th-grade science classes (28 students). The teachers were from different schools, and independently created lesson plans for their students' outdoor learning experience; students were observing birds and buds, collecting data on the organisms as well as environmental conditions (e.g. temperatures, precipitation). As the capstone assignment, students created VLEs summarizing the two-month long project, collaboratively capturing images and researching content to share what they had learned.

During preparation for the larger climate project, both teachers recognized the need for smaller lessons to "practice" using the technology. Ms. A elected to introduce her students to VLE technology with an "easy" week-long history assignment: choose an iconic photograph from 1960s U.S. history and create a VLE that would teach someone about the event. After finishing their projects, students were instructed to explore and learn from each others' projects. Ms. B opted to complement the phenology project with a project about global biomes. Student teams chose a biome to investigate, researched the organisms and their interactions that were typical of that environment, and then created a VLE to teach other students about their biome.

At the end of the study, students were administered a short online survey, consisting of six-point Likert items probing the student experience through statements beginning with "*I enjoyed…*" and "*I learned from…*" followed by some aspect of the creative production process. The survey also included an open-ended, visual item: students were shown a tree diagram with various characters presenting positive, negative, or neutral affects at different heights and asked to choose which character best represented their experience. Also, each teacher participated in a 60-minute interview. Student measures and teacher interview questions explored:

1) What is the student perspective on their learning experience?
2) What are the teachers' insights on how their students were learning with the technology?

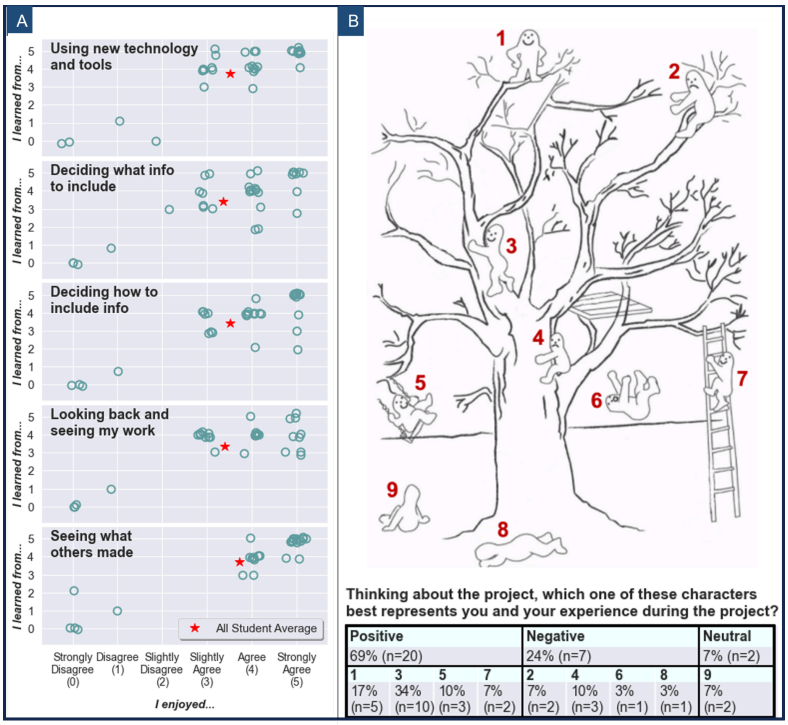
Findings

Due to space constraints, the present work focuses on the student and teacher experience during these projects; features of the student products are discussed in Authors (in prep).

Student Experiences: Figure 2A shows scatterplots of responses to five Likert-scale items. Across the five items, there are strong correlations between self-reported enjoyment and perceived learning. On each of the items, 75-88% of students (n=32) said Agree or Strongly Agree on at least one of the scales (Enjoyed or Learned). Viewing each others' VLE products had the highest combined rating, with 78% of students scoring Agree or Strongly Agree on both scales.

Figure 2B shows the visual tree item and a summary of student responses. 76% chose a character with positive or neutral affect and 68% chose a character midway or higher on the tree (1-4), indicating a high or good "sense of

Figure 2. A) Student responses to 6-point Likert scale items. **B)** Tree diagram and student responses. Chars 1, 3, 5, and 7 were grouped as positive affect (smiling); chars 2, 4, 6, 8 negative affect; and char 9 neutral.



accomplishment" in their progress. Table 1 provides example explanations for their chosen character.

Table 1. Tree item sample student responses: *We want to learn more about your experience! Please share why you picked that character.*

Char	Student response
1	I found it really fun and enjoyable and I learned a lot throughout this experience.
2	… because while I was climbing to the top of that tree, It was a little difficult to get used to … the projects I did were also a bit confusing, so it didn't make it much easier. But, in the end, I was ok.
3	[I had] some ups and down like finding enough information but for the most part it was pretty fun.
3	…he looks confident…but not so confident that he would dive in without help or instructions.
3	I had understood and learned a lot through this experience. Although it wouldn't be my favorite activity/project.
4	The people in my group didn't work at all and just watched me do everything!
5	…because I had fun but I have never had a huge interest in these kinds of things.
6	Because I try to work but it's hard so I need other people around to help me.
7	…it represents my learning and how I was/still climbing up a ladder progressing and learning.

Teacher Perspectives: In their interviews, the teachers recognized the challenges of a project in which students were simultaneously learning a new technology and had autonomy around product creation and sharing. Their comments revealed that they each made pedagogical choices to address some of these issues. For example, both teachers framed the VLE creation in service of "teaching someone something new." They also emphasized their beliefs that this instructional framing would engender a greater sense of responsibility in their students, and consequently deeper understandings of the content, a move supported by the research literature on peer teaching (Dineen, Clark, & Risley, 1977; Chase, Chin, Oppezzo, & Schwartz, 2009; Galbraith & Winterbottom, 2011).

Teacher A: To scaffold student learning of the technology, Ms. A first created her own example history VLE for her students to explore. It was relatively basic, consisting primarily of text-based information. In her post-interview, she shared some of her reasoning for her learner-driven approach: "*I don't think kids learn by what teachers tell them. Kids learn by doing stuff.*" For their own creations, she emphasized that what event, what facts to include, and how to include them were entirely up to the students.

Though only just introduced to the platform, Ms. A eagerly described the appeal and advantages of VLEs for her students, both as consumers and creators: "*[This] generation is a very visual generation…[the platform] speaks to them…the kids took to it quickly."* She praised the medium for supporting student agency and allowing "*the learner [to] drive the order of information,"* explicitly contrasting it to digital technologies like Keynote and Powerpoint as "*presenter-driven*" and "*linear.*" Ms. A also believed the choice-driven nature of the design process was essential for a richer learning experience for both the creator and consumer as it encouraged the "*breaking [of] information into smaller chunks.*" For example, student use of embedded quiz features forced creators to *"make decisions about what they want a learner to get out of their project."* Upon reflecting on her students' VLE experience as a whole, she remarked,

"*It helps them do a synthesis and analysis level of learning...a higher level of learning. They can bring different ideas into a single space."*

Teacher B: Ms. B had implemented similar biome projects in previous years. In this iteration, she used the new technology in lieu of more traditional classroom methods, e.g., presenting written "reports" or posterboards. Two primary pedagogical moves complemented this instructional switch. First, she prompted students to self-select their teams. She believed this would both encourage the students to engage in the reflective practice of self-monitoring and to help each other with the technology: "*if your partner doesn't do the work, you need to figure it out with them because you chose them.*" Second, she scaffolded the creation process by creating a rubric that combined a series of technological (e.g., graphic creativity) and science content-focused elements. Interestingly, she placed the graphical elements prominently at the top of the rubric and included human-impact and data-focused (e.g., charts, tables) content elements. The rubric allowed teams the freedom to follow their interests, but also clear guidance for the types and levels of information expected in their VLEs. Ms. B also periodically prompted the students to refer to the rubric as a tool to monitor their progress.

Ms. B reviewed their products for final assessment, but also explicitly set aside time for students to explore what other groups had made. Reflecting on her observation of the students' experiences, Ms. B felt that placing high value on creativity and agency was a driving motivator for her students: "*ThingLink is perfect for the biome project. It has everything for exactly what they needed to do…they're excited about working on it…."* Similar to Ms. A, she commented that students' having to decide what information they wanted to share and how to connect it to visual media immersed them in their own projects and others' final products in a unique way.

Discussion

This work described a pilot study of student and teacher experiences with a PBL unit using multimedia editing technology. Through their survey responses, students reported enjoying multiple aspects of the creative production process and that agency and sharing enhanced their learning. This was supported by their free-response reflections about the experience as a whole, with a majority of students indicating they had a positive experience and commenting on topics such as their growth, confidence, and just having fun.

This energy was palpable to the teachers as well, whose reflections on the student experience complemented the student data. As shared by Ms. B, *"It helped them learn because they were looking for very specific information and they had to figure out where to put it ... they think a little bit more about it…kids like the ability to connect information to something visual."* Both teachers were confident that their students learned from the experience, identifying the importance of collaboration, feedback, and peer-to-peer and peer-to-mentor learning: "*The kids are actually helping me figure it out! … [in helping others] they've learned that you can't give the answer. You have to kind of give them a walk-through of the process. What they've learned from that is that helping someone else learn cements it up here* [points to head]*."*

While the technology itself was an opportune vehicle for students to "mess around" and in some cases, "geek out," perhaps more crucial was how these expert teachers facilitated a deeper learning experience for their students. Framing took center stage, as various versions of "teach someone" motivated students to collaborate and create rich VLEs. Distinct scaffolding strategies emerged with simple first assignments, examples, and rubrics. They also adapted pedagogical moves in response to students' interactions with the technology and enjoyment in the creative process. For example, after observing how much their students were invested in and

proud of their VLEs, both teachers explicitly included share-out time, allowing students to show off their creations, to teach and learn from each other. This was all made possible, in part, by the teachers' recognition of similarities with other technologies, enabling them to adjust their normal pedagogical routines to accommodate this new medium for collaboration and sharing (Ertmer, 2005).

As educational technologies such as VLEs become more widely accessible, a teacher's instructional toolbox can start to overflow with new ways for their students to learn and share their learning processes. This means that educators seeking to use these technologies must build on their existing pedagogical and content expertise to facilitate effective implementation in the classroom (Koehler and Mishra, 2009). Teachers such as Ms. A and Ms. B can help lead the way: Ms. B, *"It's such a good platform for kids…being able to manipulate where things are and get that full vision all the way around…more immersive…they were really invested in it."* and inspire new ways to use the technology: Ms. A, *"...next year, I would absolutely use it in every aspect of my curriculum. 100%!"*

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