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"We're doing things that are meaningful": Student Perspectives of Project-based Learning Across the Disciplines

Emily E. Virtue
Clemson University, evirtue@wcu.edu

Brandi N. Hinnant-Crawford
Western Carolina University, bnhinnantcrawford@email.wcu.edu

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SPECIAL ISSUE: UNPACKING THE ROLE OF ASSESSMENT IN PROBLEM- AND PROJECT-BASED LEARNING

"We're doing things that are meaningful": Student Perspectives of Project-based Learning Across the Disciplines

Emily E. Virtue and Brandi N. Hinnant-Crawford (Western Carolina University)

ABSTRACT

Supporters of project-based learning (PBL) argue that outcomes from the model include better performance in academic (Bell, 2010; Thomas, 2000) and non-academic outcomes (Saunders-Steward, Gyles, & Shore, 2010). The New Tech Network (NTN) is a school improvement network that provides training and development for high school faculty who commit to using project and/or problem-based learning as the primary instruction methodology (New Tech Network, 2017). This study uses qualitative data to investigate student perspectives of PBL across multiple disciplines at the high school level in NTN schools. Results suggest that students find value in the "hard work" they engaged in whilst completing PBL tasks. Moreover, students can articulate the value of their work and its applicability to a "real-world" setting. We argue that for PBL to work effectively, approaches to PBL from an interdisciplinary perspective must be balanced.

Keywords: project-based learning, New Tech Network, interdisciplinary

Introduction

In recent years, a number of teachers have embraced a curricular shift from traditional teaching methods to that of project-based learning (PBL). Supporters of PBL argue that outcomes from the model include better performance in academic (Bell, 2010; Thomas, 2000) and non-academic outcomes (Saunders-Steward, Gyles, & Shore, 2010). While previous—and many would argue current—high school curriculum has been concerned with preparing students to academically succeed in quantifiable measures (i.e., state end-of-grade assessments, SAT, and ACT scores), such strategies often fail to include the opportunity for prolonged problem-solving and critical thinking. Yet, those who embrace PBL argue that a shift has occurred and that PBL lends itself to such non-academic outcomes as problem-solving, critical thinking, and making curriculum connect to "real-world" issues in addition to traditional, academic outcomes.

As educators embrace pedagogical approaches to prepare citizens for a postindustrial, information age, the "what" that students must know has changed. McPhail (2018) notes that one of the hallmarks of this curricular shift is that "the emphasis in educational discourse has moved away from knowledge content to focus almost exclusively on process; skills and learning to learn" (p. 71). In the eyes of educators who have embraced PBL, there is much promise for student outcomes. Not only will students do well on the ever-present quantifiable measures of knowledge in high school (particularly standardized tests), but they will also perform well in other areas. Yet, McPhail (2018) argues that educators and researchers should not paint too broad a brush in terms of the merits of PBL:

> While there is logic to the idea of engaging learning through contexts that connect to the real world, such approaches do not automatically invoke the foundational, generative, and the difficult concepts of

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> disciplinary thinking that bring with them the development of abstract, critical thinking; the means to confront real-world problems. (p. 71)

Using PBL is not a carte blanch method to guarantee students do more than merely memorize information that may appear on a future test. Because PBL practices and methods are so varied, it can be hard to determine what their value might be. To better understand how PBL is being used at the high school level, this study investigated how interdisciplinary use of PBL is conducted in New Tech Network (NTN) high schools. The research question that guided this study was: What does PBL look like across the disciplines, and how do students perceive the impact of PBL?

Literature Review

Project-based Learning and 21st-Century Skills

While PBL has been used for many years with various age-groups, scholars have struggled to define what it looks like in practice. However, there are a number of defining features that outline the goals of PBL. Ravitz (2010) explains, "PBL is a constructivist-based instructional approach that is designed to support more engaged learning. This approach uses 'projects' as vehicles to encourage student motivation and to provide a means for demonstrating and explaining what they have learned" (p. 293). The goal of PBL, therefore, is for the students to not only understand a concept, but to explain its importance and application to their learning. In other words, *why does this concept matter to me, my peers, and our lives outside this classroom?* PBL is one method purported to support deep learning.

Deep learning and has been studied extensively in the past decade (Huberman, Bitter, Anthony, & O'Day, 2014). Deep learning refers to "an ability to apply [that] understanding to novel problems and situations, and a range of competencies related to human interaction and self-management" (Huberman, et al., 2014, p. 1). Indeed, network schools in particular are based on the premise that there is value in deep learning practices that often result in better academic and non-academic outcomes than teaching methods that do not support deep learning (Huberman, et al., 2014).

In addition to the goal of increased content knowledge and application, PBL can foster a positive learning environment and relationships between peers and instructors. These environments and relationships are one essential component of effective PBL work. Ravitz (2010) argues that, if projects are to succeed, they must also have a quality design that will encourage the students to work hard to complete the goal. Boyd and Hipkins (2012) explain that learning is meaningful when the problems addressed are relevant to students and the "real-world." One way in which instructors make PBL meaningful is through community partnerships. These partnerships have a "positive effect on students' perceptions of learning" (Mosier, Bradley-Levine, and Perkins, 2016, p. 13). Mosier and colleagues expand on this notion and found positive relationships between the use of PBL and engagement, 21st-century learning, community culture, and school culture. Each of the outcomes are goals of the New Tech Network model.

The prominence of 21st-century skills in recent literature suggests that educators and stakeholders are concerned with non-academic outcomes in addition to traditional, academic measures of success. Conley (2007) argues that intellectual openness; inquisitiveness; analysis; reasoning, argumentation, and proof; interpretation; precision and accuracy; and problem solving are key cognitive strategies related to college success (pp. 13–14). These strategies, as Conley presents them, are the basis for success in college, as they serve as a baseline for deep thinking and prepare students for the expectations of college-level work. Such skills need to be measured at the high school level so students and their teachers can ensure proper college (and career) readiness.

Reform Models

As school and district leaders have faced low-test scores, or a lack of engagement, reform models have risen in popularity to address struggling schools' need. Many reform models employ PBL as a chief mechanism for changing outcomes. Ravitz (2010) states that reform model schools are "setting the bar" (p. 308) for PBL use and student culture transformation. Fleishman and Heppen (2009) explain that reform outcomes are considered "mediators of improvement" (p. 110). They outline five outcomes that reform models address: (1) a "personalized and orderly learning environment," (2) poor academic skills, (3) "improved instructional content and practice," (4) preparation beyond the high school classroom including higher education or career readiness, and (5) "positive change in overstressed high schools" (p. 110). There are numerous reform models present in high schools around the nation today. While not all reform models rely on PBL, many have. Some schools have seen a dramatic change in student outcomes as a result of school reform, though Borman's (2002) meta-analysis found that comprehensive school reforms that have been in place for five years or more are the most effective.

New Tech Network as a Reform Effort

The New Tech Network is a "leading design partner for comprehensive school change" (New Tech Network, 2016) that prioritizes PBL in the classroom and professional development of school teachers and leaders. While the New Tech

Network boasts strong academic outcomes from students enrolled in their institutions (Data Report, 2017), less is known about students' perceptions of their coursework. Teachers in NTN schools observed "high levels of motivation, engagement, and performance" (English, 2013) in their PBL classrooms, yet the voice of the students is often missing. This may be due to the challenges in collecting data directly from students given the level of oversight many school districts have over protecting instructional time and limiting researcher interaction with students (and rightly so). This study, however, seeks to fill that gap in the literature. In NTN schools, students are "more likely to have developed views about their school experience" (Mosier, Bradley-Levine, and Perkins, 2016, p. 4), yet little is known about this experience, and much of it is in the form of quantitative data. This study provides a more in depth look at how students in NTN high schools view their experience with PBL.

New Tech Network's Approach to Project-based Learning

As Ravitz (2010) pointed out, each teacher's approach to PBL may be different. The New Tech Network (and those employed in the schools) is no different. However, understanding how NTN goes about training and supporting their teachers is vital to the context of the study. Rather than training teachers to implement specific projects, NTN focuses on professional development for the educator (New Tech Network, 2016). This training, which may take place in face-to-face conferences or summits, virtual workshops, or on-site (at the school), allows teachers to learn the skills to implement PBL but gives them the freedom to develop projects based on their student and classroom needs. Frequency, scope, and scale of projects are determined by the classroom teacher.

In addition to training, NTN utilizes their own "collaborative learning environment" called "Echo." Echo is an online Learning Management System (LMS) that "supports project-based learning and features an innovative gradebook that aligns to deeper learning skills" (New Tech Network, 2016). Tools within Echo allow both teacher and student to focus on skills rather than traditional assessment of assignments. Additionally, Echo serves as a platform for NTN members to share and collaborate on projects.

Interdisciplinary Study

Literature on connecting course content takes many names. Two of the most common ways to qualify this approach to learning are the terms *interdisciplinary study* and *curriculum integration*. For the purposes of this study, we will use the term "interdisciplinary study" to be consistent, though other authors have used different terms. Despite the change in nomenclature, all of the terms refer to how instructors have combined subject material to better engage students in course content.

Interdisciplinary study, according to Corney and Reid (2007) is based in constructivist approaches to learning that allow the students to be co-constructors of knowledge. The benefits of interdisciplinary study have been well documented. Jickling (2003) argued it exposes students to the plurality of thinking that helps them develop perspective. Boix Mansilla, Miller, and Gardener (2000) describe one of the expected outcomes as *cognitive advancement* because students "integrate knowledge and modes of thinking from two or more disciplines in order to create products, solve problems, and offer explanations of the world around them" (p. 18). McPhail (2018) says connecting subjects was a way to "hook-in" students who would otherwise be less interested in one or more of the subjects. Beldaro, Burrows, and Dambeklans (2017) found that combining art and science, in particular, "brings personal meaning and relevance to an individual's learning experience" (p. 217). This study explores students' perspectives of interdisciplinary PBL and helps us better understand how students are impacted by their PBL experiences.

Student Perceptions of PBL

Some recent literature on PBL classes and student perception exist, though are focused on nuanced questions pertaining to perception of the problems offered in PBL (Sockalingam & Schmidt, 2011), graduate student learning (Dabbagh & Blijd, 2010), or primary student perceptions (Chu, Tse, & Chow, 2011). Specific concentrations of literature exist that highlight student perception of PBL including undergraduate engineering students (Dym, C. L., et al., 2005; Mills & Treagust, 2003; Palmer & Hall, 2011; Yadav, et al., 2013) and middle school students (Martelli & Watson, 2016). Palmer and Hall (2011) found that in one PBL course, students found the teamwork and use of "real-world" applications to be valuable but noted that such projects demand a large amount of time and that the work of the team members is often unequally distributed (p. 363). Yet, student perceptions of PBL that are discipline specific and largely housed in higher education classrooms do not shed light on the experience of high school students engaged in PBL in a range of disciplines. This study seeks to increase our understanding of the high school student experience.

Methods

This study is part of a larger concurrent-triangulation mixed-methods study that compares outcomes of non-New Tech enrolled students to their peers enrolled in New Tech Network high schools. For the purposes of this study, phenomenological data were collected in focus groups (N_{groups}= 5 $N_{participants}$ = 28) from five New Tech Network schools. The size of each focus group varied between 4 and 7 participants.

Focus group participants were randomly selected from students who returned consent forms, with some stratification with regards to gender. While the goal was to have heterogeneous groups to account for a variety of perspectives, there was some segmentation since all students in each focus group were juniors from the same school. The research questions that guide the study are: What does PBL look like across the disciplines, and how do students perceive the impact of PBL?

Data

Data were collected in three states containing schools within the New Tech Network: Michigan, Texas, and North Carolina. All participants (n = 28) were high school juniors enrolled in a NTN school. Focus groups were conducted by one or both authors during the lunch period in a private space within the school. Students were assured their responses would remain confidential and no faculty or staff would hear their comments with identifiers (all names used throughout the text are pseudonyms). The focus group used a semi-structured protocol, and students were asked about their experiences with PBL curriculum and their perceptions of how use of PBL impacts their educational experience and personal development. Research questions were not posed directly; instead, students were asked to describe their favorite assignments and teachers and to expound upon why they were their favorites. Though students were not directly asked what projects they did not like, many students offered their perspectives of projects they did not care for. All groups noted that they preferred projects (i.e., sustained time and inquiry) to assignments (e.g., worksheets and daily homework). Participants were also asked to identify aspects of the school they did not care for. After collection, audio recordings from each focus group were transcribed by the researchers.

Analysis

Transcripts were coded by theme using Saldaña's (2009 cycle coding. We began with a priori coding. Saldaña (2009) notes that the use of a priori coding can enable an analysis that directly answers the research question. Deductive coding is also useful when there is a team of researchers, so they begin with a baseline of codes and a common understanding of what the codes mean to aid in interrater reliability. Our coding approach was also provisional. As different themes emerged beyond the a priori set, they were added to the codebook (see Appendix for list of codes). Analytic memos were written after each round of coding.

Results

Multiple themes emerged from the focus groups about the benefits and potential drawbacks of employing PBL as a signature pedagogical approach across multiple disciplines. Students perceived some subjects to be better suited than others, yet gave examples of PBL in all four primary academic disciplines.

PBL Across the Disciplines

Some Subjects Work Better Than Others. Throughout our focus groups, we asked students to report on their favorite assignments in each subject. While many projects and classes were interdisciplinary, the students often focused on the course that the project favored.

Math. Students always seemed to struggle to come up with a favorite assignment or project in a math class. In one school where classes were designated New Tech (instead of the entire curriculum following New Tech guidelines), they explained math was not always a New Tech class. When given time to think about the distinction, the students explained why math was not offered as a New Tech class. Marcus explains:

> Last year I was in the New Tech math class and he was really good. It wasn't really . . . I think that's the reason they got rid of the New Tech math, because that's not offered anymore for New Tech. It's just normal math. Because there is not a lot you can do, I think, with the New Tech portion of it.

Marcus's experience demonstrates how difficult it can be to develop a PBL curriculum, even if it is only in one subject. His own experience reflects the belief that mathematics course material does not lend itself to the PBL model. Marcus could not even envision a way that math is project related. Participants often described traditional mathematics courses, where teachers demonstrated problems and then students practiced with support and independently.

Though Marcus struggled to see how PBL could be used in a mathematics course, other students illustrated the seamless integration of PBL into their mathematics courses. Luke explains that even though the project he remembers was difficult, the end product was satisfying:

> One of my favorite projects was when we…it was actually really hard, but in the end seeing it all put together, it was really like, cool how we did it. It was like a golf course that we set up. We would have to create a bunch of holes and we would have to find the trajectory of the angles and the objects in the way. And so, once it was all put together, it was nice to see how it all worked out.

For Luke, the most memorable part of the math PBL experience was the hard work and the end product.

Still others remembered that their project, while not interdisciplinary in terms of course content, connected a number of different considerations beyond math calculations. Landon explained a project in which students had to design a bridge. A crucial element of the project was the

connection to a competition judged by the state's department of transportation. Here, the students were not just designing a bridge to test its weight capacity; they were also submitting their work to be evaluated by external experts (a "real-world" audience).

> Basically, what we did was we had to design and build a model of a bridge and you have to figure out like all the math and there are certain requirements for what you have on it. Like, the length and height and everything. Then, depending on how you had to write a proposal and find out all these things about each group member and you'd submit your proposal to [the state department of transportation].

The prospect of working with a state entity made the project more authentic. In addition to figuring out the math and physics that would allow their bridge to support traffic, the students also had to consider their audience in the writing of the proposal. This experience not only helped them demonstrate their mathematics knowledge, but also helped them develop professional skills such as communication.

Finally, some math projects, though conducted in the math course, were still interdisciplinary in nature. Three students explained their semester-long math project involving zombies:

> John: Exponential. That's what I was thinking about. So, like exponential growth and decay. So, it was like a zombie project, that's what it was based around. So, we did like a whole semester based on zombies. So, the first part was like, making a sound device that would like, you know, get the attention of zombies away from you and the second part, which was kind of like, more math oriented was seeing like, in a population how you could either decline or increase exponentially with like, zombies being in the world. [*Laughter.*] So, like that was a really interactive project.
>
> Julie: We also included like, um,
>
> John: Diseases.
>
> Julie: Diseases and like, jobs that people would do. And like, like how much money and resources you would have to do and I thought that was a fun project.

Though the students were not necessarily studying epidemiology or economics, their mathematics project required them to think outside of solely their math curriculum. Such musings, while perhaps not explicit, demonstrated to the students how mathematics was connected to their ability to solve larger, more realistic problems (e.g., the problem was not just stopping zombies, but how to prevent further infection and how to account for the resources necessary to save mankind).

Science. Interestingly, many science projects, particularly in Physics, resembled math projects. To understand force and trajectories, students built catapults and launched pumpkins in Texas and shot Nerf guns in Michigan. Despite what would seem like a natural alignment, discussion of science assignments lacked enthusiasm and were the least talked about among our participants. When students did discuss science projects, many connected them to the medical field. Angela explains her favorite assignment:

> We got to um, each group was sorted in to a different category of a neurological disease. So, like stuff that effects your brain and your nerves and everything. And my group specifically got Alzheimer's Disease. And that was really nice because my great grandma has Alzheimer's and then another girl in my group, her grandpa has Alzheimer's so like, we got to learn about stuff that related to us and our families as well as a bunch of stuff that happens to people everywhere every day. And it wasn't just that disease. Other groups had different diseases so that project was really helpful to a lot of kids in that class. Because most of the kids in our human body systems class plan on going into the medical field. So, they need that information.

Angela was able to relate why the project and the class material were important to her and her peers. Her science course, Human Body Systems, was not a traditional class (i.e., biology, chemistry, or physics). Rather, its focus was interdisciplinary in nature, as it seemed to cover anatomy and the practical application of knowledge, much like a traditional health or wellness course would.

Humanities and Social Science. English and social science courses seemed to be the most consistent in their use of PBL to drive the curriculum. Instead of driven by a fact or standard, they were often organized around themes. One focus group spoke in detail about an "end of life" theme driving their English course. They read stories about the end of life and wrote unconventional writing assignments, like eulogies. In American Studies, a combination of History and English, students explored the theme of social justice, and in groups students had to teach their subtheme to their class. Elizabeth explains:

> So last year, we had right at the end of the year in American Studies we had a project where we had to teach the entire class for like, the entire class period which was about an hour so we had to come up individually with different activities for our class to do and we made like power points and stuff. And I really appreciated not only having the opportunity to do that project

but watching what other kids came up with because we . . . I really feel like I learned a lot from the other groups and we each chose a human right . . . or . . .

Joey: Civil Rights?

Elizabeth: Was it Civil Rights?

Alana: It wasn't necessarily civil rights, it was social justice.

Elizabeth: Social Justice, yeah. So, my group and I, we got Women's Rights so it was really interesting to just go back and dive in to where it all started and who were the initial instigators of what has now become you know the Women Equality and so that was really cool. So, other groups did things such as, there were children's rights, animal rights, geriatrics rights, and so it was really interesting and I really loved being able to go up there and present and talk about what I learned and demonstrate that.

Elizabeth appears to appreciate the opportunity to share her knowledge with an audience, even if the audience is her peers. In the humanities and social sciences, which were sometimes paired together in courses like American Studies, debates were a common occurrence. Sixty percent of our focus groups mentioned debates. A common characteristic of the debates is that students were not able choose what side of a debate they would argue. This forced the students to take up topics they did not necessarily agree with and also increased the amount of research required.

Dion: Oh, the debates! [*Everyone says, oh! in agreement*] It got so heated.

Lilly: People would come for each other! [*Everyone talks over each other and laughs for a moment*]

Dion: I was trying to say something and this girl was coming at me and was like, "according to getyourfactsright.com . . .

Amaré: We started naming like, fake sources. It was so fun and so real. I had like twenty million tabs open for like the whole duration of that project.

Lilly: And even if you didn't agree with the category you got, you still wanted to defend it.

Despite their laughter and colloquial expressions like "coming for you" and discussion of naming fake sources, also evident in Amaré's statement was their research for the debates. The participants discussed the research and preparation for the debate, but she also demonstrated her constant fact checking when she said she had "twenty million tabs open" during the debate.

While students tended to believe that some subjects were easier to do projects than others, their reflections show PBL can be integrated across the curriculum.

Difficulty Can Outweigh Value. Participants viewed interdisciplinary classes as conceptually valuable but practically difficult. Interestingly, in each case where students discussed how difficult it was to connect the two subjects together, biology was always one of the two classes. In our study, we found biology courses were connected to an art class, a literature class, and a chemistry class. In these examples, students remarked that the connection felt "forced" or uneven. The content from one side of the class would often overshadow the content from another. In one school, this distinction was so pronounced that students noted that one of the teachers who taught in the combined course seemed "clueless" about the course material or how to help. In a co-taught course that combined geometry with graphic design, students recognized the differential knowledge the co-teachers had, and it seemed as though the course material was taught in a parallel manner rather than co-taught, as if the instructors had not strategized how to integrate material. In these examples, students complained that projects with combined disciplines leaned heavily on one discipline and focused less on the other discipline, and at times these projects felt strained or even convoluted. Though students could understand, theoretically, why the courses were combined, the practicality was often too difficult for students and instructors to master.

For PBL to work effectively (and perhaps, more importantly, for students to feel as though they gained something from the experience), approaches to PBL from an interdisciplinary perspective must be balanced. We recognize that combining courses can be an intricate problem to address, as two instructors must align their course goals, content, and calendars to make the connection between the courses explicit and effective. While these goals can be accomplished, it should only be done if both teachers believe in the value of the project and can maintain the structure to do so. As the students in our study reflected, when the teachers do not have a good working relationship, it is obvious to their students and can affect student performance and motivation.

Perceived Impact of PBL Across the Disciplines

Satisfaction. Students believed they were engaged in "hard work" while working on PBL assignments and in the related classroom setting. These perceptions were met with a sense of value and reward for hard work. Students recognized that while some disciplines lend themselves to creativity and project-based work more readily than others, there were rarely times when they could not see the value of engaging in the assignment. Excitement and enthusiasm for PBL was

palpable. Students felt lucky to engage in this type of curriculum and felt bad for those who were not enrolled in New Tech schools. Julie describes why she came to an NTN school:

> I went to [. . .] the traditional high school my freshman year and like, the reason I switched, because I saw so many people doing like, team and group work. And I thought that would be better for me, and like, when I switched I had the chance to switch back and I wasn't going to. This was something that not everybody gets to experience and I thought it was pretty cool.

Most students cited PBL as the reason they enrolled in New Tech schools. Mike says, "The way you tackle problems, the way you have to collaborate...it's not something you can emulate through a textbook or reading about it or watching videos. You can't emulate it." For Mike and his peers, the experience of working in an interdisciplinary capacity is incomparable to a "traditional" high school setting.

Doing Something That Matters. One of the reasons students enjoyed the interdisciplinary PBL model was the emotional outcome of their work. They explained that while completing a project was in and of itself a satisfying accomplishment, what was most valuable to them was knowing their work was important to others. This was particularly true in projects that connected the students with community members. For example, one school coordinated a fall community fundraiser and required the students to demonstrate their physics projects to community members (by building a catapult). In addition to volunteering at the event by running game booths, students interacted with community members, demonstrated their knowledge, and raised money for community charities. One student said, "It doesn't feel like work because you're doing things that are meaningful to you."

While administrators and public officials might say the most important learning outcomes are "proficiency" or the ability to complete a grade, students in our study would resoundingly say "it has to apply to real life." This was the most often-cited benefit to the student experience, one that students not only explained thoroughly, but excitedly. Amaré explains:

> They [teachers] are always finding ways to connect it [the course material] like with the Health/Wealth, all of the business partners. Like we see how it works with World Studies and the pizza company [. . .] these little things that we don't realize we use all the time, we actually do use all the time.

Amaré and her peers marveled at how, upon reflection, the skills they had learned by completing the projects were useful when they collected surveys and helped run a local health and wellness fair. While they did not actively think, *Today, I need to use the information and skills I learned from my project,* they were able to identify their ability to do so after the fact. The students found that their experiences running the fair, though time consuming, were fun and productive. Their positive interactions with community members reinforced these feelings.

The connection to real-life situations was not always in the form of community interaction or addressing a real problem. Students also remarked about how interesting and impactful their projects were when they were based on real-life events in the news. To better understand the connection between biology and political science, students were asked to solve a rape case using victim DNA and testimony. The situations presented in class drew from recent topics in the news. The students reflected how difficult it was to prove their assigned side of the case given the evidence they had. This gave them a better understanding of the intricacies of both the science and human factors of such cases.

Finally, students pointed to the maturity they have developed as a result of their class work. The challenge of working with one another on numerous problems with conflicting perspectives has given them the tools to engage in material in a mature manner. One student explains:

> [W]e had a discussion about gun control in one of the classes, an open discussion, and there was no fighting. There was no animosity. Everybody was listening to one another. We didn't necessarily all agree with one another but it's the fact that we can sit down and have these adult conversations and not look like idiots like Hillary and Trump did. [*Everyone laughs.*] But no, like for real, we can communicate with each other and we're so much more tolerant and accepting of other people's ideas. Even if we don't agree we have learned to respect them.

Despite there being differences of opinions, the students recognized the changes they experienced as a result of their classroom challenges. Because they learned about different perspectives and ways of thinking in the same class, they were able to consider arguments that related to their own lives and values.

Perceptions of Productivity

Students demonstrated that they thought about the outcomes of their time working in a PBL context. They were keenly aware of how they completed their work, how it compares to their peers in non-PBL classrooms/schools, and what the drawbacks of PBL might mean for them.

Falling Behind. While acknowledging the benefits of engaging in project-based learning, on occasion students would mention perceptions of setbacks.

> The only thing that bugs me is how in doing projects, we'll focus on a certain chapter that we're learning and we have, you know, a few weeks to do it and you talk to the regular chemistry classes and they are so far ahead. I feel like in New Tech we don't get to learn everything we could be learning in a whole school year.

While the depth of their learning may be significant, students seemed concerned that they were falling behind their peers academically.

Perceptions on Assessment. Collaboration is a key part of project-based learning, and students in each focus group spoke of the role of collaboration in their approach to projects. Yet, in their discussion of collaboration, each group brought up assessment, both peer feedback and instructor feedback. They raised concerns about how collaboration may detract from the fairness in assessment while applauding the opportunity to learn and revise based on feedback from peers. For example, in an American Studies class (which is a combination of U.S. History and English), students described a feedback loop, where they received both formative and summative feedback from peers on a presentation:

> Lisa: Typically, you do something like, if a group is presenting, sometimes a teacher will have them take a piece of paper and write down a certain amount of things they learned and then like, good and bad things about the presentation.
>
> Fred: Usually the teacher will prepare you for like the day before you'll get put in what's called like "critical friends" where go to different groups and you do a mini presentation on like what you are going to present and you are going to get feedback based on that. That's probably my favorite part.

The critical feedback allowed the students to be evaluated in a low-stakes scenario where they still had time to improve their work before presenting it for a grade. Furthermore, it allowed students to better understand how their peers understood the information they were presenting.

Limitations

As noted earlier, NTN is not prescriptive with respect to what specific projects should be utilized in any course. As such, while we collected data at a number of different institutions that varied by geographic locations, student diversity, and (presumably) teacher experience with PBL, we cannot state with certainty whether the outcomes described here could not be found in other PBL classrooms regardless of the school structure. Yet, the diversity that exists within the New Tech Network would lead us to believe the voices of New Tech students may also represent the experiences of those outside the Network.

Discussion and Implications

A great deal of qualitative educational research includes the voices of students, and the constructivist paradigm acknowledges their perception of reality as valid. However, simply listening to student voice and not acting on its instruction is insufficient when considering advocating for or against a particular approach to education. Mitra (2007) explains:

> information from students is a key data collection strategy for learning about student experiences and ways to improve schools. . . . Students are often neglected sources of information in school reform efforts; yet asking students' opinions reminds teachers [and all of us] that students possess unique knowledge and perspectives about their schools that adults cannot fully replicate (p. 728).

Student perspectives are far more than interesting; they are instructive.

Satisfied Students

As New Tech and other reform partners adopt signature pedagogies, it is essential to understand how students experience that pedagogy and assess outcomes beyond traditional academic measures. The data yielded from these focus groups provide evidence of a high degree of satisfaction with PBL. Satisfaction does not simply mean the projects are fun, but that students are able to articulate the value inherent in the approach. Educational psychologists have noted for decades the relationships between students' perceptions of the value of the task and their motivations and adaptive learning behaviors. For instance, Pintrich and deGroot explicate (1990):

> Intrinsic value was strongly related to the use of cognitive strategies and self-regulation… students who were motivated to learn the material (not just to get good grades) and believed that their school work was interesting and important were cognitively engaged in trying to learn and comprehend the material. (p. 37)

Beyond value, students in these focus groups could speak to the academic objectives and the applicability of those objectives to life outside the classroom. Proponents of culturally relevant and sustaining pedagogies speak of the necessity of students seeing the applicability of what they do in the classroom to the broader world—and that they see skills introduced in the classroom as skills they can use to transform the broader sociopolitical realities (Ladson Billings, 1995; Paris & Alim, 2017). This is not to say all PBL learning is culturally relevant, but the two have the potential to overlap when done intentionally. Furthermore, that satisfaction is present even when the projects are described as difficult

or challenging. Students are proud of their ability to persist in the face of obstacles, which may be related to additional nontraditional outcomes like grit (Perkins-Gough, 2013).

The Uncomfortable Side of Change

Much of the negative experiences students have with PBL is due to the uncertainty that comes with something new and comparing it to what they have always known. Accountability has led to a relentless pace in education, a constant push forward even when material is not mastered, because teachers feel the need to cover everything that may appear on the high stakes exam. As Comber and Nixon (2009) explain in their study, teachers' "accounts impl[y] a linear trajectory (we did x, then we did y), giving a sense of relentless moving forward across time 'doing things' in class." (p. 337). Young people do not live in a vacuum and are quite aware of this pacing, so using a project to go deep into one topic, instead of pushing full steam ahead with one chapter one week and one chapter the next, may cause students to assume they are missing something without realizing the depth of learning they are gaining with the project. Similarly, being graded as a collective instead of as an individual is unsettling, especially when one is used to the traditional, individualistic methods of assessment. Studies of cultural expressions in the classroom have found individualism and competition to be quite common and pervasive, and to shift from that to collective assessment is jarring (Boykin, Tyler & Miller, 2005). One may expect that, as PBL expands and students become exposed to it throughout their educational careers, these concerns may disappear.

What Do We Do With the Student Perspective?

Opportunities for deeper learning remain sparser than proponents of PBL would like. The literature tells us, often in response to accountability demands, students from marginalized communities are most often exposed to didactic, teacher-centered pedagogies (Diamond, 2012). We also know while such approaches may pay off in short term test score gains, they leave students behind in having the skills necessary to function at optimal levels in the 21st-century workforce. As Mehta (2014) explains:

> students in more affluent schools and top tracks are given the kind of problem-solving education that befits the future managerial class, whereas students in lower tracks and higher-poverty schools are given the kind of rule-following tasks that mirror much of factory and other working class work. To the degree that race mirrors class, these inequalities in access to deeper learning are shortchanging black and Latino students. (para. 2)

This resembles Dewey's (1916/2018) assertion in the early 20th century:

> In order to have a large number of values in common, all the members of the group must have an equable opportunity, to receive and to take from others. There must be a large variety of shared undertakings and experiences. Otherwise, the influences which educate some into masters, educates others into slaves. (p. 90)

The same question remains, and now we must ask ourselves: Will we take the instruction from the voices of our students? Will we endeavor to provide an education that is truly satisfying?

Our data suggest that the student experience with PBL is positive to the extent that it merits increased consideration by teachers at the high school level. Though not all schools are willing or able to commit to the full New Tech Network design criteria, teachers who construct their curriculum around PBL may find increased engagement in the classroom. Our findings support Ravitz's (2010) earlier work, which argues that projects increase student motivation. As the students in our focus groups demonstrated, they were engaged in the projects even if they did not find the underlying concept interesting. Their motivation to complete the project opened them up to learning a topic they would have otherwise identified as "boring" or without merit.

Further, as students, administrators, and governmental leaders continue to question pedagogical choices and demand evidence of positive outcomes, PBL can be a strategy for teachers to demonstrate the value of their curriculum. In particular, the use of PBL to solve "real-world" problems, or problems influenced by issues in communities or in the national news, provides striking results. Students are engaged, interested in the project, and committed to succeeding. Yet, these projects must be deliberate and clearly connected to the course material, which requires a considerable amount of planning and awareness of student perspective and prior knowledge (Nariman & Chrispeels, 2016). To accomplish these goals, teachers must be adequately supported, value the PBL process, and work together in equal measure to prepare students for the project. Assessment of outcomes also needs to be clearly defined, as Hung (2011) argued that the variability in PBL structure can confound findings. As teachers and researchers continue to advocate for the use of PBL, it is increasingly important to articulate who benefits from these pedagogical choices and how the benefits have come about.

Finally, as Grant (2011) asserts, "the voices of learners are sometimes lost in the preparation of lesson plans" (p. 62). This study addresses the sometimes "lost" voice in PBL—that of the student. When educators develop curriculum for the PBL classrooms, it is vital they consider the student perspective—what prior knowledge they have (Narimen & Chrispeels, 2016) and what will motivate them to engage in the material.

Appendix A

A Priori Codes	Emergent Codes
Collaboration (amongst students)	Teachers (positive impact)
Interdisciplinary work	Staffing issues/teacher preparation
Independence	Family atmosphere
Application to real life	Hard work/large amount of work
Problem-solving	Technology use
College readiness	Engagement (their own)
Presentation outside of school	Changing as a person (development)
Creativity	Model fidelity (deviating from PBL)

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