Designing for Equity: Moving Project-Based Learning from Equity Adjacent to Equity Infused

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ABSTRACT

Project-based learning (PjBL) is an inquiry-based approach that aims to engage students in active, meaningful, and challenging experiences connected to the world outside the classroom. However, PjBL's student-centered approach has not always explicitly focused on educational equity. The goal of this paper is to provide a PjBL curriculum design framework that goes beyond creating engaging curriculum to providing experiences that are equitable, relevant, and meaningful to all students, while also supporting students' learning and identity development. To do so, we examined recent PjBL curricula and related literature to identify the PjBL design features leading to impactful and equitable yearlong K-12 curriculum. We present cross-cutting PjBL curriculum design principles and lenses to interpret those design principles.

Keywords: *project-based learning, curriculum design, educational equity, student-centered, critical lenses*

Given the learner-centered focus of project-based learning (PjBL), it has always been uniquely positioned to advance educational equity; however, PjBL curricula have varied in how explicit the focus on equity has been in design and who has had access to PjBL curricula in public education (Deutscher et al, 2021). This paper presents a design framework for creating equitable PjBL curricula that engage each and every student in meaningful learning experiences that are relevant to all students, equitably affirm and sustain all students' identities, and focus on the development of the whole child.

PjBL is an inquiry-based approach that aims to engage students in active, meaningful, and

challenging experiences connected to the world outside the classroom (Baines et al., 2021; Barron & Darling-Hammond, 2008; Krajcik & Blumenfeld, 2006; Lucas Education Research, 2021; Saavedra et al., 2022; Tierney et al., 2020, 2022). The goal of education is not solely to prepare students to pass a test but to foster learning in a way that is transferable to their personal, cultural, academic, professional, and civic lives. PjBL encourages students to develop the skills and understanding needed for the long-term retention and application of what they have learned (Strobel & van Barneveld, 2009). Importantly, this goal of deeper learning attends to the application of content knowledge and problem solving as well as the inter- and intrapersonal domains, which include communication and collaboration skills, and metacognition and learning to learn (National Research Council, 2012). Further, focusing on deeper learning means challenging students to engage in rigorous content, take ownership of their work, and develop skills and ideas that will have a positive impact on many areas of their future lives (National Research Council, 2012). PjBL is often cited as an example of student-centered curriculum that puts learners at the center of the learning experience in contrast to instructor-centered instruction (Baines et al., 2021; Krajcik & Blumenfeld, 2006; Lucas Education Research, 2021; Tierney et al., 2020, 2022). PjBL has the potential to center students' learning, participation, and identities, and by doing so is uniquely positioned to promote equitable learning and culturally sustaining practices. However, while a student-centered approach is valuable, it does not inevitably equate to equitable learning. PjBL has the possibility of being student-centered and simultaneously perpetuating inequitable ideas and positioning within schools.

The persistent achievement gap between groups of students in the U.S. suggests the need to create deeper-learning experiences for all students. Ladson-Billings (2006) reframes the achievement gap, focusing instead on the educational debt that has accumulated from decades of inequitable education for those in historically marginalized groups, such as students of color, economically disadvantaged students, and multilingual learners. In her call to action, which is all the more relevant today, Ladson-Billings argues that the societal disparities, both historic and current, require that we, as part of the education system, use our expertise to alleviate these inequities. To truly address the educational debt, equity must be an explicit priority in the design of classroom experiences and throughout the education system (Paris & Alim, 2017).

The goals of PjBL, therefore, go beyond deeper learning to providing experiences that are equitable, relevant, and meaningful to each and every student while supporting the development of not only students' academic learning, but also their social, emotional, and identity development. For this paper, we refer to this as a whole-child approach, which acknowledges that supporting learning is dependent on the multidimensionality of a student's life. This means teaching and learning must focus on academic and cognitive development alongside social, emotional, and identity development.

We write this paper with the perspective that PjBL, in its design and implementation, is at an inflection point. Here we can simultaneously recognize the impressive learner-centered work that has occurred thus far in PjBL writ large and specifically PjBL curriculum work, while also elevating learners' cultures and educational equity as a more explicit feature of PjBL moving forward. High-quality PjBL curricula, alongside sustained professional learning, supports larger-scale shifts in educational systems (Condliffe et al., 2017). Carefully designed PjBL courses with equity at its core can support teachers in providing students with deep and equitable learning experiences. In this paper we explore the following research questions:

1) What educational commitments and theoretical lenses can support the creation of equitable PjBL curricula?

2) What PjBL design principles lead to positive student outcomes and learning?

Theoretical Framework

Creating a PjBL curriculum that allows for deep and equitable learning is a complex and challenging task. Our theoretical framework for this paper acts both as lenses through which we identified and examined PjBL design principles, but also lenses for researchers, designers, and practitioners to enact PjBL design principles. While design principles embody values, they can still be interpreted in numerous ways. This matters deeply when seeking educational equity. The lens that is applied to design principles makes or breaks the extent to which the principles work in the service of educational equity. For example, a design principle focused on student agency, broadly defined as students' ownership of and engagement in their learning (a more specific definition is offered later in the paper), can be interpreted and used to promote student-centered curriculum but may not support the creation of equity-centered curriculum. In this way we refer to the theoretical framework of this paper as *critical lenses* to be used to interpret PjBL design principles, ensuring that all students are valued, engaged, and included. These commitments provide a frame through which curriculum developers can interpret the design principles to ensure they are not producing or reinforcing inequities. We define these pedagogical commitments as critical lenses both for their essential place in design and to denote the role of critique in curriculum design. The critical lenses are not added as additional design principles because the critical lenses need to be reflected on and infused in all aspects of the design principles for the creation of equitable PjBL curricula.

The four critical lenses that make up our theoretical framework for this paper are: Identity development, student engagement, social and emotional learning, and commitment to equity (see Figure 1).
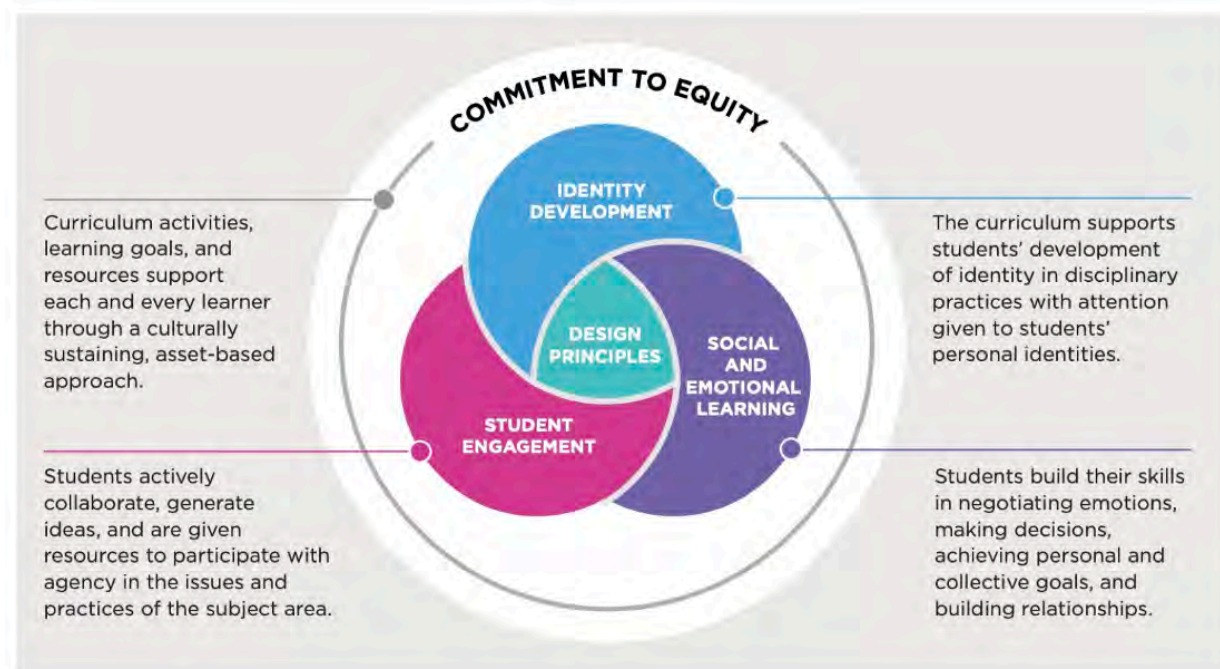

Figure 1. Critical Lenses for Interpreting PjBL Design Principles

These interconnected concepts and pedagogies support the development of the whole child, and we present them as a set of pedagogical commitments curriculum developers should use to create courses that represents the valued outcomes of the PjBL approach. As illustrated in Figure 1, these lenses overlap and come together to illustrate how to enact the design principles in curricula, while

commitment to equity also encompasses the other three, representing the constant eye toward equity that should occur in PjBL design.

Identity development refers to the process of people understanding who they are as they participate in the world. This process, which is ongoing as an individual changes over time, is not solely internal but also embedded in social interactions that are influenced by societal norms, stereotypes, and power relationships (Holland et al., 1998). *Student engagement* refers to the multifaceted way in which students interact with their learning environment, including how they participate, react emotionally, and invest in their learning and school community (Fredricks et al., 2004). Engagement can be defined at multiple levels, from moment-to-moment interactions with ideas and peers to involvement with school and subject areas across classes and academic years. *Social and emotional learning* (SEL) is the process of negotiating emotions, making decisions, navigating challenges, expressing empathy, achieving personal and collective goals, and establishing and maintaining relationships (Culclasure et al., 2019; Jagers et al., 2019). Finally, *equity-committed design* calls upon curriculum designers, as well as teachers and the broader educational system, to embrace and enact a series of anti-oppressive, culturally sustaining, and asset-based approaches that center on students, their identities, and their experience (Gay, 2020; González et al., 2005; Paris & Alim, 2017). These equity-committed approaches in PjBL design include, but are not limited to, instructional approaches supported through curriculum, learning content, and the selection of valued skills and dispositions embodied in the curriculum.

Within the broader scope of equity-committed design, we include a number of approaches: culturally sustaining/revitalizing pedagogy (Paris, 2012; Paris & Alim, 2017), culturally relevant and responsive pedagogy (Ladson-Billings, 1994; 1995), funds of knowledge (González et al., 2005), historically responsive framework (Muhammad, 2022), culturally responsive teaching (Gay, 2020; Hammond, 2015), Indigenous and land-based perspectives (Bang et al., 2014; Barajas-López & Bang, 2018), and culturally and linguistically relevant pedagogy (Hollie, 2011). Valuing, amplifying, and celebrating students' identities and backgrounds are central to all these approaches. These include, but are not limited to, students' racial, cultural, historical, linguistic, gender, ability/disability, community, and family identities and backgrounds.

Positionality Statement

As three project-based learning (PjBL) scholars and designers, we bring extensive experience in designing, implementing, and researching project-based learning (PjBL) curricula. Our approach to PjBL focuses on purposeful design that centers students and is consistently committed to equitable learning for all students. The first author, Dr. Gavin Tierney, is a cisgender and heterosexual white man, tenured faculty, and former alternative high school teacher. He approaches this work with a specific focus on designing PjBL curricula to equitably support students' engagement and identity development. His previous work on PjBL includes research on PjBL Advanced Placement (AP) curriculum with a focus on deeper learning. He approaches this work as part of a broader goal of designing equitable and engaging learning environments. The second author, Dr. Rochelle Urban, is a cisgender woman of Eastern European Jewish descent. She spent the first decade of her career designing, delivering, and leading innovative science education experiences for K-12 students both in and out of schools, where she worked with both students and teachers from a broad spectrum of backgrounds, needs, and identities. Her work at Lucas Education Research allowed a birds-eye view of how project-based learning can address inequities only if designed deliberately. The third author, Dr. Gina Olabuenaga, is Latina—first generation on her father's side—monolingual, and cisgender. She brings extensive experience as a founding teacher of a project-based magnet school in LAUSD, where she worked with historically marginalized youth. She witnessed firsthand how PjBL can serve as a tool for advancing equity. Her teaching experience was followed by over ten years of experience

designing and leading professional learning and coaching in project-based methodologies. These experiences shaped her approach and commitment to designing inclusive PjBL frameworks that aim to transform educational experiences and opportunities for all students.

Methodology

This paper is a mixture of curriculum review and a review of related literature and theory. We first analyzed a subset of PjBL curricula focused on yearlong K-12 curricula that showed positive impacts on student outcomes and learning, then turned to the educational theories and literature that informed the relevant design principles. We then iterated on this process to identify design principles, critical lenses, and approaches to design. Curricula were chosen by identifying yearlong K-12 PjBL, where the entire course was built around PjBL (see Table 1). We were specifically interested in yearlong PjBL curricula to understand the combination of design principles and perspectives present in curricula that centered PjBL as the spine of the curriculum and was persistent throughout the school year.

The five courses reported in this paper have a strong body of evidence demonstrating significant outcomes on both student learning as well as other positive student measures (For more information on the specific courses, please see: Boardman et al., 2021; Duke et al., 2021; Deutscher et al., 2021; Krajcik & Schneider, 2021; Krajcik et al., 2023; Saavedra et al., 2022; Tierney et al., 2020, 2023).

The results reported in this study are a synthesis of design principles and design frameworks reported in literature and curriculum from the five courses. We identified design principles reported in the findings by first cross-referencing the stated design principles from each course (see Table 1).

Course Name	Curriculum Description and Literature	Design Principles
Knowledge in Action	*AP U.S. Government and Politics and AP Environmental Science courses – Two Advanced Placement courses for high schoolers co-designed by researchers at the University of Washington and high school teachers (Nolen, Wetzstein, & Goodell, 2020; Parker et al., 2011, 2013; Saavedra et al., 2022; Tierney, Adams, & Ward, 2023; Tierney et al., 2020)*	1. Project as the spine of the course (main dish). 2. Building depth through looping (Looping big ideas/concepts). 3. Engagement First (Need to know: How should students use information from lectures, labs, textbook reading?). 4. Course Master Question and Project Driving Questions (Framing). 5. Technology and including the "unavoidable core texts" (Learning from Text). 6. Subject-Matter Experts. 7. Group-worthy tasks. 8. Teachers' Multiple Roles.
Multiple Literacies in Project-Based Learning	*Science courses for third, fourth, and fifth graders that integrate math and English language arts designed by researchers at Michigan State University and the University of Michigan (Krajcik & Schneider, 2021; Krajcik et al., 2023; Miller & Krajcik, 2019)*	1. Pursue solution to a meaningful question (Driving Question). 2. Use big ideas to frame 3-Dimensional learning goals. 3. Explore the question by participating in scientific practices to "figure out" why phenomena occur and learn important ideas in the discipline. 4. Engage in collaborative activities to find solutions to the driving questions and make sense of phenomena. 5. Use learning tools and other scaffolds to help students participate in activities normally beyond their ability. 6. Create artifacts–tangible products–that address the driving question and represent student

		knowledge.
Compose Our World	*Ninth-grade English language arts course developed by researchers at the University of Colorado at Boulder (Boardman et al. 2021; Garcia et al., 2020; Polman et al., 2018)*	A. Authentic Making A1. Project has coherence through consistent connection to challenge or question. A2. Activities are authentic to the learner. A3. Activities have a meaningful audience other than the teachers. A4. Authentic tools and practices are used. A5. Activities are production- oriented. B. Collaboration B1. Teacher encourages collaboration among group members. B2. All members of the group participate, share with one another and collaborate. B3. Group members interact and value contributions of others. C. Reflection C1. Students reflect on work or process. C2. Students reflect on thoughts and feelings. C2. Reflection is shared with others. D. Feedback & Revision D1. Teacher gives feedback along the way (formative). D2. Teacher gives at end (Summative feedback) D3. Students give feedback to one another. D4. Students revise based on feedback.
Project PLACE	*A Project Approach to Literacy and Civic Engagement – Second-grade curriculum integrating social studies and literacy developed by researchers at the University of Michigan and Michigan State University (Duke et al., 2021; Halvorsen et al., 2012)*	1. Each unit session contributes to the project. 2. Projects are highly standards aligned. 3. Projects incorporate research-supported instructional practices. 4. Projects are field tested. 5. Project sessions follow a consistent structure. 6. Unit and session plans are designed to be highly supportive for teachers, while providing some room for teacher and student voice and choice.
Learning Through Performance	*A yearlong science course for sixth graders developed by researchers at Stanford University (Deutscher et al., 2021; Holthuis et al., 2018)*	1. Project-Based Learning 1a. Access multiple forms of information needed to successfully complete the learning tasks and apply and demonstrate their knowledge in different ways. 1b. Actively engage in their learning by making choices and decisions demonstrating self-directed learning. 1c. Reflect on their learning and make revisions based on self- assessment, peer review, and/or teacher feedback. 2. Performance-Based Assessments 2a. The individual and group components of the projects allow students to demonstrate mastery of rigorous content and scientific practices in various ways. 2b. Culminating projects provide evidence of what individual students learned, what content or skills they may still be struggling with, and how

teachers might change their instruction to address gaps in student understanding.

3. Structured Groupwork

3a. Assign student roles to promote active learning and equitable rates of participation in groups.

3b. Develop activities that are open-ended and productively "uncertain," thus replacing step-by-step procedures with multiple methods for achieving multiple solutions.

3c. Shift instruction so that teachers act more as facilitators and coaches focused on group interactions, probing and challenging student thinking, and monitoring student learning.

Table 1. Design Principles for Yearlong K-12 PjBL Curricula

To identify the collection of principles for this paper, we looked at the aforementioned five K-12 PjBL curricula. Using the stated design principles, we examined how the principles repeatedly occurred in the curricula and/or were particularly important to aligning fully with the critical lenses framework described earlier in the paper and achieving equitable learning for each and every student.

From there, we explored related literature as central to the design principles used in the curriculum design (Boardman et al. 2021; Deutscher et al., 2021; Duke et al., 2021; Garcia et al., 2020; Halvorsen et al., 2012; Holthuis et al., 2018; Krajcik & Schneider, 2021; Krajcik et al., 2023; Miller & Krajcik, 2019; Nolen, Wetzstein, & Goodell, 2020; Parker et al., 2011, 2013; Polman et al., 2018; Saavedra et al., 2022; Tierney et al., 2020, 2023). In the curriculum review, we explored the nuanced differences of how the common features of PjBL were represented in each curriculum creating a set of design principles that applied. An example of this is content coherence, a feature of all the curricula we examined and one of our design principles. To further refine our collection of design principles and their definitions, we reviewed literature from both project-based practices and cognitive psychology as it relates to how people learn. This allowed us to both strengthen the case for principles identified in the curriculum review and surface minor or yet-to-be included aspects of the principles. Oftentimes, principles were identified and their definitions refined because of their important role in advancing educational equity. An example of this type of design principle includes the authenticity of projects. While authenticity exists in all of the reviewed PjBL curricula, the implementation of it with the expressed purpose of lifting up students' context, identities, and communities changes the definition of the principle. The definitions of the design principles and the literature supporting them was iterated on as we circled back across the five courses, until the definitions of the principles were representative of all courses.

For each of the design principles, we will define the characteristics, describe related seminal publications, and highlight the ways that the design principle supports this type of learning and engagement across multiple disciplines and grades.

Findings

Design principles are often used as a tool to help designers organize and center qualities they would like the developed curriculum to embody. In PjBL, design principles have been used to emphasize aspects such as student agency, authenticity, and collaboration (Tierney et al., 2020, 2022, 2023). We describe a set of design principles that can support the creation of content-rich, student-centered experiences across a year of PjBL curricula. In doing so, we recognize that PjBL is not the

only curricula to use design principles and, in many ways, it is the unique combination of design principles that makes PjBL curriculum what it is. Because of this, it is possible that the critical lenses framework in this paper could be applied to other student-centered curricular approaches. However, we believe it is uniquely suited for PjBL because of the combination of design principles that PjBL uses and how PjBL approaches learners, course structures and content, and the format and framing of the curriculum itself.

We present the design principles in this paper in three major categories: 1) learner-centered approaches, 2) course structures, and 3) curriculum supports. The order in which we present these categories does not imply a sequence to the design process, nor does it suggest levels of priority. In addition, while we present each principle as a distinct idea, there is a significant amount of overlap between them. The design principles are presented as an interlocking set of ideas, best used together.

Following each principle, we have included examples from the curricula in the study. In our analysis, as well as the design principles and relevant literature, the connections to equity were not always embedded in the PjBL topic but embodied projects that went beyond student-centered, focusing specifically on identity development, student engagement, social and emotional learning, and a commitment to equity.

Finally, recognizing that while design principles embody values, they can still be interpreted in numerous ways, we provide reflective questions following each example of the design principles to support designers' interpretation of the design principles through the lenses, to further support PjBL to center equity. It is through the interpretation of the design principles through the critical lenses, specifically the commitment to equity, that qualities of equitable curricula, such as universal design for learning (UDL) (Meyer et al., 2014) and diverse representation, will be integrated.

Learner-Centered Approaches

We begin with the *learner-centered approaches*, which focus on how students experience the curriculum. Project-based learning that attends to the development of the whole child and deeper learning places students at the center of learning in ways that value and build upon what students know, the skills they have, and what they care about. The principles in this first category answer these questions: "How do students engage with the project and their learning?", and "How do learners experience the project and course?" The design principles in this category support the development of PjBL curricula that are authentic to students and integrate the critical lenses. These principles attend to engagement, connect to students' lives, value student voice, allow students to develop fundamental cognitive skills, generate understanding collaboratively, promote independence, and support success in college, career, and life.

Purpose for Learning

Providing students with a purpose for learning is fundamental to the creation of a PjBL curriculum that commits to deeper application, understanding, and engagement and is based in the science of how students learn. In "A Time for Telling," Schwartz and Bransford (1998) state that providing students a context for what they are learning, the need to know primes them for learning and engagement. At the beginning of a PjBL unit, students discover the context for the project before any content is introduced, often through some kind of shared experience and the introduction of a problem to solve or question to answer. In the project launch, students generate their own ideas and questions on the project/topic connected to prior knowledge and drawing on racial, cultural, historical, personal, and community funds of knowledge (Lo & Tierney, 2017). This launch might also introduce students to the roles they will have in the project context, giving further motivation for completing project tasks.

Curricular Example

A well-crafted driving question tied to an engaging launch can allow students to connect to their purpose for learning throughout a project. In the Multiple Literacies in PjBL curriculum, a unit leads with a driving question (see Table 1). For example, in the third-grade unit on birds and genetics, students answer the question, "How can we help the birds near our school grow up and thrive?" Students begin the unit by observing birds near their school, gaining first-hand experience that provides motivation for learning. The progress toward the driving question along with student-generated ideas and questions are then made public on the Driving Question Board, which allows students to have an ongoing link back to the purpose.

Reflective Questions Connecting the Design Principle and the Critical Lenses

In what ways does the problem, question, or context given to engage students value and amplify the diversity of experiences and identities of the students? What opportunities do students have to draw on prior knowledge and their racial, cultural, historical, personal, and community funds of knowledge at the launch of and throughout the project?

Authenticity

Authenticity connects students' learning and work to the world outside the classroom, situating learning in a way that is meaningful and relevant. When students see value in the learning due to its relevance, they are more intrinsically motivated to engage (Priniski et al., 2018; Vansteenkiste et al., 2018). Providing an authentic context for learning also supports the importance of building on existing understanding to successfully learn new knowledge (National Research Council, 2000). Finally, perceiving a PjBL curriculum as relevant has been shown to increase transfer of learning and practices into students' everyday lives (Tierney et al., 2020).

Curricular Example

In the Civics and Government unit in Project PLACE, students identify a problem they want to solve at a local park or public space (see Table 1). Students learn about the purpose of government and engage in the practices used by community members, thoughtfully researching, writing, and presenting a proposal for their park improvements to a local official.

Reflective Questions Connecting the Design Principle and the Critical Lenses

To what extent is students' perceived relevance of the project considered in curriculum design for students across a range of communities and backgrounds? In what ways are approaches to authenticity rooted in students' cultures and identities in positive and affirming ways that allow students to explore their personal and disciplinary identities both within and across projects?

Student Agency

Students develop agency – ownership of and engagement in their learning – when they have a voice in the content, process, value, and assessment of their learning (Calabrese Barton & Tan, 2010; Mirra & Garcia, 2020). The proper supports for student agency deepen engagement and identity development, create a space for learners to express themselves in practice, and develop student identities in the context of the discipline (Nasir, 2012; Nasir & Hand, 2008; Tierney et al., 2020, 2023).

Student Agency as a PjBL design principle can support the creation of projects that allow students to take different approaches and pathways as they engage in PjBL courses and to add their own voices to the projects. Designing a curriculum that allows students to make consequential choices supports the development of key social and emotional skills, such as making decisions, navigating challenges, and setting goals.

Curricular Example

In Knowledge in Action AP Environmental Science, the curriculum focuses on students' ability to make choices in the project and have agency over their actions outside the classroom (see Table 1). In the Ecological Footprint unit, students analyze their families' ecological footprints and create a proposal to convince their families to reduce their footprints. Finally, students reflect on how their actions have the power to add up to larger changes.

Reflective Questions Connecting the Design Principle and the Critical Lenses

To what extent do projects and tasks in which students are making substantive choices include and value knowledge and experiences of each and every student's practices and ideas? To what extent do curriculum materials provide supports for teachers to recognize and honor all students' voices?

Collaboration

Collaboration is deeply embedded in project-based learning curricula. It includes group work with a shared goal and the fostering of a community of learners in which teachers and students can build on one another's ideas to advance their individual and collective understanding. Collaboration in a PjBL classroom also includes opportunities for peer-to-peer feedback and co-construction of knowledge and products. These different facets of collaboration can help students develop their social and emotional skills (Culclasure et al., 2019), perform better academically (Saavedra, 2022; Wilder, 2015), and build essential skills for college, career, and life (Barron & Darling-Hammond, 2008). Collaboration can encourage community building, strengthen student relationships with peers and teachers, and enhance a sense of belonging in the classroom (Darling-Hammond et al., 2020).

Curricular Example

To build students' capacity to work productively in groups, the Learning Through Performance course begins with a short introductory unit focused on group work (see Table 1). That gives students time to recognize that all their peers have something to contribute and to reflect on the importance of roles and behavior norms in working together. Students have opportunities to practice these roles and norms. Throughout the rest of the course, as students collaborate as active learners and in creating the products for their projects, teachers review the group roles and norms.

Reflective Questions Connecting the Design Principle and the Critical Lenses

In what ways are social and emotional learning and practices related to effective collaboration explicitly taught, supported through routines and scaffolds, and revisited throughout the course? To what extent is collaboration scaffolded to disrupt negative and inequitable roles and identities, including the provision of tools to confront interpersonal conflict and address race and racism in small-group settings?

Metacognition

Metacognition refers to the awareness and understanding of one's own thinking and learning. While this principle is often called reflection, we call out the underlying process as it is important that the reflection be in service of metacognition. When students use metacognitive strategies, they are more engaged in both academic and nonacademic learning and achieve greater academic outcomes. For example, students can improve academic performance beyond their current ability level through the use of metacognitive strategies (McCormick et al., 2012). Further, the more learners can engage in metacognitive reflection, the better able they are to identify when they lack knowledge or skills. This allows them to advocate for help or seek out additional strategies or support, which leads to better teacher awareness of a student's learning needs.

Curricular Example

Course materials can provide a structured approach to scaffolding metacognitive skills. The Individual Project Organizer provided in Learning Through Performance gives students opportunities to reflect on what they have learned and connect it to their project and purpose for learning (see Table 1). For each project in Compose Our World, students use a journal "to build students' capacities to reflect, record ideas, analyze project content, and build a metacognitive understanding of their own learning process" (Compose Our World curriculum; Boardman et al., 2021) (see Table 1).

Reflective Questions Connecting the Design Principle and the Critical Lenses

To what extent is metacognition used as a tool to support the development of social and emotional learning? Do students have the opportunity to reflect on identities, content knowledge, skills development, and their learning process?

Course Structures

The second category, course structures, contains principles concerning the scope and sequence of the content and supporting a coherent learning experience. While the previous category applies to how students experience individual projects, here we address what happens at the course level. This category of PjBL design principles answers the question, "How are the course content and skills chosen, designed, and organized?" The principles outlined in this section are essential for a tightly designed PjBL curricula that attends to how content is approached and organized across projects in the course (i.e., the scope and sequence of content, as well as the structure of each project) and integrates the ideas of the critical lenses.

Centrality of Projects

The centrality of projects design principle highlights that the projects are not simply a peripheral means to assess learning or engage students; they frame the entire process and purpose of learning throughout a unit and course (Condliffe et al., 2017). Placing projects as the focus of the course means projects are the setting in which learning occurs in the course, with each activity framed by its context to the project. Parker et al. (2011) describe this as making projects the "spine of the course," which is in stark contrast to the more common instructional approach in which projects occur after lectures and tests (p. 538). The authors "aimed to create a course experience where challenging projects provided the spine of the course, not the appendages; that is, the entrée, not the dessert; the main show, not the sideshow" (p. 538). Projects as the entrée provide a context and meaning for all learning

that occurs. This is in contrast to "dessert" projects, in which projects, such as a poster or presentation, are a final application of learning but not the context and reason for learning (p. 538). In considering the critical lens of student engagement, the projects must be sufficiently complex and open-ended to authentically solve the problems of the discipline.

Curricular Example

PjBL curricula designed with projects at the center are often organized by and around projects. The Knowledge in Action AP Government course is divided into five projects, each of which is a simulation that allows for the experience of the project to be central to what students are doing and learning (see Table 1). Project PLACE also puts projects in the foreground of learning in each of the four social studies units (see Table 1). Each session contributes to a project, so there is a clear motivation for the learning driven by the project. In the third-grade Multiple Literacies in PjBL science course, the year is divided into four units, each framed by a driving question and anchored with a shared first-hand experience (see Table 1).

Reflective Questions Connecting the Design Principle and the Critical Lenses

To what extent does learning of all content – including disciplinary concepts, skills, and social and emotional learning – occur within the context of a project? To what extent does the framing around the purpose of lessons and activities rely on the project rather than needing to be done for the sake of school?

Integration of Rigorous Content

Following from the centrality of projects and purpose for learning principles, the content of the course needs to be integrated into the projects across the course. The integrated content includes opportunities for students to engage with core disciplinary ideas, thinking, and practices. Since projects provide the context for learning, the experiences students have as they participate foster understanding and develop core disciplinary ideas, practices, and thinking at a progressively deeper level than non-PjBL courses (Darling-Hammond et al., 2008; Parker et al., 2013). Further, integrating rigorous disciplinary content should be done in the service of supporting students' development of identities linked to the content area by providing links between course content and students' lives and cultural practices (Nasir, 2012), as well as by setting high expectations for all students. Content for authentic projects also focuses on integrating learning across disciplines. In particular, embedding reading, writing, and speaking into PjBL curriculum materials in other disciplines can improve student outcomes (Duke et al., 2021; Halvorsen et al., 2012; Li et al., 2021). To increase relevance and commitment to equity, this focus on literacy also includes developing students' criticality, which builds their capacity to understand power, privilege, social justice, and oppression (Muhammad, 2022).

Curricular Example

Covering grade-level standards through projects requires deliberate planning. AP courses have a significant amount of content to cover for the exam. The projects in Knowledge in Action AP Government address all the big-picture topics of the College Board's AP Government framework while remaining focused on building deep understanding (see Table 1). The purpose is not just to prepare students to pass the AP Exam but also to empower students to become civically engaged citizens.

Reflective Questions Connecting the Design Principle and the Critical Lenses

In what ways does the course content honor students' diverse cultural, racial, and linguistic practices and perspectives? To what extent do the curriculum materials specify explicit learning goals directly related to the project that draw connections to both subject-area standards as well as literacy, SEL, and equity?

Coherent and Purposeful Content

Building from the previous two principles, the content of the course as a whole in a PjBL curriculum is coherent and strategically sequenced. To successfully understand content and skills, students need cycles of learning in which they come back to ideas, deepening and refining their conceptual understanding as well as connecting to related ideas (Schwartz & Bransford, 1998). The learning cycles not only build on subject knowledge but also include deliberate sequencing of SEL, equity, identity, and engagement goals. Using the backwards planning described in the section on the content integration principle, the deliberate sequencing of the learning goals within and across projects considers how students build from previous learning goals and experiences.

Curricular Example

In Multiple Literacies in PjBL, each unit has a science storyline document that illustrates how the project fits with the big-picture science content and how each lesson connects to core subject-area ideas and practices as well as SEL, equity, math, and literacy goals (see Table 1). To make this coherence visible to students, each lesson has its own driving question that directly ties back to the purpose of the project, and units provide multiple opportunities for students to discuss their progress toward answering the driving question.

Reflective Questions Connecting the Design Principle and the Critical Lenses

To what extent are learning experiences deliberately sequenced across the course for grade-level subject-area, SEL, equity, and engagement goals? To what extent does the curriculum include diverse representation? In what ways does the curriculum support students' identities throughout the course through iterative connections to students' lives and the world and opportunities for students to make projects their own?

Assessment

Assessment in PjBL curricula is ongoing, authentic, and performance based. Opportunities for assessment are not exclusive to the core disciplinary content and include assessments of other valued areas, such as subject-area practices, interdisciplinary content and practices, and SEL. PjBL is inherently a performance-based model in which students apply their learning to products and performances that teachers can evaluate for the purposes of feedback and student learning. Though this performance-based approach appears to emphasize the final summative product, frequent formative performance-assessment opportunities allow teachers to regularly check for understanding and empower students to reflect and revise their thinking and work (Taylor & Nolen, 2008). In the highly collaborative learning environment of a PjBL classroom, the design of assessments allows each individual to demonstrate understanding.

Curricular Example

Tangible artifact creation over the course of a project can serve as a tool for authentic, performance-based assessments. In Multiple Literacies in PjBL, these artifacts include physical objects or drawn models, plays or short stories, and engineering solutions, presented to the community, that allow teachers to see student thinking and allow students to reflect on their learning (see Table 1). In the third-grade unit on motion, students design a moving toy. In preparing to do so, they draw a model of the motion of toys, which they iterate on to come up with their final design.

Reflective Questions Connecting the Design Principle and the Critical Lenses

To what extent are assessments authentic with respect to alignment with the project, realistic disciplinary problems, and connections to students' communities and the broader world? How can planning frameworks, such as universal design for learning and backwards planning, support the integration of more equitable and inclusive assessments in the curriculum?

Curriculum Structures

The last category, *curriculum supports*, includes principles that help students and teachers navigate the course and their learning. Teaching PjBL is complex. It involves deep content-area expertise, pedagogical knowledge, and a commitment to equity, which requires supportive curriculum materials. Similarly, students need supports and structures embedded in curriculum materials. This final category of PjBL design principles answers the question, "How do the materials support teachers and students?" While the other principles can describe the experience of PjBL in the classroom more broadly and independently of curriculum materials, these final two principles are unique to curriculum design.

Curricular Supports for Student Learning

With carefully designed materials, a PjBL curriculum can promote deep learning and engagement by supporting each and every student in developing an understanding of content, ideas, and skills regardless of the learner's starting point. We highlight three ways in which this design principle can be accomplished in a PjBL curriculum: (1) framing lessons and activities, (2) using appropriate scaffolds, and (3) designing learning materials to support equitable and inclusive learning.

Curricular Example

Compose Our World provides student supports throughout the curriculum, including global, course-wide protocols and specific support steps within a lesson (see Table 1). These are explicitly called out in the teacher materials with strategies to teach each and every student so that all learners can access the content and be successful. Compose Our World used universal design for learning (Meyer et al., 2014) as a guiding principle during course development to ensure that all instruction provides multiple means of representation, expression, and engagement.

Reflective Questions Connecting the Design Principle and the Critical Lenses

To what extent does the framing of lessons and activities draw on students' funds of knowledge and value cultural, racial, and linguistic identities? Does the curriculum offer

scaffolds for disciplinary ideas and practices as well as other skills and aspects of learner development, such as social and emotional learning, identity, and criticality? In what ways are students' language use and learning scaffolded, with a recognition of native languages as assets to student thinking?

Curricular Supports for Teacher Learning

PjBL requires shifting teacher practice from traditional teacher-led instruction to a student-centered approach, with a learning partnership between teachers and students. Depending on an educator's existing practice, this shift might be large and require changes to content and pedagogical knowledge as well as teacher identity, beliefs, and values (Davis et al., 2017). Educative supports in curricula provide ongoing and explicit opportunities for teachers to learn within the instructional materials and can support this shift in practice (Nolen et al., 2020). Educative supports embedded in curriculum materials are a part of teachers' daily practice, connect theory to practice, and improve teachers' instructional and assessment strategies (Ball & Cohen, 1996).

Curricular Example

To support teachers in understanding how ideas build and the purpose for activities, Multiple Literacies in PjBL provides a looping chart and detailed storyline document that lays out the way the content story develops for students (see Table 1). The storyline document connects each lesson activity to student assessments, standards, and learning goals related to literacy, math, SEL, and equity. In the Compose Our World curriculum, each lesson includes a description of how the activities connect to PjBL principles and other ideas, such as advocacy and empathy, that are connected to SEL and equity (see Table 1).

Reflective Questions Connecting the Design Principle and the Critical Lenses

To what extent do embedded supports for teachers cover a broad range of pedagogical knowledge and practices, including identity, engagement, equity, and social and emotional learning? Are models, exemplars, or reflective exercises provided to facilitate teachers' shifts in beliefs and identities toward a student-centered, asset-based approach and a commitment to equity?

Findings Summary

In order to move PjBL from equity adjacent to equity infused, we argue that it is not enough to simply add equity as another design principle. Instead, we highlight pedagogical commitments, or critical lenses, to ensure that, in PjBL curriculum design, all students are valued, engaged, and included. These commitments provide a frame through which curriculum developers can interpret the design principles to ensure they are not producing or reinforcing inequities. The four critical lenses presented in this paper include: commitment to equity, identity development, student engagement, and social and emotional learning. All of these lenses overlap and come together to define how to enact the design principles in curricula, while commitment to equity also encompasses the other three, representing the constant eye toward equity that should occur in PjBL design.

While not every PjBL project or course will topically focus on issues of equity, diversity, and inclusion, the critical lenses, provide a pathway for how the design principles can be interpreted to support the learning within PjBL for all students. The reflective questions provided help interpret the design principles so that, at every phase of design, there is a clear focus on all students' identity development, engagement, social and emotional learning, and, above all, a commitment to equity.

Conclusion

This paper describes the key design principles and critical lenses, required to develop yearlong project-based learning curricula. These principles, divided into three categories, describe PjBL curricula that have (1) learner-centered approaches to support purposeful, authentic learning that values students' voices and encourages collaboration and reflection; (2) course structures that deeply integrate coherent and authentically assessed content in projects; and (3) curriculum supports for students and teachers to enable the deep learning and practice shifts needed. As stated earlier, we believe the principles are best utilized together, instead of designers picking and choosing individual principles. In addition, we report on design principles from yearlong PjBL curricula. While many or all the design principles may be present in individual projects embedded into courses that are not PjBL from start to finish, additional design principles may need to be included to consider how PjBL projects interconnect with other non-PjBL curricula used in the course.

While design principles provide guidance for the creation of curriculum, developers can often interpret and enact the design principles in a variety of ways. Therefore, the critical lenses, align the pedagogical commitments needed to interpret the principles in a way that promotes the goal of equitable, deeper learning that attends to the development of the whole child. Educators should consider the perspectives they use as they create and revise curricula for deeper learning and equitable development of diverse youth. The perspectives educators use become operationalized in the developed curriculum, influencing the ways teachers implement and, therefore, what students will experience in the classroom. To help illustrate this idea, imagine a photojournalist tasked with capturing an event. The intended audience, the photojournalist's personal style and perspective, and the context of the event all shape both the content and composition of the end result. This is similar to the work of curriculum designers, whose experiences, values, and pedagogical knowledge all influence – intentionally or not – the curriculum they create. In this paper, we present the critical lenses to support educators as they interrogate their process and approach in PjBL design, helping them become more purposeful in designing for educational equity. As stated before, while we believe the framework presented in this paper is uniquely suited for PjBL, it is possible that the framework could be adapted for other student-centered curricular approaches. In particular, we think that the idea of using critical lenses to interpret design principles may be useful in curriculum design writ large.

Creating a PjBL curriculum that perfectly captures all aspects of each design principle and critical lenses is challenging, especially when developers must also consider specific priorities and contexts for their curriculum. For example, while the principles as described here have strong evidence that they are effective in science, English language arts, and social studies classrooms, it may be that PjBL in a mathematics classroom would require somewhat different interpretations of the principles. Regardless of its context, a curriculum that prioritizes deeper learning and equity must draw on all the principles and lenses as they encompass pedagogical best practices and draw on evidence of how students learn.

In the design of equitable PjBL curriculum, we believe it is important to not view equity as an endpoint but instead something that educators need to constantly focus on as they engage in the cycles of designing, revising, and implementing curricula. The lenses and design principles presented in this paper are meant to support work towards more equitable PjBL curricula and suggest the need for iteration to further support equity, diversity, and inclusion. In addition to a focus on design principles and critical lenses, future work would benefit from specifically examining how the design process of PjBL curricula can better support educational equity.

Designing a curriculum that embodies equity and deeper learning requires educators to push against the traditional structures of education. Indeed, one motivator for designing PjBL curricula is large-scale systems change. For example, while curriculum designers may not have the power to change required content standards, they may push beyond standards that are problematic and

perpetuate historic inequities by prioritizing deeper learning and whole-child development. We hope this paper ensures that, regardless of who the curriculum designers are or their specific learning context, there will be a shared understanding about the goals of creating PjBL curricula that supports the development of all students and provides equitable experiences in deeper learning.

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