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Please enjoy this complimentary excerpt from *Bringing Project-Based Learning to Life in Mathematics, K-12*.

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Planning a project from start to finish may seem overwhelming, yet with the support of all the ideas presented in this book, and this concluding chapter, you can successfully develop a high-quality project-based learning (PBL) mathematics experience for your students. To aid your design of a project, let me share my planning process for the seventh-grade *Mugs O' Math* project.

This chapter will explore step-by-step how to plan a project, referencing all the ideas from the previous chapters.

BRAINSTORM

Remember as a student all those times your teachers asked you to brainstorm before writing a paragraph or an essay? Well, creating a project starts with that same process. Let's brainstorm! Brainstorming takes on many forms, from mind maps to doodles to bulleted lists. As you brainstorm your PBL mathematics experience, consider how each of the Six Essential Attributes impacts the overall project. Figure 18.1 highlights my project brainstorm for the *Mugs O' Math* project.

MAP THE PROJECT

After a project brainstorm, consider mapping out the entire project. This is like creating a large outline or road map that highlights the essential experiences that move students from Point A (the project launch) to Point B (the project conclusion).

Figure 18-1 • Mugs O' Math Project Brainstorm Example

PROJECT BRAINSTORM		
Brainstorm project ideas by considering the top three Essential Attributes first. Ensure the Rigorous Content, Authentic Connections, and Meaningful Assessment are aligned, forming a cohesive project.		
Rigorous Content	Authentic Connections	Meaningful Assessment
<p>What content standards will this project meet? What Mathematical Habits of Mind and success skills will students engage in?</p> <p>content standards:</p> <ul style="list-style-type: none"> • surface area & volume of 3D objects • circumference & area of a circle • formal writing <p>Mathematical Habit of Mind:</p> <ul style="list-style-type: none"> • Communicate Mathematically <p>success skill:</p> <ul style="list-style-type: none"> • design thinking (emphasize iteration) 	<p>What will be my authentic situation or problem? What audience might care about this topic?</p> <p>authentic situation:</p> <ul style="list-style-type: none"> • small businesses need support marketing their business • small businesses owners may not have time or finances to create marketing materials <p>authentic audience:</p> <ul style="list-style-type: none"> • small business owner • Downtown Mainstreet Inc. • marketing majors from local universities • businesses that develop promotional items & materials 	<p>What product will my students create? What culminating experience will highlight student work?</p> <p>product ideas:</p> <ul style="list-style-type: none"> • formal introductory letter • client intake form • ongoing correspondence • orthographic sketches • Tinkercad designs & video • mathematical specifications sheet (aka spec sheet) • 3D-printed mug <p>culminating experience ideas:</p> <ul style="list-style-type: none"> • visiting each small business • short presentation by students to business owner or employee • #socialmediablitz • local news coverage
Using your brainstorm of the first three Essential Attributes, brainstorm ways you will engage students in Productive Inquiry, enhance student Identity & Agency, and promote Growth Through Reflection.		
Productive Inquiry	Identity & Agency	Growth Through Reflection
<p>What activities will engage students in learning about content? How will students develop the Mathematical Habits of Mind and success skills needed for the project?</p> <p>activities:</p> <ul style="list-style-type: none"> • investigation of promo items • nets of 3D shapes • surface area & volume of a cylinder exploration • converting cubic cm to fluid oz • professional writing & communication • how to use 3D printing software (Tinkercad) <p>potential experts:</p> <ul style="list-style-type: none"> • Designz (local promotional item business) • university marketing majors • In*Tech Integrated Marketing Services 	<p>How will students develop a mathematical identity or increase their sense of agency through this project?</p> <p>identity:</p> <ul style="list-style-type: none"> • students embody role of a marketing professional • student identity as a mathematician elevated through communicating mathematics with client (small business owner or employee) <p>agency:</p> <ul style="list-style-type: none"> • students use mathematics to positively impact a small business • students choose businesses run by diverse family or community members, helping these local businesses thrive & compete against larger businesses 	<p>How will students engage in critique? How will students use reflection to grow in content understanding and skills?</p> <p>critique opportunities:</p> <ul style="list-style-type: none"> • ongoing feedback from client (small business owner or employee) • Gallery Walk of initial sketches (Glows & Grows) • See-A-B protocol with draft of Tinkercad designs • Tuning protocol before submitting finalmug design <p>reflection opportunities:</p> <ul style="list-style-type: none"> • after receiving feedback from client • after each critique protocol (above) • after presentation of mugs to local business owners: audio reflection

YOUR TURN

How is the project you brainstormed in Chapter 12 aligned to the Six Essential Attributes of the PBL mathematics classroom?

PROJECT BRAINSTORM

Brainstorm project ideas by considering the top three Essential Attributes first. Ensure the Rigorous Content, Authentic Connections, and Meaningful Assessment are aligned, forming a cohesive project.

Rigorous Content	Authentic Connections	Meaningful Assessment
What content standards will this project meet? What Mathematical Habits of Mind and success skills will students engage in?	What will be my authentic situation or problem? What audience might care about this topic?	What product will my students create? What culminating experience will highlight student work?

Using your brainstorm of the first three Essential Attributes, brainstorm ways you will engage students in Productive Inquiry, enhance student Identity & Agency, and promote Growth Through Reflection.

Productive Inquiry	Identity & Agency	Growth Through Reflection
What activities will engage students in learning about content? How will students develop the Mathematical Habits of Mind and success skills needed for the project?	How will students develop a mathematical identity or increase their sense of agency through this project?	How will students engage in critique? How will students use reflection to grow in content understanding and skills?

PLAN THE LAUNCH

Start your engines! Time to plan that engaging project launch. Remember, a project launch has four key pieces: the engaging hook, driving question, project overview, and “need to know” questions.

Driving Question

I like to begin by writing, revising, and refining my driving question first. Remember, a strong driving question is engaging to students, open-ended, and aligned to learning goals. Here are a few iterations of the driving question of my *Mugs O’ Math* project. To make my thinking visible, I’ve included annotations of why I made each change. After reading my example in Figure 18.2, try creating several iterations of your driving question!

Figure 18-2 • *Mugs O’ Math* Project Driving Question Iteration

Iteration Number	Possible Driving Question (DQ)	Reason to Change
1.	How do businesses create promotional items that attract and retain customers?	This DQ doesn’t really align to my project goals. Based on my wording, the emphasis is on how and why businesses create promotional items, not on how students could do this.
2.	How can we use mathematics to create a mug for a local business?	This DQ is moving in the right direction. It brings the student (we) into the action. It specifies a product and is aligned to learning goals. This DQ doesn’t sound engaging to students. The students know they will be using mathematics, so I don’t need to say that.
3.	How can we, as seventh graders, create promotional items to help local business owners attract and retain customers?	This is really close to what I want! I can think of a better role because my students are already seventh graders. The end of the question gets a little wordy.
4.	How can we, as marketing professionals, partner with local business owners to create a promotional item?	Final choice! I like the role as I imagine students in teams of two or three, where they pretend they are a marketing agency and have even more specific roles within their agency. I like the change in word choice to <i>partner</i> with local businesses to emphasize the collaboration about to happen.