

“You are a....” The Integral Role of Apprenticeship in Problem-Based Learning.

“You are a member of the Council of Elders. It’s a rainy day in 1348, and someone has just announced that a disease has struck near your town of Lucca, Italy....” (paraphrased from Gallagher, 2012a).

So starts a Problem-Based Learning (PBL) unit. Those who are familiar with PBL know what happens next: students begin to ask questions about the scenario they were presented: *What is the disease? Is it contagious? How long do we have before it arrives? Where is Lucca, Italy? What authority does a Council of Elders have? What is life like in 1348? What medicines are available?* The search for answers to these and other questions will chart the students’ course through the problem.

Problem-Based Learning takes advantage of the power of story and the allure of problems to create effective, engaging learning environments. Indeed, the ill-structured problems alone are so captivating they tend to dominate the conversation about K-12 PBL. But PBL is not just another word problem, it’s not even just another problem-solving strategy, it is a system of curriculum and instruction designed to immerse students in a problem-solving experience from the viewpoint of someone inside the problem. The single-minded emphasis on the problem in most K-12 PBL literature is lopsided and keeps teachers and students from benefiting from the full potential built into the model.

A learner-centered focus to PBL corrects the imbalance and turns attention to a short but influential phrase in the problem introduction: *“You are a...”* This statement introduces students to their stakeholder role. In the problem above, the stakeholder is the Council of Elders. Students will be asked to enter this perspective and solve the problem as though they had the fate

of the town in their hands. It is, in essence, an apprenticeship. Using *apprenticeship* as the centerpiece of the PBL experience, and the ill-structured problem as the apprentice's story may help improve practice and enhance appreciation for this tightly integrated model of curriculum and instruction.

Shifting Focus from Problem to Apprentice

When Howard Barrows and his colleagues (Barrows & Tamblyn, 1980) transformed medical education, their chief aim was not to use ill-structured problems; it was to create better doctors. They wanted aspiring physicians to practice being professionals from their very first day in school, stepping out of the role of 'student' and into the role of 'apprentice physician'. It quickly became apparent that the apprentices needed to solve the problems a doctor solves by using a doctor's method of problem-solving. This insight led to the decision to initiate learning with the presentation of simulated patients; each patient's symptoms were an ill-structured problem. The use of ill-structured problems was a result of a desire to provide an authentic learning environment to apprentice doctors. The apprenticeship, not the problem, is the heart of Problem-based Learning.

Ironically, the contribution made by assigning a stakeholder role is largely absent from the medical school literature. In medical school the role is implicit; medical students adopt roles and perspectives of health care professionals because they are preparing for health care fields. However, the influence of the stakeholder/apprentice is crucial to the K-12 PBL experience—a lot happens in the simple act of asking students to don the role of "Council of Elders" facing the black death.

Apprenticeship in Ill-Structured Problems. While the stakeholder role is not discussed in medical PBL, the notion of a cognitive apprenticeship is (Savery & Duffy, 2001; Hmelo-Silver

& Barrows, 2006). A cognitive apprenticeship is defined as, “learning-through-guided-experience on cognitive and metacognitive... processes.” (Collins et al, 1989, p. 456). In PBL the cognitive apprenticeship is focused on helping students learn how to approach, and ultimately solve, an ill-structured problem. Ill-structured problems form the perfect landscape for an apprentice’s learning journey because they are the heart of an expert’s everyday practice. Within an ill-structured problem students learn content knowledge, thinking skills, learning procedures, and metacognitive reflection. Moreover, ill-structured problems require that students learn to use these skills in different sequences and combinations (Jonassen, 1997). This is especially beneficial for gifted students, who have many of the attributes of expertise early in life (Gallagher, 2009; 2012). Problem-based Learning is an ideal environment to transform a gifted student’s raw potential into refined practice.

Engaging through Story. Among the most consistent findings in research on ill-structured problems is that they enhance student engagement and investment in learning (Barron et al. 1998; Bransford, Brown & Cocking, 2000; Brophy et al. 2008). This effect is amplified in Problem-based Learning through the use of the stakeholder role. When students assume their stakeholder/apprentice role, they enter into the world of the ill-structured problem and become the collective protagonist of a story. Stories are more memorable than other forms of narrative (Graesser, Olde & Klettke, 2002) even capturing the imagination of children who normally find it hard to focus (Willingham, 2004). The storyline of the ill-structured problem engages the same mindset that children use when they imagine they are at Hogwarts, in Narnia, or on Tatooine. The role serves as a signal that students aren’t supposed to think like kids, but as someone else. Suspending disbelief and standing in the shoes of someone inside the problem, students step away from who they are and imagining who they could be. The stakeholder/apprentices begin to

wonder what will happen next and become curious about the possibilities (*How does the plague travel? When will it get here?*). They understand that while inside the world of the problem their actions could have an impact beyond themselves, and they imagine themselves both empowered and in need of knowledge (*How many people live in town or in the country? How can we save lives?*). The real-world settings of most ill-structured problems lend immediate relevance to the content and skills students are required to learn, leading to higher levels of achievement than in traditional instruction (Hickey, Moore, & Pellegrino, 2001).

The apprenticeship concept also helps explain the use of a *single* stakeholder role in PBL: the goal is to have students travel together through the landscape of the problem. The adoption of a common role promotes collaboration and coordinated self-directed learning. Students begin to ask a new set of questions, this time about themselves (*How are we going to answer all these questions about the Black Death?*). Working together, students learn how to divide the workload and how to listen to alternate perspectives on a common issue (*Should we save the town or disband it?*). Thinking together, learning the same habits of mind, reflecting on common questions, students support collective intellectual growth (*How does our role as Council members affect our thinking? How does fear affect our thinking?*). Acting together, students create their own *community of practice*, with the ill-structured problem as their shared training ground (Hoadley, 2012).

Selecting Stakeholders and Charting the Journey

The advantage in curriculum design for K-12 PBL is that there are an endless variety of apprenticeships that can benefit young learners while building knowledge, skills, and perspectives. Selecting the problem that will serve as the storyboard for the cognitive

apprenticeship is primarily a matter of finding a topic that can lead to significant, standard-based content and then finding what is problematic about that topic.

Selecting the stakeholder is another matter. This decision, more than any other, sets the direction and tone of the unit, for it defines the nature of the apprenticeship. The choice of stakeholder affects the content students will learn, the tools that they will use, and the questions they will address. Sometimes the selection of a stakeholder is conscribed by subject matter. *Black Death* is a social studies unit so it makes more sense to have students think like town leaders than to have them think like medieval doctors. Placed in the role of town leaders, students could be reliably guided to target social studies objectives. Ideally, the stakeholder in a PBL unit will also lead students to engage in consideration of ethical behavior and will not place them in no-win situations: medieval physicians did not have a cure for the plague, so putting students in that position could not lead to a satisfying end without introducing science fiction in to the problem.

Once the stakeholder role is selected, the opening scenario can be crafted to generate the catalytic first questions that guide students to the unit's core content. But planning needs to go beyond the first day and this where it can help to think of curriculum planning as storytelling, and the scope and sequence as an apprentice's journey. The storytelling process is comprised of anticipating Learning Issues questions, when and how students will gather information, and when and how they will analyze what they find. This sequence unfolds like chapters in a mystery. In *Black Death*, it is easy to anticipate that the apprentice Council of Elders will need to learn how to read a map of Italy, and about the symptoms and outcome of the plague. Perhaps they need a surprise visit from someone who reveals new information and leads them along a new path of inquiry. All of these can be prepared as moments of embedded instruction within

the unit, while always leaving room for students to take the unit in legitimate, but unexpected directions. Each event provides clues that move the apprentices forward until they reach the end of their story, when they present their solution in a manner consistent with their role.

A Guide for the Apprentice's Journey: The Metacognitive Coach.

Perhaps the most substantial benefit from thinking of PBL as an apprenticeship is that it sharpens focus on the role of the guide, or metacognitive coach. Despite the pivotal role of instruction in K-12 PBL, pragmatic resources on coaching are still few and far between (Gallagher, 2009b, 2012; Hmelo-Silver, Duncan & Chinn, 2007; Vardis & Ciccarelli, 2008). It is the coach's job to ensure that students benefit from the learning potential provided by the ill-structured problem by scaffolding for self-directed learning, promoting metacognitive reasoning, to cultivating high-quality thinking, and to encouraging independent action among her apprentices.

Scaffolding for Self-Directed Learning. The first step in scaffolding the classroom is selecting or designing a problem that is carefully constructed to be open, yet reliably achieves content objectives. This liberates the coach to focus on thinking instead of content acquisition. Some of the most important work for a metacognitive coach occurs behind the scenes by modulating the level of challenge in a problem, ensuring that students have access to helpful resources, thinking about ways to scaffold student thinking.

Scaffolding while teaching involves supporting learning processes as well as thinking processes. Scaffolds for the learning process includes establishing clear expectations about what will happen during a PBL unit, roles for teacher and students, and also by providing aides that help students become independent, like discussion guides or procedures young apprentices

should use when leaving the classroom for research. Process guides can take the form of handouts, class charts, or learning center materials; additional ideas are included in Table 1.

Supporting the Storyline. One of the most influential changes a teacher can make in PBL is teaching students as though they are apprentices, not as though they are children who are role-playing. Although this necessarily varies by student age, experience suggests that PBL problems work best when teachers treat the students as though they were in charge, and the teacher is there to assist. Students usually respond well when teachers explain that they are being given an opportunity to practice in the manner of a professional. If teachers take the responsibility of having apprentices seriously, and matter-of-factly expect students to accept their role, then the experience can be fulfilling far beyond role playing in class. It is both inspiring and motivating to see students enjoying a PBL experience. However, the goal of PBL is not to be fun, but to be meaningful.

Occasionally, the coach keeps the story alive throwing a twist or “kicker” in the plot to introduce a new idea or to pull everyone back on track. The Council of Elders in *Black Death* unit could be surprised by news that a neighboring town is closing a trade relationship, or there could be a fire in the middle of the unit, potentially forcing people to live in even closer proximity. This is one of the most important ways a coach has to manage the direction and content of the problem after the first day.

Promoting Metacognitive Reasoning. The Learning Issues (or Need to Know) Board is the hub of metacognitive instruction throughout the unit. The simple graphic organizer frames classroom conversation with fundamental metacognitive questions “What are my hunches (assumptions)?”, “What do I know?”, “What are my learning issues?”, and “What is my Plan of

Action?”. While filling out the chart, students learn to discern between assumptions and facts, question self-knowledge, and alternate between broad and narrow forms of thinking.

The Learning Issues Board remains a point of reference throughout the unit, and can help the teacher/coach to scaffold metacognitive questions for class. Each class should start at the Learning Issues Board with questions like *Where do things stand right now?*, *What kind of questions do you think you should ask as members of the Council of Elders? Which questions do we need to answer today?* Each class should end with *What have we accomplished in the past hour? Who can summarize what we’ve learned today? Where did we hit stumbling blocks? How can we fix them?* or *What, if anything, do we need to get done overnight to be ready for tomorrow?* at the end. Framing class sessions with these questions ensures that no one loses focus and keeps students involved in the decision-making process.

Cultivating Higher-Order Thinking. While PBL teachers don’t lecture, they do teach. Instead of teaching content, they use the information students bring to class to teach thinking skills and dispositions. They transfer their knowledge of how to think by first modeling and coaching, as apprentices try out thinking skills and then by fading into the background when apprentices integrate new skills into an intellectual toolkit. In classrooms for gifted students, the skills and standards transferred from coach to apprentice should include methods of conceptual reasoning and advanced standards of judging ideas, such as elegance or parsimony.

A crucial element in planning PBL and in the apprenticeship experience is building in time to think. It is easy to let activity overtake analysis in Problem-based Learning, but evidence suggests that students become more independent and are more satisfied when moments of exploration are balanced with analysis and discussion of what they have learned (Hmelo-Silver,

2004). Remembering that that goal of PBL is to provide students with a cognitive apprenticeship helps keep the need for protected time for discussion in the forefront of curriculum planning.

Encouraging Independent Action. In a successful apprenticeship the guide becomes unnecessary; over time, the same should happen in PBL. This realization throws a new light on the notion of self-directed learning. Often strategies for self-directed learning stop short of actual independence and focus instead on self-direction within a group project or a conscribed activity. Comprehensive independence should eventually involve all aspects of classroom practice, from running classroom conversation at the Learning Issues Board to determining the sequence of learning experiences, to selecting and scheduling guest speakers, requesting time in the media center, and resolving class conflicts. Naturally, the path to complete self-directed learning is longer for K-12 students than it is for medical students, but PBL requires attention to a scope and sequence for real independence. At all times a PBL coach should be reflecting on the questions: Where can I give my apprentices practice in decision making? What tasks are they ready to take from me? How can I make these apprentices less dependent?

The Journey and the Destination

In the full model of PBL, the ill-structured problem and metacognitive coaching each make singular contributions to the apprentice experience, as suggested in Figure 1. When all the parts are working well, PBL creates an environment where students can begin to collaborate in all decisions from what to study to the sequence of instruction. The problem provides the apprentices with a realistic context that engages their imaginations with the power of story and heightens their desire to become knowledgeable, while at the same time incorporating standards-based content and skills. But without a focus on the all apprentices' learning needs, the problem could lack depth and substance. Metacognitive coaching responds to needs for apprentices to

access systematically more challenging resources and to stretch their ability to work with a variety of tools as they ask questions and then gather, analyze, and report information. Eventually, student/apprentices should have enough practice that they can run a PBL on their own—not just logistically but interpersonally and intellectually.

The final benefit gained from focusing on the apprenticeship in PBL is the implicit reminder that the most significant benefits of PBL occur when students have repeated exposure to the model. PBL is among the most researched educational model in use today, including research using gifted students (Feng et al, 2005; Gallagher & Stepien, 1996; Gallagher, Stepien & Rosenthal, 1992; Van Tassel-Baska et al, 1998). The evidence is clear that students have everything to gain and little to lose from increased use of PBL. The model works, especially with gifted students, even those who are traditionally under identified in gifted programs (Gallagher & Gallagher, 2013).

An apprenticeship is a lengthy business that requires repeated practice. Eventually students should move from *learning* strategies to *selecting* strategies. Eventually the coach should move from the front of the room, modeling, to the back of the room, consulting. Apprentices should, someday, cease to be apprentice as they continue the expedition from dependent ignorance to independent insight.

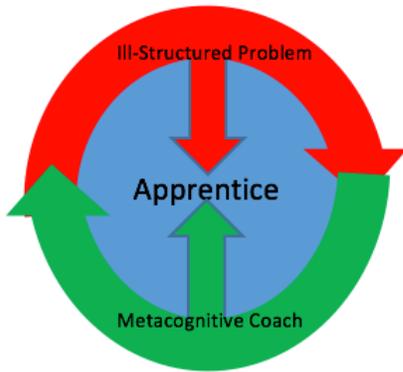
Table 1. Classroom Scaffolds for Problem-Based Learning

Purpose of Scaffold	Type of Scaffold	Example
Communicate Expectations	Orientation	Discussion about expectations and roles during PBL before beginning the problem.
	Rubrics describing performance expectations	Classroom Engagement Rubric
	Classroom structures	Discussion Guidelines Procedures for leaving the classroom for research Graphic organizer of the flow of PBL problem solving
Support Independent Action	Outside contacts	Guidelines for contacting guest speakers or email mentors Templates for invitations and appreciations for guests
	Communication skills	Outlines or graphic organizers to prepare written and oral presentations
	Interactions	Procedures to resolve classroom disputes Perspective taking rubric
Support Effective, Independent Investigation	Balance between student-discovered research and assigned articles	WebQuests with prescreened articles Assigned articles
	Helping students connect research to the problem	Note-taking guide requiring explicit connection to a Learning Issues question

		Clear, specific, researchable Learning Issues questions
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Adapted from Gallagher, 2009.

Figure 1.



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