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*Learning, Teaching, & Technology, Michael Orey, Editor*

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## **Constructionism, Learning by Design, and Project Based Learning**

**by S. Han & K. Bhattacharya**

### **Constructionism: Instructional Model**

The trainers at Performance Solutions were excited. Finally, a workshop on designing and delivering effective web-based instruction was being offered! When they first heard about the workshop, the trainers thought it odd. Management had explained that clients are more impressed with better design and delivery for web-based instruction, which leads to better buy-in for product sales. Typically, the trainers just followed the company protocol. They really had no strategies for effectively delivering web-based instruction. Now, with this conference, they felt that they could look forward to learning techniques and strategies to improve delivery and increase their well-deserved commission. The training was designed to comprise one face-to-face introductory meeting, followed by web-based instruction for the remainder of the six-week course.

The workshop, held on a Saturday, was composed of attendees that were trainers who normally consulted with clients, and those who trained their trainers and managers. Kayla Johnson, a veteran in this type of instruction, facilitated the workshop on "How to Design and Deliver Effective Web-Based Instruction". Performance Solutions had hired her because of her ability to make instruction more creative, personalized, hands-on, meaningful, and effective for the participants.

As the meeting began, the participants settled down. Kayla, who was dressed in casual, business attire, had a friendly yet professional attitude. She provided some time for the participants to pair up and learn about each other so introductions could be exchanged. As the participants introduced each other, Kayla asked insightful questions about the participants' backgrounds, their clients, and what they hoped to take away from the class. She carefully noted facts when appropriate. After the introductions, Kayla previewed the activities she had planned for the day and opened the floor to questions. Realizing that it was too early for the participants to begin, she announced a ten-minute break before continuing with the next part of her instruction.

After the participants returned from the break, Kayla asked the audience for their ideas about effectively designing and delivering web-based instruction, while encouraging the participants to elaborate with examples from their own experience. As ideas were offered, Kayla recorded them on a flip chart. Among the ideas generated were preparation, multiple assessment strategies, learner assessment,

knowledge of the topic, flexibility, and functional interface design. Kayla, after listening to and recording all the responses, highlighted common themes and salient points, which were integrated into her PowerPoint presentation. At the end of her presentation, Kayla again opened the floor to questions. After answering a few questions with anecdotal examples, Kayla suggested they break for lunch.

After lunch, Kayla anticipated that the participants might be lethargic. She began the afternoon session by engaging them in an exercise that would be meaningful and energizing for the afternoon's tasks. Kayla guided the attendees through examples of a variety of web-based instructions as the learners observed their own strengths, weaknesses and functionality of the sites. Kayla made a list of their observations and provided a copy to each participant of the workshop.

Kayla moved very quickly to the next task that she had prepared for the participants. Each participant was to design a plan for a web-based instruction. The project should be one they were currently working on for their own clients. Instruction was to follow tips and guidelines from handouts she had provided. The participants would determine the form of media used and were free to use the software on their workstation computers or the from Internet if appropriate. The components to be present in the planning stage of their selected projects were: learner analysis, time frame, interface metaphor, multiple modes of presentation, assessment strategies, variety of learning tasks, and creation of a learner-centered environment. The participants were to work first individually and then in groups to discuss their plans, obtain feedback, and make necessary modifications and re-evaluations. Then, each group would choose one plan to be presented to the class. The participants would have an opportunity to offer feedback based on the guidelines provided in the handout. They could choose to deliver their presentation through concept models, oral explanation, flip charts, PowerPoint presentations or the Internet. The process was interactive, and the participants were thoroughly engaged. Ideas were plentiful as the participants planned and designed their own projects considering ways to deliver and evaluate them. Ongoing feedback was provided to group members by both Kayla and group peers. Kayla circulated, listened to ideas, helped with questions and cleared up any confusion that arose.

By the time presentations began, the groups were excited about hearing each other's thoughts and ideas. After each presentation, comments and questions were solicited from the audience. Ample feedback was provided in the areas of navigation issues, various communication tools, web-course management tools, multiple modes of presentation, and how to relate to learners on a personal level. Realizing that the participants had probably been overloaded with information, Kayla proposed a break after the last presentation.

When the workshop reconvened, participants were generally in high spirits as they discussed the presentations. They discussed their own design ideas and sought more feedback. Kayla started the session again by asking for a reflective discussion to guide the session. She asked the participants to relate their experiences, noting what stood out for them, what they had learned and what they would do differently. Kayla received rich feedback from this discussion. Sam offered that planning for an authentic project--one that he was working on rather than a meaningless mini project chosen by the instructor--was particularly helpful for him. Brainstorming and generating great ideas made him feel that he was now ahead of the game. Sonia found listening to others to be the greatest benefit to her; it helped her to generate new ideas about her own project. She asserted that she had learned more that day

from the hands-on work than in previous, boring workshops. She mentioned that Kayla's interest in the participants' experiences had made her feel valued as an adult learner and had encouraged her participation.

Kayla was pleased with all the reflective comments. She provided some additional internet resources and handouts for the participants. Kayla reminded them that the communication for remaining sessions between the participants would be done mainly via emails, chat sessions and bulletin board discussions which would allow the participants to share their ideas and learn from each other. At the end of four weeks, they would do their first pilots and gather feedback to guide necessary modifications. A pilot of their final product would be shared with the class and their intended target audience at the end of six weeks. Feedback from the instructor, peers, and clients would be used to make the final modifications to their projects. She offered some time slots for the participants to sign up for chat sessions to discuss ongoing topics and issues regarding the projects. Finally, she thanked everyone for their cooperation and asked them to remember that instruction is only effective when the learners can relate personally and take something away from it. The process of constructing a product as a learning outcome to engage learners was emphasized as an important hands-on activity. After this comment, Kayla concluded the session.

During the next three weeks, participants used journals and bulletin board postings to detail their progress. This allowed all the participants to gauge their own progress and provide insightful comments to each other. Chat sessions were held biweekly to discuss progress issues, roadblocks, and difficulties with subject-matter research. Kayla facilitated the first chat session; in subsequent sessions, participants were allowed to select a session to facilitate in any way they chose. Kayla provided some timely topics to guide discussion at various stages of the project. The participants found that taking part in leading a discussion in a chat session was enjoyable and beneficial. This not only generated new ideas, but allowed them to reflect on the appropriateness of those ideas for use in their own web-based instruction projects.

At the end of four weeks, the participants provided Internet links to their projects, and the participants were invited to critique those that were completed. With the feedback obtained, the learners further modified their projects. Chat sessions and bulletin board postings continued to be vehicles for sharing ideas and generating discussions. Finally, at the end of six weeks, participants piloted their projects both to the class and to a sample of their respective target audiences. Kayla assessed the participants based on their participation, progress in their work from the beginning to the end of the project, reflective discussions and self-reflection postings. Later, Kayla received many e-mails from her participants reporting that their projects were going well after implementation, and that they were remaining flexible in meeting the needs of their learners.

### **Questions to Consider from the Scenario**

1. How would you describe Kayla Johnson's class to an outsider?
2. What kind of instructional strategies did you observe?
3. Do you agree with the strategies used? Please explain.
4. Did you feel that learning took place, if so, to what extent?
5. How much of yourself do you see in Kayla and why?
6. What would you add or do differently in the scenario?

It is clear that Kayla used some powerful instructional strategies. Her session was learner-oriented; it focused on the learners, and on activities that allowed them to interact with the content and each other by sharing their ideas. Kayla took a keen interest in understanding the participants' contexts, and provided feedback accordingly. Through interactive strategies such as brainstorming and discussion sessions, Kayla engaged the learners both as a class and in groups. Moreover, Kayla allowed the learners the opportunity to interact with the content by designing web-based instructional projects used with their own clients. This personalized instruction engaged the participants. At the end of the exercise, each left the workshop with a unit of web-based instruction as an artifact created through the exploratory process. Moreover, Kayla used multiple methods of presenting content and engaging the learners so that they were motivated and maintained attention throughout both face-to-face and online sessions. Kayla's session incorporated elements of two constructionist models of education--specifically, Learning by Design and Project-Based Learning.



[Click Here to Play the Movie](#) Caption: The Project-Based Learning (PBL) video depicts a second grade classroom involved in the three phases of Project-Based Learning: the planning phase, the implementing or creating phase, and the processing phase. The class is shown choosing a topic and searching for resources during the planning phase. The class then works in groups to create the project in the implementing phase. The final project is shared with the class and visitors in the processing phase. Special thanks to Ms. Tina Matlock and her second grade class at Annistown Elementary in Gwinnett County, Georgia. **By Mary Taylor and Linda Van Lith (2003)**

### **Constructionism: What is it?**

For a description of the differences between Project-based Learning and Problem-based Learning, [click here](#).

Constructionism (Papert, 1993) is both a theory of learning and a strategy for education. It builds on the ["Constructivist" theories of Jean Piaget](#), asserting that knowledge is not simply transmitted from teacher to student, but actively constructed in the mind of the learner. Learners don't get ideas; they create ideas. Moreover, constructionism suggests that new ideas are most likely to be created ideas when learners are actively engaged in building some type of external artifact that they can reflect upon and share with others. Papert (1991) differentiated between constructivism and constructionism:

"The word with the v expresses the theory that knowledge is built by the learner, not supplied by the teacher. The word with the n expresses the further idea that happens especially felicitously when the learner is engaged in the construction of something external or at least sharable" (Papert, 1991, p.3).

Constructionism supports the constructivist viewpoint--that the learner is an active builder of knowledge. However, it emphasizes the particular constructions of external artifacts that are shared by learners. Although learners can construct and present knowledge or meanings without producing external products, the processes of construction are more evident when learners produce through social interaction with others and share representations of their understanding and thoughts.

### **Constructionism in the Classroom: What does it involve?**

A classroom based on constructionism has many elements that promote a learner-

oriented learning environment. In this learning environment, the instructor acts as a facilitator and guides the learners along their paths of learning. Learners are assigned tasks in which they must implement particular instructional goals. They investigate, create, and solve problems. Some of the elements in a learning environment guided by constructionism are:

- Presentation of rubrics which define expectations
- Dialogue on interpretation of the assignment
- Exploration of multiple strategies for tackling the assignment
- Inquiry/learning discussion
- Presentation of work
- Projects which include revision and development of an idea
- Learner collaboration
- Learners working with professionals in the outside world
- Learners engaging in "genuine," authentic real-world tasks

In a learning environment guided by constructionism, it is important to set lesson/unit goals and expectations at the outset, so that learners understand what they are trying to achieve and the level of that achievement. Explaining multiple strategies allows the learners various ways of solving the problems that they encounter. Obtaining feedback through presentation and discussion allows the learners to revise their projects/artifacts. Lastly, an involvement with application in the real world allows the learning process to take place in a more meaningful context.

#### *Constructionism In Kayla's Training Session*

Many of the above mentioned elements were present in the learning environment created by Kayla. She started the session with an agenda, clarifying expectations in a handout she created. She offered learners multiple strategies to handle their projects. Participants were allowed to brainstorm with colleagues, work on their own, solicit Kayla's help and have access to the Internet as well as other planning and design software for quick research. The discussion and the presentation allowed the participants to obtain rich and varied feedback. The tasks chosen by the participants were those that were real to them. This environment, like most learning environments guided by constructionism, required the learners to construct artifacts reflecting their acquisition of knowledge. As a result, learners became researchers, investigators, and to some extent artists in designing the learning environment for their target audience. The rationale is that the ways learners analyze the external world reveal their thought processes.

Constructionism can be implemented in two forms-- Learning by Design (LBD) and Project-Based Learning (PBL). Because constructionist theories and strategies guide LBD and PBL, they have many features in common; however, they also differ in the kind of tasks that are expected of participants. Both LBD and PBL share a student-centered environment, as stipulated in constructionism. Learners in both environments are expected to take more responsibility for their learning; in both environments, learners have choices and are provided with opportunities to participate in real-world tasks that are meaningful for them.

In LBD, the participants are expected to design an artifact for their pre-selected target

audiences; this can be an individual undertaking or a group work. However, PBL can involve long-term project work or working with other people and does not necessarily involve designing a learning environment for a targeted audience.

So what does this imply for implementing constructionism in practice? What issues should be considered in creating an environment grounded in constructionism? A significant part of a constructionist learning environment involves planning and preparation by the instructor. However, these planning and preparation strategies seem to differ from classroom to classroom and from instructor to instructor. Another issue that emerges is the accommodation of learner preferences. The instructor's role is complex one; teachers must balance the functions of disseminating information and facilitating while confronting their own biases towards learning and instruction. Communication of instructional procedures and strategies is another problem to be addressed in a constructionist environment. Learners must, at least to some degree, understand the design process which enables them to create their sharable artifact. What kind of procedures and processes should an instructor implement to ensure this understanding?

Moreover, assessing learners is a challenge in an open-ended and ill-defined learning environment which offers multiple choices. Thus, setting clear criteria for measuring progress or learning can be difficult and can vary from learner to learner. What kinds of feedback strategies should be implemented and how much should instructors change their approach based on learner feedback? Clearly, constructionism in practice raises several questions, that need answers. A discussion of the two types of constructionism in practice- Learning by Design and Project-Based Learning may provide answers. In the following sections, many of the questions are answered through explanations, strategies, and examples.

### **Learning By Design: What is it?**

Learning by Design emerges from the constructionist theory that emphasizes the value of learning through creating, programming, or participating in other forms of designing. The design process creates a rich context for learning. Learning by Design values both the process of learning and its outcomes or products. The essence of Learning by Design is in the construction of meaning. Designers (learners) create objects or artifacts representing a learning outcome that is meaningful to them.

### **Goals of a Learning by Design Environment**

Many goals can be identified for an environment driven by Learning by Design. These goals may vary with the learner, content, task, and the instructor. However, there are some common trends permeating most environments that follow the principles of Learning by Design. The following reflects the common goals of Learning by Design, that are not, however, exclusive to this type of constructivist learning.

- Extracting essential concepts and skills from examples and experiences
- Engaging learners in learning
- Encouraging question posing
- Confronting conceptions and misconceptions

## Components of Learning by Design

There are many perspectives on what constitutes Learning by Design. As this field evolves, the list will become more fluid. The following components allow for a rich learning environment that provides the learner with opportunities to interact with the content in a meaningful way. These elements also add to the value of effectively designing and reflecting on process and product to make the learning experience worthwhile. The following are the components most readily identified in a LBD environment.

- Authenticity: tasks based on real-world applications
- Multiple contexts for design activities
- A balance of constrained, scaffolded challenges with open-ended design tasks
- Rich, varied feedback for designers
- Discussion and collaboration
- Experimentation and exploration
- Reflection

Learning by Design strongly suggests that tasks should be based on hands-on experience in real-world contexts. The designers/participants should be given the option of multiple contexts so that they can devise multiple strategies when they use the problem-solving process. Because the learning process is open and varied according to the student learning preferences, skills, and knowledge, it is important that there be a balance among guided tasks, challenges, discussions and reflections that follow. Collaborative work allows the learners to obtain feedback from both peers and the instructor, who primarily plays the role of facilitator.

The visual model of the Design Process (see Figure 1) represents the essence of Learning by Design. The learner begins walking down the "path of knowledge," and stops to choose a topic or task (Stop 1). This task would be based on a real-world application that is meaningful for the learner. The next stop (Stop 2) is to describe the audience. The choice of audience will guide the learner as he designs the specific artifact. The following stop (Stop 3) along the path is the actual creation of the artifact. Once the artifact is created, the learner will then pilot the artifact (Stop 4). At this point, the learner should receive feedback from the facilitator and peers (Stop 5). The learner then reflects on the artifact and the feedback in order to evaluate his work (Stop 6). The learner can then modify the artifact based on this evaluation (Stop 7). The entire design process is overseen by the facilitator who is represented by the "eye in the sky."



Caption: In the above flash animation a learner begins walking down the "path of knowledge" by brainstorming (represented by a cloud) and finally choosing a topic, task, challenge, or idea to explore. This takes place under the careful watch of the facilitator, represented by the "eye in the sky." This chosen topic is based on a real-world application that is meaningful for the learner. The target audience is described and individual differences are noted. With this in mind, the learner creates an artifact (in this case a bridge) to solve the challenge (crossing the chasm). The artifact is piloted as the learner crosses the newly built bridge. The learner immediately receives feedback from the target audience and the instructor. Instructor feedback is represented by the "owl of wisdom" descending from the eye to sit on the learner's shoulder. After reflection, the learner modifies the artifact to improve it (in this case, make it more stable). The learner gains knowledge at each step in the process. This animation was designed and developed by Bill Gray, Sangmin Lee, Tana Martin, Suzy Searcy, Jason Thomas, and Carole Williams

### Learning by Design in Kayla's Session

Kayla incorporated many strategies suggested by the Learning By Design (LBD) framework. First, Kayla created a learner-centered environment in which she assumed the role of the facilitator by minimizing lecture time and increasing learner participation through thought-provoking questions, feedback and guiding or scaffolding the learners as they began planning and designing their projects. The task Kayla prescribed was to construct an artifact, web-based instruction for their target audiences. The learners were provided with examples of many different contexts if they had none of their own. However, because each of the trainers had their specific clients, they were provided with multiple contexts as options. Additionally, the group discussions allowed the participants to obtain feedback from their peers, which they used to modify their projects; further input came from the facilitator and their projected target audience when the projects were piloted at the end of the training session. Participants were allowed to reflect on their learning and what they were taking away from the instruction. This reflection process is helpful for both the facilitator and the participants, as constructionism is geared to prepare learners with skills that will make



them life-long learners.

### Learning by Design: Instructional Strategies

As with any learning environment, many strategies can be employed to make the learning process more meaningful. Because the learner is an active builder of knowledge, according to constructionism, it is essential that the learning environment be learner-centered. Some strategies can be implemented in the learning environment to promote a LBD framework. (Table 1). There is no prescribed set of linear procedures in creating a LBD classroom environment ; however, the table offers strategies and examples that can ensure an enriched LBD environment.

Table 1: Learning by Design (LBD) - Strategies and Examples

| Strategies   | Implementation Examples   |
|--|---|
| 1. Clear expectations from day one   | <ul style="list-style-type: none"> <li>• Handouts</li> <li>• Explanation</li> <li>• Discussion session</li> <li>• Web page</li> <li>• Clarification of questions embedded in the course</li> </ul>  |
| 2. Inform participants of implicit and explicit objectives and how they will be evaluated    | <ul style="list-style-type: none"> <li>• Discussion following pre-test</li> <li>• Handouts</li> <li>• Web page</li> <li>• Question/answer sessions</li> <li>• Collaboratively determined evaluation criteria</li> </ul>   |
| 3. Learner should be the active builder of knowledge   | <ul style="list-style-type: none"> <li>• Brainstorming</li> <li>• Group discussions</li> <li>• Games</li> <li>• Decision making</li> <li>• Learner has a choice of topic</li> <li>• Learner has a choice of context</li> <li>• Investigative tasks</li> </ul>                                 |
| 4. Instructor should take on the role of a facilitator, motivator                            | <ul style="list-style-type: none"> <li>• Scaffold learners' activities</li> <li>• Challenge learners</li> <li>• Assign open-ended design tasks</li> <li>• Balance scaffolding, challenging learners and assignment of tasks</li> <li>• Reinforce concepts, confront misconceptions</li> </ul> |
| 5. Tasks given should allow learners to design and construct an artifact that can be shared. | <p>Design tasks can include but are not limited to:</p> <ul style="list-style-type: none"> <li>• Educational software</li> <li>• Educational games</li> <li>• Web sites, PowerPoint presentations</li> </ul>  |

|   |  |
|---|--|
| <p>6. Provide rich and varied feedback for the designers/learners</p> | <ul style="list-style-type: none"> <li>• Agreeing on a rubric initially</li> <li>• Self evaluation through reflection</li> <li>• Journals</li> <li>• Progress reports</li> <li>• Class discussion</li> <li>• Short paper</li> <li>• Peer evaluation</li> <li>• Portfolio: progress report</li> <li>• Piloting to target audience</li> <li>• Piloting to subject matter experts</li> <li>• Feedback by observing student interaction and participation</li> </ul> |
|---|--|

These strategies can effectively prevent problems common in LBD environments such as:

- Unclear expectations
- Minimal or incomplete information
- Lack of clear instructional objectives
- Accommodation of learner preferences
- Complex instructor role: moving from traditional to innovative
- Assessment of the learning process

For example, to address the issue of unclear expectations, instructors should clarify the expectations from the outset. Various modes of clarification have been suggested, but it is crucial that the communication of expectations and questions be clear.

### **The Essence of Learning by Design : Constructionism in Practice**

In summary, the essence of Learning by Design lies in the experience of the learner as a designer and creator of an external, shareable artifact. Learners become more accountable for their learning through designing, sharing, piloting, evaluating, modifying their work, and reflecting on the process. The instructor acts as a facilitator and motivator by creating an open-ended learning environment and by challenging and scaffolding the learners in a balanced manner while providing options with rich and varied feedback. Through this experience, learners construct meaning and internalize the learning process.

### **Some examples of Learning by Design:**

<http://www.cs.colorado.edu/~l3d/research/projects.html>

<http://www.learningdesignstudios.com/flash.html>

<http://www.avalon.net/~synapse/webpages/home.html>

<http://www.positivepractices.com/LearningbyDesign/LearningbyDesign.html>

[http://www.ues.gseis.ucla.edu/curriculum/Room1and2/Teachers/Galas/outreach/HTML\\_Presentation\\_folder/sld006.htm](http://www.ues.gseis.ucla.edu/curriculum/Room1and2/Teachers/Galas/outreach/HTML_Presentation_folder/sld006.htm)

<http://cms.mit.edu/games/education/Extreme/Learning.htm>

**Articles:**

[http://www.ptc.com/for/educational/virtual\\_reality\\_sdsu.pdf](http://www.ptc.com/for/educational/virtual_reality_sdsu.pdf)

**Books:**

Gagnon, George W. & Collay, Michelle (2001). [Designing for Learning: Six Elements in Constructivist Classrooms](#) Corwin Press, Incorporated

## Project-Based Learning - What is it?

Project-Based Learning is a comprehensive instructional approach to engage learners in sustained, cooperative investigation (Bransford & Stein, 1993). Project-Based Learning is a teaching and learning strategy that engages learners in complex activities. It usually requires multiple stages and an extended duration--more than a few class periods and up to a full semester. Projects focus on the creation of a product or performance, and generally call upon learners to choose and organize their activities, conduct research, and synthesize information. According to current research (Thomas, Mergendoller, & Michaelson, 1999; Brown & Campione, 1994), projects are complex tasks, based on challenging questions, that serve to organize and drive activities, which taken as a whole amount to a meaningful project. They give learners the opportunity to work relatively autonomously over extended periods of time and culminate in realistic products or presentations as a series of artifacts, personal communication, or consequential tasks that meaningfully address the driving question. PBL environments include authentic content, authentic assessment, teacher facilitation but not direction, explicit educational goals, collaborative learning, and reflection.

Constructionism is reflected in PBL by

- creation of a student-centered learning environment
- emphasis on artifact creation as part of the learning outcome based on authentic and real life experiences with multiple perspectives

Thus, learners are allowed to become active builders of knowledge while confronting misconceptions and internalizing content and associated conceptions.

## Components of Project-Based Learning

Seven features can be identified as key components of Project-Based Learning. These features can be used in describing, assessing, and planning for projects. They are:

1. Learner-centered environment
2. Collaboration
3. Curricular content
4. Authentic tasks
5. Multiple expression modes
6. Emphasis on time management
7. Innovative assessment

*Learner-centered environment:* This component is designed to maximize student decision-making and initiative throughout the course of the project including topic selection to design, production, and presentation decisions. Projects should include adequate structure and feedback to help learners make thoughtful decisions and revisions. By documenting learners' decisions, revisions, and initiative, teachers (and learners) will capture valuable material for assessing student work and growth.

*Collaboration:* This component is intended to give learners opportunities to learn collaborative skills, such as group decision-making, interdependence, integration of peer and mentor feedback, providing thoughtful feedback to peers, and working with others as student researchers.

*Curricular content:* Successful integration of content requires projects to be based on standards, to have clearly articulated goals, and to support and demonstrate content learning both in process and product.

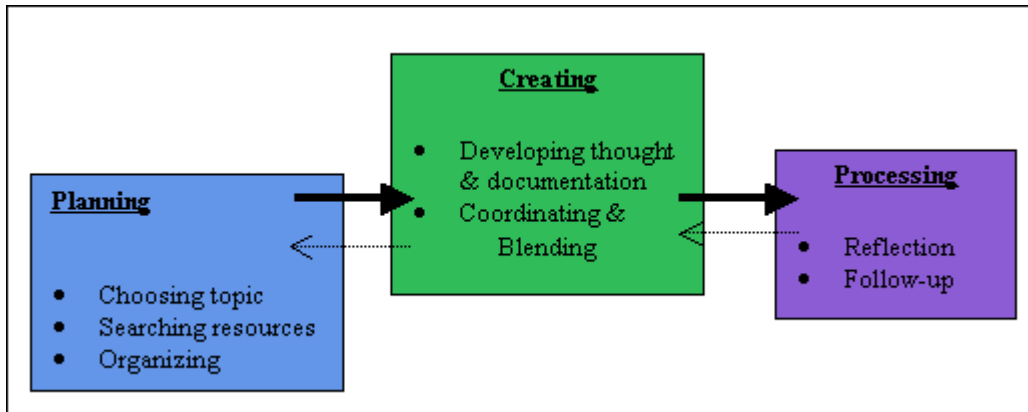
*Authentic tasks:* This element can take on many forms, depending on the goal of the project. PBL may connect to the real world because it addresses real world issues that are relevant to learners' lives or communities. A project may be connected to real professions through the use of authentic methods, practices, and audiences. Communicating with the world outside the classroom, via the Internet or collaboration might also make real world connections with community members and mentors.

*Multiple presentation modes:* This component gives learners opportunities to effectively use various technologies as tools in the planning, development, or presentation of their projects. Though the technology can easily become the main focus of a given project, the real strength of the multimedia component lies in its integration with the subject curriculum and its authentic use in the production process.

*Time management:* It builds on opportunities for learners to plan, revise and reflect on their learning. Though the time frame and scope of projects may vary widely, they should all include adequate time and materials to support meaningful doing and learning.

*Innovative assessment:* Just as learning is an ongoing process, assessment can be an ongoing process of documenting that learning. PBL requires varied and frequent assessment, including teacher assessment, peer assessment, self-assessment, and reflection. Assessment practices should also be inclusive and well understood by learners, allowing them opportunities to participate in the assessment process in ways not typically supported by more traditional teacher-centered lessons.

Generally, three phases can be suggested in conducting Project-Based Learning: planning, creating and implementing, and the processing.



**Figure 2: General framework of Project-Based Learning**

Caption: Figure 2 represents the general framework of project-based learning. PBL can be divided into three main processes. In the planning phase, the learner chooses the topic, searches for resources for needed information, and organizes the resources into an usable form. In the implementation or creation phase, the learner develops the project idea, combines the contributions of the group, and builds the project. In the processing phase, the project is shared with other groups, feedback is obtained, and then the groups reflects on the project.

In the "planning" phase, the learner chooses the project, locates the required resources, and organizes the collaborative work. Through these activities, the learner identifies and represents a topic, gathers relevant information and generates a potential solution.

The second phase is "creating", or implementing the project. This phase includes activities such as development and documentation, coordination and blend of member contributions, and presentation to class members. In this stage learners are expected to build a product that can be shared with others.

The activities for the third phase, "processing" the project, include reflection and follow-up on the projects. In this stage, the learners share their artifacts in a small group or with the entire class, obtain feedback, and reflect on the learning process and the project. Learners share each group's or individual's project and exchange feedback.

See also:

Houghton Mifflin's Project Based Learning Space

The four phases model of Project-Based Learning: searching, solving, creating, and sharing

(<http://www.college.hmco.com/education/pbl/background.html>)

Mission to Mars

This project provides four stages model of Project-Based Learning: problem generation, creation of cooperative team, jigsaw group, and culminating a consequential task

(<http://www.college.hmco.com/education/pbl/project/project4.html>)

### Project-Based Learning in Kayla's situation

Kayla's workshop fits well in the general framework for Project-Based Learning. Kayla created a learner-centered environment by empowering the learners with options to choose their topics and contexts, to work collaboratively and to provide rich feedback in evaluating authentic tasks that reflect real-world issues.

In the planning stage, learners chose their topics for designing and delivering effective web-based instruction. The participants formed groups by interest area and were asked to narrow their focus by changing their ideas to question format, thus identifying and representing a problem. A web communication technologies group, for example, may decide to list the features of effective communication tools and discover potential situations to implement them. They are aware of the resources available to them; they collaborate to fine-tune their ideas. Such activities increase learner decision-making and initiative throughout the course of the project.

In the creation stage, learners built their own web-based instructions. They had options in both multimedia/multiple presentation modes and delivery strategies and incorporated feedback into their presentations.

In the processing stage, the learners' reflective discussion allowed them to analyze and share their learning experience as they constructed their web-based instruction.

### Project-Based Learning: Instructional Strategies

The full benefits of projects cannot be achieved without considering the nature of the student's knowledge, the extent of teacher knowledge, and the complexity of the classroom setting. The following strategies can be implemented in the learning environment to promote a Project-Based Learning framework. Table 2 shows the general procedure and strategies for using PBL, and includes both learner and instructor perspectives.

Table 2. Project-Based Learning : Procedure and Strategies

| Context                      | Procedure and Strategies   | Learner Perspective   | Instructor Perspective   |
|------------------------------|--|---|--|
| <b>Planning</b>              |  |   |  |
| 1. Designing overall climate | <ul style="list-style-type: none"> <li>• Create environments that will promote inquiry and challenge</li> <li>• Make real-world connections</li> </ul> | <ul style="list-style-type: none"> <li>• Allow sufficient time for project work</li> <li>• Provide input for creation of questions, approaches and artifacts</li> </ul> | <ul style="list-style-type: none"> <li>• Understand project content to help learners</li> <li>• Provide open-ended situation</li> <li>• Facilitate learning</li> </ul> |
| 2. Inquiry                   | <ul style="list-style-type: none"> <li>• Choose topic</li> <li>• Locate resources</li> <li>• Organize collaboration</li> </ul>                         | <ul style="list-style-type: none"> <li>• Ask and refine questions</li> <li>• Formulate goals</li> <li>• Plan</li> </ul>   | <ul style="list-style-type: none"> <li>• Discover prior knowledge before the project begins</li> <li>• Provide</li> </ul>  |

|  |   |   |  |
|--|---|---|--|
|  |   | <p>procedures</p> <ul style="list-style-type: none"> <li>• Debate ideas</li> <li>• Incorporate "Jigsaw" method</li> </ul>                             | <p>structured set of inquiry steps for learners to follow</p>  |
| <b>Creating</b>                        |   |   |  |
| 1. Analyzing Data                      |   | <ul style="list-style-type: none"> <li>• Make predictions</li> <li>• Design plans and/or experiments</li> <li>• Collect and analyze data</li> </ul>   | <ul style="list-style-type: none"> <li>• Guide to analyze data</li> <li>• Incorporate a technical assistance model</li> </ul>  |
| 2. Collaborating with others           | <ul style="list-style-type: none"> <li>• Communicate ideas and findings to others</li> </ul>  | <ul style="list-style-type: none"> <li>• Possess skills needed to work with others and knowledge necessary to explore questions that arise</li> </ul> | <ul style="list-style-type: none"> <li>• Emphasize individual and group learning process</li> <li>• Provide norms for individual accountability</li> </ul>   |
| 3. Developing thoughts & Documentation | <ul style="list-style-type: none"> <li>• Create artifacts</li> <li>• Visualize and construct ideas</li> </ul>                         | <ul style="list-style-type: none"> <li>• Ask new questions</li> <li>• Draw conclusions</li> </ul>   | <ul style="list-style-type: none"> <li>• Design activities</li> <li>• Provide resources</li> <li>• Give advice to learners as they progress in their projects</li> </ul>   |
| <b>Processing</b>                      |   |   |  |
| 1. Presenting Knowledge and Artifacts  | <ul style="list-style-type: none"> <li>• Monitor what is known</li> </ul>   | <ul style="list-style-type: none"> <li>• Demonstrate the full range of one's competence</li> </ul>  | <ul style="list-style-type: none"> <li>• Incorporate presentation opportunities involving external audiences</li> <li>• Require multiple criterion performances (e.g. collaboration, explanation, demonstration, self-report)</li> </ul> |
| 2. Reflection & Follow-up              | <p>Assessment</p> <ul style="list-style-type: none"> <li>• Peer evaluation</li> <li>• Self-evaluation</li> <li>• Portfolio</li> </ul> | <ul style="list-style-type: none"> <li>• Understand the teacher's method of evaluation</li> <li>• Create and agree on the norm of</li> </ul>          | <ul style="list-style-type: none"> <li>• Create a classroom culture that supports frequent feedback and assessment</li> </ul>  |

|  |            |  |  |
|--|------------|--|--|
|  | evaluation | assessment initially <ul style="list-style-type: none"> <li>• Reflect their own learning</li> <li>• Share and acquire multiple perspectives</li> </ul> | <ul style="list-style-type: none"> <li>• Find ways for learners to compare their work with others</li> </ul> |
|--|------------|--|--|

### Project-Based Learning in the Classroom : What does it involve?

Project-Based Learning offers many advantages and challenges when implemented in the classroom. However, there are strategies to successfully meet these challenges. Some of the advantages in PBL learning include but are not limited to:

- Increased motivation
- Increased problem-solving ability
- Improved media research skills
- Increased collaboration
- Increase resource management skills

*Increased motivation:* Learners can choose their topics, the extent of content, and the presentation mode. Learners build their projects to suit their own interests and abilities. These kinds of activities are highly motivating for learners.

*Increased problem-solving ability:* Project-Based Learning encourages learners to engage in complex and ill-defined contexts. From the beginning, learners identify their topics and problems, then seek possible solutions. By participating in both independent work and collaboration, learners improve their problem solving skills thereby developing their critical thinking skills.

*Improved media research skills:* Project-Based Learning provides a real world connection to context. Learners conduct research using multiple information resources. By locating the resources themselves, their research skills develop and improve.

*Increased collaboration:* In the processing stages, learners create and organize their groups. They share knowledge and collaboratively construct artifacts. Through collaboration, they develop social communication skills and obtain multiple perspectives.

*Increased resource-management skills:* Successful Project-Based Learning provides learners with experience in project organization and time management with necessary scheduling resources.

### Potential Challenges and Solutions

As with any instructional strategy, Project-Based Learning presents some challenges. The following highlights some challenges of a PBL environment:



*Support of student learning:* Teachers may be unprepared to implement activities for Project-Based Learning due to a lack of familiarity with this pedagogy. They must stimulate discussion through open-ended questions that facilitate creative thinking. Instructors should also encourage learners to find answers independently from resources rather than simply "feeding" them information.

*Assessment:* Evaluating academic performance in a Project-Based Learning environment is problematic for instructors. Evaluation of learners' knowledge acquisition is difficult because individual contributions can seldom be identified with certainty. Several strategies are available for evaluating learner achievement, such as individual or group self-evaluation, or comparison between student performance and class objectives. The process of assessment should also address how the learners share the responsibility of peer-work.

## **Examples of Project-Based Learning**

### K-12 Classroom Examples

Selected Examples of Student Work (<http://pblmm.k12.ca.us/projects/projects.htm>)  
This site contains several of the exemplary projects from Challenge 2000 learners.

Classroom web pages (<http://pblmm.k12.ca.us/ClassExamples/classsites.html>) This site contains various Project-Based Learning web sites as implemented in the classroom by teachers across the nation.

Project Grid (<http://pblmm.k12.ca.us/ClassExamples/projectgrid.html>)  
This site contains a list of the projects that Challenge 2000 PBL and multimedia teachers are doing this year. It is an excellent opportunity for idea exchanges.

Project Analysis: School Improvement Project  
<http://pblmm.k12.ca.us/ClassExamples/ProjectImprovement.html>  
This site contains some perspectives on a school improvement project with real world and mentoring connections.

## **Sample Project Descriptions**

Below are three examples of how the framework and web site can be used in three very different projects.

### Writer's Yearbook

[http://pblmm.k12.ca.us/PBLGuide/Guide/Writer\\_Yrbk.html](http://pblmm.k12.ca.us/PBLGuide/Guide/Writer_Yrbk.html)

### Interactive Quiz

[http://pblmm.k12.ca.us/PBLGuide/Guide/Interactive\\_Quiz.html](http://pblmm.k12.ca.us/PBLGuide/Guide/Interactive_Quiz.html)

### Civics Project

[http://pblmm.k12.ca.us/PBLGuide/Guide/Interactive\\_Quiz.html](http://pblmm.k12.ca.us/PBLGuide/Guide/Interactive_Quiz.html)

## **The Essence of Project-Based Learning: Constructionism in Practice**

In conclusion, the essence of Project-Based Learning lies in the engaging experiences that involve learners in complex and real world projects through which they develop and apply skills and knowledge. In this environment, learners choose, plan, design and construct artifacts as part of their learning outcomes. The instructor facilitates by designing learner-centered activities, providing resources, and advising learners as they reflect on their learning process.

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