

The activity design methodology provides the critical steps for systematically constructing a learning experience that supports the learning cycle (Learning Process Methodology) so that learners can effectively meet the intended learning objectives and performance criteria in an efficient manner.

A Methodology for Designing Learning Activities

The community of practitioners involved in the Problem Solving Across the Curriculum (PSAC) conference was interested in active learning and therefore engaged in the development of activity books — a common practice in the early 1990s (Kramer & Beery, 1990). In the development of their learning activities, this community incorporated the use of PC:SOLVE, a modeling language consisting of tools for use in problem solving. This was a strategy for improving student understanding of key concepts in a course, such as those seen in *Calculus with Analytical Geometry* (Swokowski, 1990).

Following the development of the Learning Process Model (Apple, 1991), these Process Education learning activities were comprised of standard components: models, critical thinking questions, and application challenges (Apple, Beyerlein & Ford, 1993). The first formal Activity Design Methodology, was published in the 1995 *Teaching Institute Handbook* (Apple); it closely followed the Learning Process Methodology and offered 14 steps for creating high-quality learning activities:

1. Identify the focus
2. Create the model
3. Assign a title
4. Write a “why” statement
5. Identify learning objectives
6. Write performance criteria
7. Create critical thinking questions
8. Identify resources and information
9. Create a glossary
10. Write a plan for completing the activity (meeting the learning objectives)
11. Create skill exercises
12. Develop an assessment component for the activity
13. Create problem-solving exercises
14. Provide a research project

The same handbook also provided information on how to write three types of critical thinking questions (directed, convergent, and divergent) and included an activity template that modeled the organization and presentation

of a learning activity. That model is still the basic structure used today in a wide range of Process Education activity books.

Learning Activities and Levels of Learning

Research focused on levels of learning informed the 1998 *Teaching Institute Handbook* (Apple & Krumsieg) and emphasized that activities needed to be designed so that learners achieve each level of knowledge before moving on to construct the next level:

- Level 1: **INFORMATIONAL** The learner can talk about a concept, process, tool, or context in words and can regurgitate definitions or descriptions.
- Level 2: **KNOWLEDGE** The learner is able to construct a certain degree of comprehension about a concept, process, tool, or context.
- Level 3: **KNOWLEDGE SKILL** The learner has the skill to apply and transfer the particular item of knowledge to different situations and contexts.
- Level 4: **PROBLEM SOLUTION** The learner has the ability to integrate the knowledge skill with his/her other knowledge skills to produce a generalized problem solution.
- Level 5: **NEW KNOWLEDGE** The learner, who is now defined as a researcher, can develop knowledge to a new level of understanding. Through the use of lateral thinking, the researcher makes new linkages among concepts and problem solutions which have not been seen before.

This research was expanded during the Advanced Teaching Institute held at Madison Area Technical College in 2000, where the methodology for elevating knowledge from Level 1 to Level 3 was designed (Pacific Crest, 2000). This methodology was formalized and published in the *Faculty Guidebook* module *Elevating Knowledge from Level 1 to Level 3* (Nygren, 2007b) and is shared in Figure 1.

Making the relationship between activity design and levels of learning even more explicit, *An Evaluation System that Distinguishes Among Levels of Learning in Engineering and Technology* (Apple, Nygren, Williams, & Litynski, 2002) helpfully presents the levels of learning as they

specifically relate to the components of a learning activity, with special emphasis of how to structure problem-solving challenges that elevate learner knowledge to Level 4.

A Handbook and the Guidebook

A major milestone for Process Education was the creation of an *Activity Design Institute Handbook* that formalized and brought together the Learning Process Methodology, levels of learning, and a comprehensive Activity Design Template for faculty that also works well as a methodology for designing Process Education learning activities (Apple & Krumsieg, 2007; see Figure 2).

The scholarship behind the *Activity Design Handbook* contributed to and leveraged from the *Faculty Guidebook* project, which included several modules directly related to activity design. Table 1 correlates these modules with the steps in the Activity Design Template. Of global interest to the design of learning activities are *Overview of Learning Activities* (Wasserman, Davis, & Astrab, 2007) and *Designing Process-Oriented Guided-Inquiry Activities* (Hanson, 2007a). The module, *Assessing Learning Activities* (Loertscher & Minderhout, 2007) provides critical information and two useful tools that allow faculty to assess not only the **design** of an activity, but also its **impact** in the classroom. Also useful for measuring the effectiveness of an activity is *Elevating Knowledge from Level 1 to Level 3* which, in addition to providing the methodology for constructing knowledge, also includes the table, “Levels of Knowledge Across Knowledge Forms,” which provides descriptions of what a learner should be capable of doing at each level of learning.

Evolution of the Process

Over the past decade, improvements in available technology, the proliferation of open source content and software, and the common practice of bundling learning activities with additional resources have made it easier than

ever to enliven and enrich learning activities. The design process itself hasn't changed; what has changed is what constitutes the contents and implementation of specific steps in the Activity Design Template/Methodology:

4. Learning Model/Instrument
11. Pre-Activity
13. Information and Resources
18. Technology

Learning models can now include interactive animations, such as the interactive simulation of Hooke's Law offered on the resources site for *Foundations of Organic Chemistry* (Bucholtz, 2015; the model is available on the secure course site, but is also available at <https://phet.colorado.edu/en/simulation/mass-spring-lab>), and flash animation of Gel Filtration Chromatography for *Foundations of Biochemistry* (Loertscher, Minderhout, & Frato, 2015; https://www.gelifesciences.com/gehcls_images/GELS/Related%20Content/Files/1314774443672/litdoc29091645_20140915112231.swf).

Foundations of Mathematics (Fremeau, 2007) was the first activity book to integrate pre-activities as a way to help students prepare for in-class activities. *Foundations of Learning* (4th ed.) (Redfield & Hurley Lawrence, 2009) modeled how that content can fully support the learning process by providing a package of reading to be done prior to the classroom activity. In *Learning to Learn: Becoming a Self-Grower* (Apple, Morgan, & Hintze, 2013), the learning activity was expanded into a learning experience consisting of three activities to be done: before class, during class, and after class. This strategy was used as a way to make the most effective possible use of learner time.

In *Quantitative Reasoning and Problem Solving* (Ellis, Apple, Watts, Hintze, Teeguarden, Cappetta, & Burke, 2014), learning activities took advantage of web-based learning objects, information and resource websites, real-world examples and data, and web-based or common

Figure 1 Methodology for Elevating Knowledge

1. Establish and solidify an informational base (Level 1).
2. Identify the cornerstones for the knowledge. Knowledge is built upon a foundation of prior knowledge (Level 2).
3. Identify the key inquiry questions for comprehension and key issues for constructing the knowledge (Level 2).
4. With the framework in place, test the conditions of the structure; use critical thinking to explore the assumptions or logic of the knowledge model (Level 2).
5. Transfer and apply the knowledge to a familiar context to enrich understanding (low Level 3).
6. Transfer and apply the knowledge to another context that is similar (low Level 3).
7. Transfer and apply the knowledge to a context that is some distance from the original context (Level 3).
8. Transfer and apply the knowledge in a totally unfamiliar context with the teacher acting as consultant (Level 3).
9. Independently make a generalization of the new knowledge (Level 4).

Figure 2 Activity Design Template for Faculty

1. Identify purpose	9. Key Critical Thinking Questions
2. Title	• Directed
3. Type of Knowledge Item	• Convergent
• Concepts • Process • Tool	• Divergent
• Context • Way of Being	10. Plan/Tasks for Execution of Activity
4. Create Learning Model / Instrument for the Knowledge Item	11. Pre-Activity
• Interactive Model (Concept)	12. Sequencing Critical Thinking Questions
• Methodology (Process)	13. Information and Resources Needed
• Template (Tool)	14. Prior Knowledge Required
• Story/Case Study (Context)	15. Glossary
• Profile (Way of Being)	• Previous Terms • New Terms
5. Why? (What?, Big Picture, Relevance)	16. Skill Exercises
6. Learning Objectives	17. Problems to Be Addressed
7. Performance Criteria with attributes	18. Technology to Be Used
8. Learning Skills	19. Validation/Reflection of Learning
• Cognitive • Social	20. Self-Assessment
• Affective • Psychomotor	21. Closure

Table 1 Steps from the Activity Design Template Correlated with *Guidebook* Modules Pertinent to Activity Design

Step	<i>Faculty Guidebook</i> Module (all citations 2007)
3. Type of Knowledge Item	"Forms of Knowledge and Knowledge Tables" (Quarless)
4. Create the Learning Model / Instrument for the Knowledge Item	"Methodology for Designing Methodologies" (Smith & Apple)
9. Key Critical Thinking Questions	"Writing Critical Thinking Questions" (Hanson)
12. Sequencing Critical Thinking Questions	"Bloom's Taxonomy — Expanding its Meaning" (Bobrowski) "Elevating Knowledge from Level 1 to Level 3" (Nygren)
17. Problems to Be Addressed	"Developing Working Expertise (Level 4 Knowledge)" (Nygren) "Overview of Problem Solving" (Morgan & Williams)
18. Technology to Be Used	"Overview of Effective Learning Tools" (Nancarrow)
19. Validation/Reflection of Learning	"Self-Validation of One's Learning" (Armstrong)

software tools in order to create a textbook that is 50 percent online. This is not technology for the sake of technology; while the “bells and whistles” available to activity designers may be exciting and serve to effectively capture learner interest (a good thing), the actual benefit

of technology integrated in a learning activity must be measured with respect to how well that technology supports the learning cycle and how fully it can help learners realize an activity's learning objectives.

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