Activity Design Handbook

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Activity Design Handbook

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Table of Contents

Section 1: Preparation Materials	1
Pre-Institute Preparation	
Faculty Guidebook 2.4.13 Overview of Learning Activities	5
Faculty Guidebook 2.4.8 Methodology for Course Design	9
Section 2: Introductions and Background	
Sample Agenda	
Pacific Crest: A Brief Overview	
Broad Learning Goals for an Activity Design Institute	
Activity Design Institute: Overview.	
Activity Design Institute: Learning Outcomes	
Dale's Cone of Experiences	17
Section 3: The Transformation of Education	19
The Transformation of Education (introduction)	21
The Transformation of Education (table)	22
The Compass of Higher Education	
Overview of Process Education	
Principles of Process Education	26
Group Exploration Activity: Exploring Educational Transformation	27
Key Performance Areas and Performance Criteria	
Mapping between Key Performance Areas and Pacific Crest Institutes	
Recommended Sequencing of Pacific Crest Institutes	
Section 4: Course Design for the Activity Design Institute	33
Activity Design and Critical Areas of Course Design.	
Course Design Template: Activity Design Institute.	
Section 5: Writing Personal Outcomes	43
Reflective Activity: Developing Personal Outcomes	45
Section 6: Team Formation and Outcomes	47
Faculty Guidebook 2.4.5 Learning Outcomes	
Forming Teams and Performance Criteria for Team Roles	53
Criteria for Reflector and Recorder Reports.	55
Team Activity: Building Team Learning Outcomes	57
Section 7: Assessing Learning Activities	63
Faculty Guidebook 2.4.17 Assessing Learning Activities	65
Sample Activity 1, Knowledge Form = Concept Model	69

Section 7: Assessing Learning Activities (continued)	
Sample Activity 2, Knowledge Form = Process	74
Sample Activity 3, Knowledge Form = Tool	80
Sample Activity 4, Knowledge Form = Contexts	88
Sample Activity 5, Knowledge Form = Way of Being	100
Section 8: Understanding the Value of a Knowledge Table and the	
Classification of Learning Skills	107
Activity: Team Generation of a Knowledge Table and Identification of Learning Skills	109
Faculty Guidebook 2.3.9 Forms of Knowledge and Knowledge Tables	111
Faculty Guidebook 2.3.3 Classification of Learning Skills	115
Faculty Guidebook 2.3.4 Cognitive Domain	119
Faculty Guidebook 2.3.5 Social Domain	123
Faculty Guidebook 2.3.6 Affective Domain.	127
Correlation of Activity Design with Course Design	131
Section 9: Forms of Knowledge and Activity Types	133
Common Activity Types	135
Matching Activity Types with Knowledge Forms.	137
Section 10: Introduction to the Methodology for Activity Design	139
Faculty Guidebook 2.4.14 Designing Process-Oriented Guided-Inquiry Activities	141
Criteria for Activity Design	145
Activity Design Template	148
Activity: Conceptualizing Activity Design and Implementation	151
Section 11: Phase 1: Preplanning	153
Phase 1: Preplanning (overview)	154
Activity: Preplanning of an Activity	155
Worksheet: Purpose	159
Worksheet: Title	160
Worksheet: Type	161
Worksheet: Learning Model/Instrument	162
Faculty Guidebook 2.4.16 Methodology for Creating Methodologies	163
Faculty Guidebook 2.4.3 Development and Use of an Expert Profile	167
Section 12: Phase 2: Designing the Core Activity Elements	171
Phase 2: Design Core Elements (overview)	172
Worksheet: "Why?"	173
Worksheet: Learning Objectives	
Definition and Information: Performance Criteria	175
Worksheet: Performance Criteria	176

Worksheet: Learning Skills	177
Worksheets: Critical Thinking Questions	178
Faculty Guidebook 2.4.15 Writing Critical Thinking Questions	181
Section 13: Phase 3: Enhancing an Activity	
Phase 3: Enhancing an Activity (overview)	184
Worksheet: Plan	185
Worksheet: Pre-Activity	186
Faculty Guidebook 3.4.7 Using Reading and Lecture Notes Log to Improve Learning	187
Worksheet: Sequencing of Critical Thinking Questions	196
Faculty Guidebook 2.2.1 Bloom's Taxonomy—Expanding its Meaning	197
Faculty Guidebook 2.2.2 Elevating Knowledge from Level 1 to Level 3	201
Worksheet: Information and Resources	205
Worksheet: Prior Knowledge	206
Worksheet: Glossary Terms	207
Worksheet: Skill Exercises	208
Worksheet: Problems	209
Faculty Guidebook 2.2.6 Overview of Problem Solving	210
Worksheet: Technology	214
Faculty Guidebook 3.4.1 Overview of Effective Learning Tools	215
Worksheet: Validation of Learning	219
Faculty Guidebook 3.3.5 Self-Validation of One's Learning.	220
Worksheet: Self-Assessment	224
Worksheet: Closure	225
Section 14: Preparing an Activity Sheet	227
From Planning to Using: Activity Design Sections and What the Student Sees	229
Section 15: Facilitating for Student Success	231
Ways to Help Learners Improve Performance in Learning Activities	233
Faculty Guidebook 3.2.3 Facilitation Methodology	237
Faculty Guidebook 3.2.5 Creating a Facilitation Plan	241
Faculty Guidebook 3.3.3 Process-Oriented Guided-Inquiry Learning	245
Section 16: Peer Assessment of Activity Design	249
Activity Design Criteria	251
Activity Design Template	254
Activity Sheet (Table: Explicit versus Implicit Activity Sections)	256
Faculty Guidebook 4.1.9 SII Method for Assessment Reporting	257
Faculty Guidebook 4.1.2 Distinctions Between Assessment and Evaluation	259
SII Assessment Form (2)	263

Section 17: Developing a Plan for Implementation	
Implementation Planning Worksheet	
Section 18: Forms	269
Activity Design Assessment	271
Activity Design Criteria	
Activity Design Template for Faculty	
Activity Impact Assessment	277
Facilitation Plan: During/After Class	278
Facilitation Plan: Prior to Class	
Implementation Planning Worksheet	
Recorder's Report	
Reflector's Report	
SII Assessment Form (2) ·····	
Section 19: Selected Glossary	
Section 20: Selected Bibliography	297
Section 21: The Faculty Guidebook and the Personal e-Guidebook	311

Section 1

Preparation Materials

Pre-Institute Preparation

Faculty Guidebook: 2.4.13 Overview of Learning Activities

Faculty Guidebook: 2.4.8 Methodology for Course Design

Pre-Institute Preparation

We recommend that you commit approximately two hours of preparatory time prior to attending so that you can optimize the learning experience. There are four things that we suggest that you do.

- *First* Read the following modules that are found in the *Faculty Guidebook*.
 - 2.4.13 Overview of Learning Activities
 - 2.4.8 Methodology for Course Design
- **Second** Please determine the course on which you will be choosing to focus your energies at the institute, and bring a copy of the course design for that particular course, as well as the textbook for that course.
- **Third** Be prepared to share the following with the group: Name, Department, and one tip about activity design or activity implementation that might help your peers.
- **Fourth** Please respond to the following questions to help us gain an understanding of those who will be in attendance.
- 1. Have you participated in prior faculty development institutes offered by Pacific Crest? If so, which institute(s) have you attended?
- 2a. If you have not participated in the Pacific Crest Course Design Institute, have you participated in course design institutes offered by others?
 - b. If so, do you have the course design(s) that resulted from that learning?
- 3. Within your course designs, have you identified where formalized activities will optimize achievement of the learning outcomes that you have for one of your courses? If so, please explain where those conditions exist.

4.	Please identify which of the following kinds of activities you currently use in your classroom:
	Process-Oriented Guided-Inquiry Learning
	Methodologies
	Templates
	Case studies
	Profiles
	Other (describe:)
5.	If you already have some of these types of activities, do you see them as something you wish to improve? In what way? If so, we recommend bringing these activities to the institute.
6.	Are there specific challenges with activity design that you hope to address in the institute? If so, please elaborate on those challenges.



2.4.13 Overview of Learning Activities

Jack Wasserman (Mechanical Engineering, University of Tennessee at Knoxville), Chris Davis (Director of Assessment, Baker College), and Donald P. Astrab (Executive Vice President, Brevard Community College)

The core unit of instructional design is a *learning activity*; it organizes a unit of time, in or out of class, to address a subset of course learning outcomes. Learning activities vary widely, from the delivery of knowledge (lecture) to the development of student learning skills (problem solving). Activity design is most effective when it produces a guide for the instructor that includes pre-planning, a plan for presentation and facilitation, and a plan for assessment of the learning. This module provides a table of more than fifty different activity types. It also provides recommendations for selecting the activity types that are best done inside or outside of class.

Need for Activity Design

Learning activities are those in which actual student learning occurs. In designing learning activities, one must take into account how learners make sense of new information, how they acquire new skills, or how they develop a new way of being (Bransford, Brown, & Cocking, 2000). Learning activities must also be designed so that the learning leads to the achievement of the course and program outcomes. *Activity design* is the process by which learning experiences are planned to systematically accomplish those two goals.

Characteristics of Effective Learning Activities

1. Align with course outcomes

Learning activities are designed to develop learning that supports course outcomes. All learning activities should support course outcomes, and all course outcomes need to be supported by learning activities.

2. Focus on student learning

The purpose of any learning activity is student learning; all components of the activity should focus on that goal (1.1.3 Efforts to Transform Higher Education). All lectures and reading should support the learning outcomes identified for the activity. The teacher should not do anything for the students that they can do for themselves (Weimer, 2002).

3. Have a compelling purpose

Activities cannot be successful if the students do not recognize their value and importance. 3.1.6 Obtaining Shared Commitment and 3.1.5 Getting Student Buy-In both address processes for communicating the purpose of the activity to students.

4. Have clear objectives

Each activity has the potential to provide a combination of information, solution methodologies, and the opportunity to develop specific learning skills. These objectives need to be specifically identified. Effective

Table 1 Characteristics of Effective Learning Activities

- 1. Align with course outcomes
- 2. Focus on student learning
- 3. Have a compelling purpose
- 4. Have clear objectives
- 5. Support the type of learning desired
- 6. Balance content and skill development
- 7. Support the needs of diverse learning styles
- 8. Include assessment of student learning
- 9. Include assessment of the activity
- 10. Result from an explicit design methodology

techniques for writing quality learning outcomes and objectives are described in *2.4.5 Learning Outcomes*.

5. Support the type of learning desired

The learning activity must be appropriate for the type of learning called for in the learning objectives. Not all concepts, tools, processes, contexts, ways of being, or rules are well served by the same types of learning activities. *2.3.3 Classification of Learning Skills* describes different types of learning; it is helpful to use in selecting the right type of activity.

6. Balance content and skill development

Learning objectives should specify the proper balance between content and skill development. When a learner is exposed to something for the first time, content will typically receive most of the attention. Later, the learner will want to focus on developing skills by applying this new content.

7. Support the needs of diverse learning styles

Learners have a variety of preferences for how they learn new material (Felder & Silverman, 1988). When

constructing an activity, it is important to consider which types of activities will address the preferences of multiple learning styles. It is also critical to use a variety of learning activities in a single course to be inclusive of all learning styles.

8. Include assessment of student learning

If student learning is the goal of an activity, then assessment of student learning should be integrated into the activity itself (Wiggins & McTighe, 2005). An activity cannot be successful if it has not produced the targeted student learning. Learning must therefore be assessed based on predetermined performance criteria.

9. Include assessment of the activity

Upon completion of an activity, facilitators and learners should assess the learning activity itself. The results of this assessment should strengthen the future development and application of the activity.

10. Result from an explicit design methodology

A strong activity design methodology will support the designer in achieving the characteristics of effective learning activities outlined here. **2.4.14 Designing Process-Oriented Guided-Inquiry Activities** provides an excellent example of such a methodology.

Instructor's Guide

Activity design should include a facilitation plan for instructors that specifies the required resources for the activity and provides prompts for successful facilitation. Activities may require varying amounts of time, space, materials, or technology. Prerequisite knowledge for the learners should also be provided. The modules 3.2.5 Creating a Facilitation Plan and 3.2.3 Facilitation Methodology provide resources for creating a sound facilitation plan. Inasmuch as activities are increasingly shared amongst faculty, a facilitation plan is an essential product of the activity development process.

Learning Skill Development

Learning activities should result in the development of transferable learning skills. Several modules describe a variety of learning skills across cognitive, social, affective, and psychomotor domains (2.3.3 Classification of Learning Skills, 2.3.4 Cognitive Domain, 2.3.5 Social Domain, and 2.3.6 Affective Domain). In addition to the disciplinary outcomes of the learning activity, the activity can focus on specific learning skills that are important in general education or specific degree programs.

Activity Type Selection

There are many types of activities that can facilitate student learning: Table 2 lists more than fifty. Activities may focus on the work of individual students or teams. Some activities are best used during formal class sessions, while others are best used outside of the classroom. Whatever types of activity are used, it is crucial that they support intended learning outcomes. It is suggested that, throughout the semester, instructors consider using five to ten different types of activities in the design of the course.

Table 2 Activity Types and Appropriate Venue

In Class ONLY	Both INSIDE and OUTSIDE of Class	Outside Class ONLY
competition/quiz show concept mapping cooperative learning debate demonstration fishbowl group discussion guest speakers guided-discovery learning interactive lecture jigsaw just-in-time lecture laboratory panel discussion poster session rubric design simulations story telling	artistic expression brainstorming case studies collaborative learning consulting critique drill and practice event production interviewing journaling peer assessment planning presentations/skits problem solving projects research reviewing role playing self-assessment/ reflection self-validation student teaching supplemental instruction/tutoring surveys team building technology videos writing	clinicals field trips job shadowing portfolio building reading scavenger hunt self-study service learning

Common Activity Types

A brief discussion of widely applicable learning activities follows.

1. Guided-Discovery Learning

This type of activity requires students to construct knowledge in one of five forms: conceptual, process, tool, context, or way of being. Typically, the level of knowledge attainment for students is at the working-knowledge or problem-solving level (2.2.1 Bloom's Taxonomy—Expanding its Meaning). In guided-discovery activities the instructor identifies key resources, models, and background information, and provides a set of critical-thinking questions that guide students' thought processes in constructing knowledge at the desired level (2.4.14 Designing Process-Oriented Guided-Inquiry Activities).

2. Interactive Lecture

This is an alternative to an uninterrupted lecture that lasts for an extended period of time. The goal is to build in checkpoints during the lecture during which students test their understanding of what has been presented. Techniques for generating interactivity include giving a short quiz at the end of class; providing a set of critical-thinking questions that are intended to be processed during the lecture; taking breaks during which teams of two or three students think, pair, and share responses to interesting questions; assigning homework problems; and asking students to write one-minute papers in which they identify main points or muddiest points in what has been presented (Angelo & Cross, 1993).

3. Student Teaching

Educators know that those who teach learn the most, and that the true test of understanding comes when a person is put in a position of teaching others. The more often students are put in the role of teacher, the more responsibility they will feel for the important learning outcomes in the course. The measure for assessing the performance of student teaching should be based on the ability of learners to perform using the knowledge associated with the activity, not on whether the faculty member likes the quality of the presentation or the level of understanding demonstrated by the student teacher (2.4.5 Learning Outcomes).

4. Problem Solving

These activities require students to apply knowledge to new contexts, integrating complex relationships with prior knowledge (3.3.4 Problem-Based Learning).

Problems should be relevant, challenging, and motivating; they should integrate knowledge gained in the class, and should require the use of a problem-solving methodology. This type of activity also lends itself well to team competition and games.

5. Projects

Compared to problem solving, projects involve even greater amounts of problem identification and definition, they occur over longer periods of time, and they place more emphasis on communicating the results in a formal manner (2.2.3 Developing Working Expertise (Level 4 Knowledge)). Projects that involve team formation and development can promote the development of learning skills in the social and affective domains (3.4.3 Teamwork Methodology). An excellent way to celebrate project success is to create a poster session that is open to faculty and students outside of class.

6. Self Assessment and Peer Assessment

If student learning is the goal of an activity, then assessment of student learning should be integrated in some form into almost every learning activity (Wiggins et al., 2005). A variety of assessment tools and methods are found throughout the *Faculty Guidebook* that can be incorporated in free-standing activities or supporting components of other activities (4.1.4 Assessment Methodology, 4.1.9 SII Method for Assessment Reporting, and 3.4.4 Team Reflection).

7. Student Presentations

This can be a less formal variant on student teaching. Students display some aspect of part of a performance in the class, such as homework solutions, answers to quizzes, findings from reading assignments, peer assessments, and team assessments. A higher-stakes variation of the student presentation is a *fishbowl* situation in which a team of students works through a problem while the rest of the class watches and assesses what they see. An important part of any public performance by students is a class-wide discussion that acknowledges strengths, constructively suggests improvements, and generalizes lessons learned.

8. Self-Study

The nature of this activity is to allow the student to self-facilitate his or her own learning to meet the performance criteria. The facilitator's role is to provide the learner with a complete set of resources, performance criteria, and assessment tools. When using the self-study technique it is important to make sure

that the scope of the activity is within the boundaries of the learner's performance capabilities, that the activity is self-contained, that there are measures for assessing performance, and that the learner has an opportunity to apply the knowledge in a relevant context.

9. Reading

In this type of activity students are responsible for comprehending written material, but typically they do not understand what they are supposed have learned or what they should be able to do as a result of reading the material. Quizzes and short essay questions can be used to motivate students to come to class better prepared when a reading has been assigned (3.4.7 Using Reading and Lecture Notes Logs to Improve Learning).

10. Technology

Computer-based and internet learning systems, called *interactive learning systems*, offer an asynchronous environment in which students interact with the computer and with classmates as they think through, practice, and synthesize new knowledge. This taps into an emerging part of youth culture that may engage students whose learning styles lead them to be less vocal in the classroom.

11. Role Playing

Students are encouraged to consider new perspectives and issues associated with a situation when they engage in role playing. The instructor creates a scenario, assigns appropriate roles, provides information, and asks the groups to enact that scenario being faithful to their roles and using their knowledge of the subject. The module on *Cooperative Learning (3.3.2)* has more information about using formal roles in learning activities as well as case studies and jigsaw sessions.

12. Consulting

This is a popular alternative to lecture where faculty members lend their expertise to questions and problems posed by students. While this can be a very effective starting point for a just-in-time lecture, faculty are advised to limit the time they spend consulting and redirect this effort to assessing learning. The quality of student thinking can be improved if students are challenged to process information prior to consultation and are limited in the number of questions they can ask.

Concluding Thoughts

The creation of effective high-quality learning activities begins with adherence to an explicit design process. During and after each activity, student learning must be assessed to verify that the activity produced the depth of understanding that was desired. The activity should also be assessed to determine ways to strengthen it for future application.

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2.4.8 Methodology for Course Design

by Chris Davis (Director of Assessment, Baker College)

This module addresses the sequential steps of quality course design. Program design includes the identification of long-term behaviors that are reflected in learning outcomes in the course design. The course learning outcomes in turn determine the content, methodologies, and activities of the course and are assessed with measures that can be compared to performance criteria. While the design of specific learning activities is addressed in activity design, course design involves the sequencing of the learning activities within the course to support student learning and enable a course assessment and evaluation structure.

Systematic Design of Instruction and Instructional Design for Process Education

Virtually all models of instructional design follow the ADDIE model (analysis, design, development, improvement, and evaluation) (Kruse & Keil, 2000; Reiser, 2001).

Consistent with the instructional design model, the Methodology for Course Design (Table 1) presents the steps taken for an effective course design process. A discussion of the sections and subsequent steps of the methodology follows.

Analysis: Learning-Outcome Driven Instructional Design

The analysis stage of the instructional design process addresses what the learner is to learn. The results of this analysis should drive the rest of the instructional design (Dick, Carey & Carey, 2004). All content, methodologies, activities, sequencing, and assessment of the learning experience should be traceable to the results of the analysis. The analysis must consider what the learner should be expected to know at the outset of the course as well as what the learner will need to know and be able to perform in the future (Gagné, Briggs, Wager, Golas, & Keller, 2005). For courses, this means that to avoid either duplication or gaps in knowledge or application, the analysis must address what is covered in previous courses and what will be addressed in future courses. A course analysis must also examine how the course fits within the context of the larger program. The behaviors, objectives, and learning outcomes of the course should mesh with the behaviors, objectives, and learning outcomes of the program. Steps 1 through 4 are included in the analysis stage.

Step 1—Construct long-term behaviors.

The long-term behaviors that result from one's participation in a program are the behaviors that a graduate should practice throughout his or her life and professional career; they include working knowledge, performance skills, and attitudes. The long-term behaviors that result from of a course should reflect selected long-term behaviors of the program.

Table 1 **Methodology for Course Design**

Analysis: Learning-Outcome Driven Instructional Design

Step 1—Construct long-term behaviors.

Step 2—Identify course intentions.

Step 3—Construct measurable learning outcomes.

Step 4—Construct a knowledge table.

Design: Activities and Knowledge to Support Learning Outcomes

Step 5—Choose themes.

Step 6—Create the appropriate methodologies.

Step 7—Identify a set of activities.

Step 8—Identify a set of specific learning skills for the course.

Development: Construction and Selection

Step 9—Identify activity preference types.

Step 10—Match the activity types with the chosen activities.

Step 11—Choose the in-class and out-of-class activities.

Step 12—Allocate time across the themes.

Step 13—Sequence the activities across the term.

Step 14—Create individual activities from a prioritized list.

Step 15—Enhance activities by using technology.

Step 16—Ask peers to review the activities you create.

Step 17—Produce key performance criteria.

Step 18—Locate or build key performance measures.

Step 19—Design a course assessment system.

Step 20—Design a course evaluation system.

Step 21—Design a course syllabus.

Implementation: Facilitating Learning

Evaluation and Assessment: Instruction that Learns From Itself

Step 2—Identify course intentions.

Course intentions describe the intended results of the class. These can take the form of key learning objectives that identify the essential content of the course, including significant learning processes and skills. Other examples of course intentions that are not direct learning objectives for the learners include goals or objectives such as increased student retention and success.

Step 3—Construct measurable learning outcomes.

Learning outcomes connect course intentions and longterm behaviors. The learning outcomes describe what knowledge the student should possess at the conclusion of the program or course. Measurable learning outcomes are critical for the development of assessment and evaluation systems and should address the application of the knowledge as well as retention of the knowledge itself. Since the observation of long-term behaviors will generally be beyond the scope of a class, these learning outcomes are the indicators that long-term behaviors are being developed.

Step 4—Construct a knowledge table.

Once the course learning outcomes have been constructed, a knowledge table should be created for the course. The knowledge table describes the concepts, processes, tools, contexts, and "ways of being" that the student must master in order to achieve the course learning outcomes (2.3.9 Forms of Knowledge and Knowledge Tables).

Design: Activities and Knowledge to Support Learning Outcomes

Once the learning outcomes have been determined through analysis, the design process develops a plan for how the learner will achieve these learning outcomes. The design stage is a creative and generative process in which one envisions what the instruction will look like. Steps 5-8 are included in the design stage.

Step 5—Choose themes.

The themes for a course should focus on specific processes, tools, or ways of being to support the development of the long-term behaviors. The themes provide a continuous infrastructure through the course connecting multiple course activities and course learning outcomes to help improve performance in these areas.

Step 6—Create the appropriate methodologies.

Each key process that is to be included in a course should have a corresponding methodology that is identified or developed. A methodology explicitly models those practices that are essential for a novice to learn, and shows how the process is practiced by experts.

Step 7—Identify a set of activities.

Activities include both what happens in the classroom and what the student does outside of class. Each of the items in the knowledge table must be supported by a learning activity appropriate for the type and level of knowledge of that item. At this step, the goal is to generate as many potential activities as possible without fully developing the specifics of those activities.

Step 8—Identify a set of specific learning skills for the course.

In addition to providing content, the course should also incorporate learning skills on which to focus during the course. Learning skills come from four domains: cognitive, social, affective, and psychomotor. While these skills support the learning outcomes of the course, they are also transferable to other courses and environments.

Development: Construction and Selection

The design and development phases are tightly intertwined, highly iterative, and often indistinguishable. At a certain stage in an instructional design project, the activities of the designers will shift away from brainstorming and generating possibilities to making selections and constructing materials and activities. Steps 9-21 are included in the instructional design stage.

Step 9—Identify activity preference types.

To assist in selecting what activity types should be incorporated into the course design, one should review both student and instructor preferences for different types of activities.

Step 10—Match the activity types with the chosen activities.

Collect all possible activities that were identified earlier and organize them by the type. No single type of activity should account for more than twenty-five percent of the activities in an individual course, and one should try to use at least ten different activity types.

Step 11—Choose the in-class and out-of-class activities.

Items on the knowledge table that students have had success with in the past can be addressed outside of class. In-class activities should emphasize activities that are the most critical and challenging for the student and also those steps in the learning process that students have the hardest time learning. When possible, courses should be flexible enough to allow for adjustments in time allocation.

Step 12—Allocate time across the themes.

The time for each theme needs to be allocated both inside and outside of class activities. A percentage of total student learning time should be allocated for each theme.

Step 13—Sequence the activities across the term.

The sequence of activities should provide a progression across the course learning outcomes and the prerequisite knowledge needed to achieve those learning outcomes. In addition, the sequencing needs to provide variety in the activities for students.

Step 14—Create individual activities from a priority list.

The activities that have been selected need to be developed and documented. At a minimum, the documentation must justify the reason for the inclusion of the activity in the course as well as the components of the knowledge map and themes that it addresses.

Step 15—Enhance activities by using technology.

Activities should be reviewed for opportunities to enhance them with instructional technologies (Kruse & Kiel, 2000).

Step 16—Ask peers to review the activities you create.

Peer review of activities increases the quality of the activity design. Student review is also an opportunity to get feedback on the activity.

Step 17—Produce key performance criteria.

One should establish comprehensive, integrative performance criteria for the set of learning objectives and outcomes. The performance criteria describe the expectations for student performance at the end of the course and are used in the design of assessment and evaluation systems.

Step 18—Locate or build key performance measures.

For each of the key performance criteria, identify or create instrument(s) to measure different levels of performance for assessment and evaluation. The performance measures should also be used to assess student performance of the learning skills.

Step 19—Design a course assessment system.

The course assessment system provides a mechanism for both the student and faculty member to track student performance in the course and identify opportunities for performance improvement. The assessment system should relate to the performance measures, and address how students can improve their performance. This step focuses on the design of the student assessment embedded within the class rather than the assessment/evaluation of the class itself, which is a separate stage of instructional design.

Step 20—Design a course evaluation system.

The course evaluation is based on the performance measures and criteria. However, unlike the course assessment system, the evaluation system measures the student's performance relative to standard benchmarks and results in a grade. This step focuses on the design of the student evaluation embedded within the class rather than the assessment/evaluation of the class itself, which is a later stage of instructional design.

Step 21—Design a course syllabus.

The course syllabus should capture the results of the other steps of the design process and clearly communicate the course design and expectations to the student.

Implementation: Facilitating Learning

During the implementation stage, one takes the materials and activities created during the design and development stages and puts them into practice with learners. Implementation is the delivery stage of instructional design. It is the end-result of the instructional design process and is combined with the teaching and facilitation practices of the instructor. Chapter 3.2, **Facilitating Learning**, contains more information related to this stage.

Evaluation and Assessment: Instruction that Learns from Itself

Traditionally in instructional design, the evaluation component involves a summative evaluation that reviews whether the goals determined during the analysis stage were achieved during instruction (Reiser, 2001). A more effective way to approach this phase is to shift from an evaluation model to an assessment model that reviews what aspects of the instruction worked, what aspects did not work, and asks how the instruction might be improved. Ultimately, effective assessment leads to instruction that learns, improves, and adjusts from itself. The assessment process provides a feedback loop to improve the previous stages of the process (analysis, design, development, and implementation) for continuous improvement of the instructional design. For additional information on course assessment, see Chapters 1.5, Added Value through Program Assessment and 4.1, Assessment as a Foundation for Growth

Assessment or evaluation of learner performance and activities at this stage of instructional design are not the same as the assessment or evaluation of learner performance within the class. Evaluation and assessment of the class should examine whether or not learners achieved the established learning outcomes. In addition, other aspects of the entire class should be looked at for opportunities to increase the effectiveness and quality of the learning experience. This stage should provide feedback into any and all of the previous steps with guidance on how to continuously improve the instructional design.

Concluding Thoughts

The instructional design process has significant differences at three levels: program design, course design, and activity design. At the heart of all three are learning outcomes and the means to help students to achieve these outcomes, assessment of processes, and evaluation of achievement. Courses include multiple activities to address a set of learning outcomes; these are derived from the long-term behaviors determined in the program design process. Learning activities (or learning objects) are the smallest unit of instructional design and target singular learning outcomes.

The instructional design process uses a structured approach that begins with an analysis to determine the course learning outcomes. This is followed by a process of design and development of instructional activities to enable students to achieve those learning outcomes. The output of instructional design is learning on purpose rather than learning by accident or chance. Without a clear

road map for how learning is to occur, the learning event cannot be repeated, nor can it be reviewed and assessed for continuous improvement.

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Section 2

Introductions and Background

Sample Agenda

Pacific Crest: A Brief Overview

Broad Learning Goals for an Activity Design Institute

Activity Design Institute: Overview

Activity Design Institute: Learning Outcomes

Dale's Cone of Experience

Sample Agenda

Day

Introductions

Institute Overview

The Transformation of Education

Overview of Course Design

Writing Personal Outcomes for Institute

Break

Team Formation and Outcomes

Assessing Existing Activities

Lunch

Foundational Elements from Course Design

Understanding Linkages between Knowledge Forms and Activity Types Understanding Knowledge Table and Classification of Learning Skills

Activity: Conceptualizing Activity Design and Implementation

Overview of Day 2

Assessment of Day 1

Day

Modifications to agenda based on assessment of Day 1 and identification of unmet needs/questions

Designing a Team Activity

Preplanning Phase

Building Core Elements

Lunch

Enhancing Phase of Activity Design

Peer Review of Activities Designed

Overview of Day 3

Assessment of Day 2

Day

Prepare Activity Sheet for Students

Prepare Facilitation Plan for Activity

Break

Peer Assess Work Products

Select Final Activity for Design by Team

Begin Process

Lunch

Complete Activity

Peer Assessment of Activities

Describe an Implementation Plan for Future Design Work

Identify Items Needing Group Feedback

Institute Assessment



Pacific Crest: A Brief Overview

Pacific Crest is the favored strategic partner of many higher education institutions when it comes to building human and organizational capacity—whether it be in learning, teaching, mentoring, designing instruction, or assessing. Our work in these areas has resulted in the development and articulation of an educational philosophy called Process Education™, which focuses on the development of broad, transferable learning skills.

Implementation of this philosophy means using processes and tools to create new types of environments in which students take center stage and discover how to improve their learning and self-assessment skills within a discipline. This philosophy also supports the current institutional reform movement that calls for a shift in emphasis from an agenda driven by teachers' desires and designs to one focused on student learning outcomes. It consistently seeks answers to the question, *How do students learn most effectively and enduringly?* and then works to translate the answer into teaching practice and, ultimately, institutional policy.

To these ends, Pacific Crest offers a variety of *Faculty Development Institutes*, *Custom Publishing Services* and the centerpiece of our ongoing commitment to Process Education™, the *Faculty Guidebook*.

Broad Learning Goals for an Activity Design Institute

Pacific Crest's goals for this Institute are to help participants:

- 1. Provide a clear and compelling model for course and activity design.
- 2. Develop comfort in faculty with a top-down curriculum design philosophy and understand that activities provide the evidence for realization of the overall design.
- 3. Advance skills in activity design by applying tested methodologies in creating three activities.
- 4. Create activities that contribute to the development of a set of transferable learning skills.
- 5. As a by-product of instructional design, create a facilitation plan that can help others implement a learning activity with repeatable, high quality outcomes.
- 6. Collaborate with colleagues on a project that will extend beyond event.
- 7. Empower a local community of scholars that will support one another in development of learning activities and will routinely use peer review by fellow faculty to upgrade and revise these said activities.
- 8. Appreciate that a high-quality course is never stagnant and can always be improved through incremental integration of high-quality, high-return learning activities in the existing curriculum.
- 9. Generate excitement about using and adapting Process Education™ activities developed by others.

Activity Design Institute: Overview

Curriculum design is an extremely important process because the type of curriculum used, along with its quality, significantly influences the manner in which students learn and the way faculty teach. By integrating learning theory into the design process, curricula can be created that support Process EducationTM approaches, thereby creating learning environments which challenge students to develop essential learning skills while mastering content. This Institute offers practical strategies, techniques, and tips for creating activities and materials to support process-oriented guided-inquiry approaches to teaching and learning.

Activity Design Institute: Learning Outcomes

COMPETENCIES

Write directed questions to build foundational knowledge.

Write convergent questions to build comprehension and meaning of the knowledge item.

Write divergent questions to test boundary conditions and solidity of the knowledge.

Develop motivating why statements that engage learners.

Write performance criteria that clarify expectations for the learning experience that align with course learning outcomes.

Produce quality facilitation plans.

MOVEMENT

Increase proficiency in assessing activities to strengthen level of learning, enjoyment of experience and learning skills, and decrease the level of noise for learners.

Increase creativity in designing learning experiences with different activity types.

ACHIEVEMENT

Produce a publishable curriculum product that others are interested in adopting.

EXPERIENCE

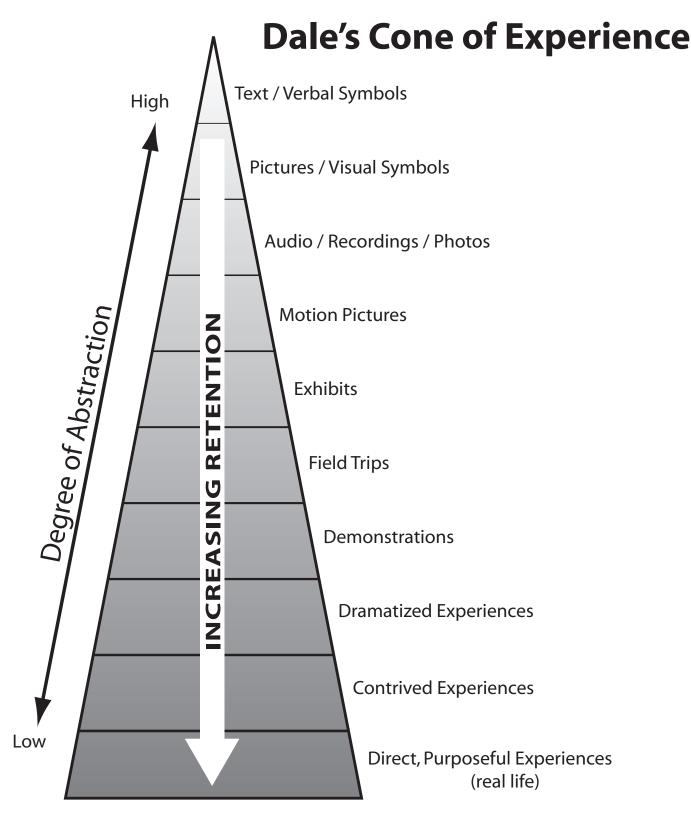
Participants will analyze and assess a variety of activities from different disciplines to understand and value the impact that active learning has on overall learning. Participants will work in design teams and enjoy collaborating with others for design, assessment and improvement and see the added value of team efforts in these processes. The iteration of the design process under different conditions will expand the design creativity including knowledge forms, methodologies, models, stories, skills, use of technology, on-line, collaborative, and team teaching. Participants will understand the relationship between active learning, student assessment of their own learning and student ownership of learning. Participants will also consider the use of activity design to structure classroom research efforts.

INTEGRATED PERFORMANCE

A designer needs to produce an effective activity that produces level 3 or 4 knowledge by exposing all students to a variety of learning experiences while embedding assessment to improve specific learning skills by:

- 1) Producing motivation
- 2) Setting clear expectations
- 3) Identifying learning skills to be improved
- 4) Writing quality inquiry questions
- 5) Building methodologies

- 6) Constructing models
- 7) Providing relevant skill exercises
- 8) Integrating problem solving
- 9) Enhancing learning through technology
- 10) Testing effectiveness with assessment to improve its design



Notes:

In moving up the cone (increasing abstraction), fewer senses are involved in each level Contrived experiences simulate real life situations or activities

Dramatized experiences allow a learner to act out a role

Adapted from the "Cone of Experience" developed by Edgar Dale (1969). Audio-Visual Methods in Teaching, 3rd ed. New York: Holt, Rinehart, and Winston.

Section 3

The Transformation of Education

The Transformation of Education (introduction)

The Transformation of Education (table)

The Compass of Higher Education

Overview of Process Education

Principles of Process Education

Group Exploration Activity: Exploring Educational Transformation

Key Performance Areas and Performance Criteria

Mapping between Key Performance Areas and Pacific Crest Institutes

Recommended Sequencing of Pacific Crest Institutes

The Transformation of Education

Over the past 25 years or so, there have been tremendous sociocultural (economic, political, etc.) forces pushing, arguing, and pleading for change across the entire continuum of education. What has and continues to emerge at a seemingly ever-increasing pace is not an overarching model or even a singular and coherent description of what education should be. There is, however, much common ground where values and ideals are shared across historically disparate disciplines and interests. These shared values have been articulated and advocated by thinkers and practitioners such as Paulo Freire, Lev Vygotski, Maria Montessori, Carl Rogers, Howard Gardner, Daniel Goleman, Jerome Bruner, John Dewey, Thomas Friedman, among many others. These shared values appear, sometimes only implicitly, in current initiatives such as No Child Left Behind and 21st Century Skills. What these different perspectives all share is a belief in the potential growth in performance of learners if new roles are assumed by teachers and learners with each placing emphasis on processes which differ from those commonly and traditionally used in the past.

The implication of these new roles and directions yields a much-transformed view of educational practices and attitudes. The table which follows captures the major dimensions of education and shows both current or traditional practice and attitudes as well as transformed practices and attitudes. Because transformation is more than just a simple change, and change is typically something that human beings resist, there are some common affective or emotional responses to those changes. These are likewise available in the table.

The final aspects of the table are seen in the right-most column: Cultural Assumptions and Tensions. This column provides a list of thought-provoking questions, designed to poke and prod buried or unconscious assumptions. None of these questions have right or wrong answers; the point is that whatever your answer, when you respond, you're doing so on the basis of a pre-conceived notion or value. Those pre-conceived ideas or values can form a kind of paradigm that effectively limits your ability to identify alternative ways of seeing and acting. Assumptions are like habits; breaking them or changing them requires first becoming aware of them!

A final word: society and culture not only dictate who we are (how we see and define ourselves and our value) to a very great degree, but underlie some of our most basic assumptions about the world around us. We have learned to see and conceive of ourselves, others, the world, values, morals, practices, etc., on the basis of our society and culture. Getting to the point where we become aware of some of those assumptions and thus able to either leverage them for greater success (however you choose to define it) or begin to step beyond them to achieve that success is a tremendous challenge, and likely to prove nearly as uncomfortable as making the shift from "what is" to "what can be".

You are welcome to view the Transformation of Education Learning Object at: http://www.pcrest2.com/transformation/lo/

The Trensformetion of Education

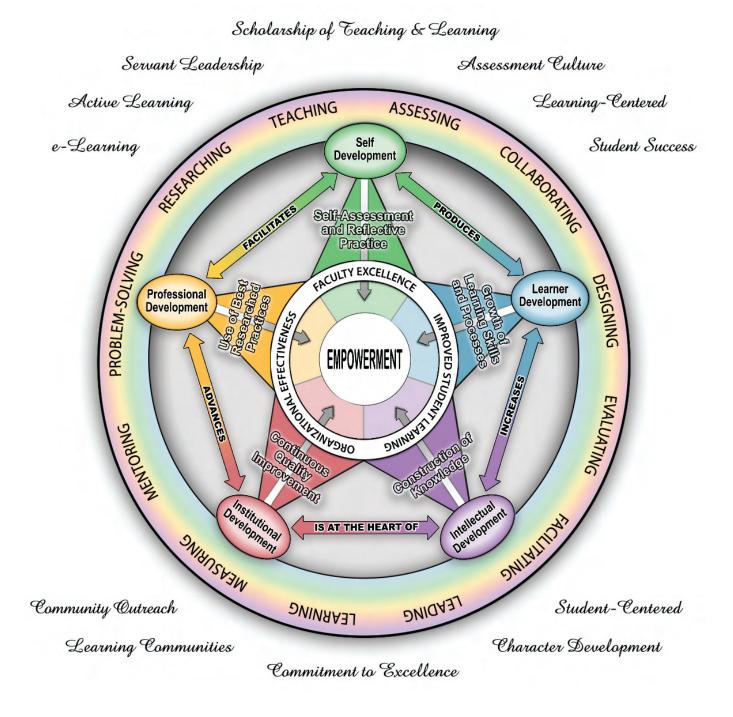
Dimension	Current Tendency	Common Affective Responses	Future Direction	Cultural Assumptions and Tensions
Delivery (mode)	Presentation • learning by listening	Engagement requires energy and risk-taking! Just tell me what I need to know; don't make me struggle to learn.	Activity • learning by doing; discovery as education; Montessori method; Jerome Bruner; Confluent Education	Can knowledge be given to someone? When? How? Do you still have the knowledge others gave to you? How do you know? Can you learn everything you need to know through activity? Do you ever leam things that are meaningful by listening? Why aren't sermons interactive?
Context of Performance	Private • shame-based culture where failure is private & success is public; fear of judgment	What if they think I'm stupid? What if they laugh at me? I'm too embarrassed to share my work until I know it's perfect.	Public • "nobody is perfect, we all make mistakes"; support of a team or friends	Do you enjoy seeing people fail? If not, why encourage them to perform publicly? Why don't art museums display just anyone's art, if 'we all make mistakes'? Are you willing to appear on a reality show? If not, why not? How do you handle it when you make a mistake in front of your students? Are you willing to even put yourself in that position?
Ownership	Directed · 'tabula rasa'; students as blank slates	It should be up to my teacher to decide what I'm going to learn; how could I possibly know??	Self-Directed • Freire & Dewey — learner experience is the foundation of any meaning constructed	Do people really want to improve, if it's hard work and hurts? Or is ignorance truly bliss? Would people seek education if it weren't mandatory/required/strongly urged? Do you? If you can read, study, and learn on your own, why go to school?
Control	Faculty-centered • authority, tyranny	I'm afraid of that level of responsibility; please just give me what you think I need.	Learner-centered democracy; servant leadership; Piaget	Who is worthy of being "in charge"? Are all voices worth listening to? Do all opinions carry the same weight? Is the choice of control one between authority and anarchy? If you met someone who you honestly believed was a better teacher than yourself, would you be willing to give him or her your job? Why not?
Social	Individual • "education as a an individual enterprise"; competition of individuals creating great individuals; survival of the fittest	What if I drag down my team? How can I hide in such a small group? or I know I'm smart enough to earn my A; don't interfere by making me responsible for others.	Collaborative • Dewey's education in society; Sesame Street: Cooperation!; "It takes a village"	Can you learn from someone else's experience? Are you more important than a stranger you've never met? Does the good of the many truly outweigh the good of the individual? Always? Is grading on a curve fair? It is ok to punish several people for the crimes/sins of one?

Dimension	Current Tendency	Common Affective Responses	Future Direction	Cultural Assumptions and Tensions
Expectations	Low (sufficiency) • 'education is wasted on some people'; the "C" student	This is hard! I can't do it! It's too much! Don't you know I also have a family/job/other courses? Don't ask for so much from me!	High (unlimited) • "positive thinking"	Are all people worthy of the same amount of time and effort? When is the last time you had a conversation with your janitor/mechanic about anything other than janitorial issues/ vehicle issues? How often are you surprised by your students? If you are, does this say anything about your expectations?
Goal	Learning • content mastery; rote learning; memorization; fill-in-the-blank and multiple-choice questions	Just tell me what I need to know for the test/to get an "A"/to graduate. Give me specific information; don't make me solve problems.	Learning to Learn • creativity; extracting from context to universals (Platonic levels of abstraction); learning skills; an essay/project	How did you lean your 'times tables?? Your ABGS? Did you learn number theory or study phonetics first? Do you use what you learned in high school biology in your everyday life? If not, why don't we stop teaching biology and teach more reading or even social skills? Ditto for calculus, trigonometry and most other courses you don't use. Is there a difference between who should engage in each kind of learning? What about a teacher? An electrician? A surgeon?
Efficacy of Learner	Level projected by educator • Aristotle's "natural masters and natural slaves"; determinism	Let me be comfortable with what I think I can do; I'm ok with sufficient performance. I get by.	Potential not presumed to be limited • free will; Albert Bandura	Do you believe that everyone is actually born with unlimited potential? What about individuals who score low on an IQ test? Do they have the same potential as someone who scores as a genius? If potential is unlimited, why require exam scores before letting someone in to college? Why not let everyone in who wants to learn?
Efficacy of Educator	Success is up to the student · nature	I can't possibly be held accountable if a student chooses not to learn. I'll teach but it's up to my students to succeed or fail.	Student Success is up to ME • nurture	Do people have the right to choose failure? Do YOU have the right to decide what someone else should or should not do? Can you force someone to succeed?
Modeling	Telling • Hypocrisy; 'do as I say, not as I do'	I have to actively observe rather than just read or listen; haven't I already got enough to do??	Showing "Be the change you want to see"	Are your actions in accordance with your beliefs? Is it OK to say one thing and do something else? Ever?

Dimension	Current Tendency	Common Affective Responses	Future Direction	Cultural Assumptions and Tensions
Relationship	Emotionally distant • science versus social; the mind/ heart gap; thinking versus feeling; objectivity	If he/she cares whether I learn and grow, I risk disappointing him/her. I want the safety of being anonymous!	Emotionally invested (empathic) • Carl Rogers (person-centered); educating the whole child	Do emotions ever get in the way of other considerations? Do you respect someone who cries when they talk or are tears a sign of weakness? Does a leader ever have to make decisions that hurt people? Are you willing to do that? Is your classroom a place where personal problems are left at the door? Are students capable of doing that? Are you? Is that a good thing?
Challenge	Enabling easy success improves self-image; struggle and pain are always bad; unconditional approval	Stop pushing me! You're mean why do you have to make it so hard?!	Empowering • "raising the bar"; "teach a man to fish instead of giving him a fish"; "n + 1"; struggle is good; tough love	If you see a certain change as "good for someone", how can it be good for them, if it causes them pain? What gives you the right to decide it's ok or even good for them to suffer? Isn't happiness better than suffering? Is it better to BE good or to FEEL good? Are they even related?
Design	a script or canned design, rigid/non-responsive/static tradition	I don't like change; I need to rely on things staying the same. Aren't we supposed to stick to a script?	a design that maximizes opportunity, is responsive, evolvable • jazz; "success" in evolutionary terms	Is it ok to take a risk when others, beside yourself, may suffer the consequences? Is predictability more important than a 50/50 chance of improvement? When and why? Why do we adhere to outdated laws and beliefs (i.e. when is the last time you referred to "the sun coming up or going down")? Presuming you believe that the Earth rotates and moves around the sun, Is it because we've failed to evolve our perspective? What are we clinging to?
Feedback/ Reporting	Evaluation • judgment; pass/fail	Assessment is great, but I NEED evaluation to know if I measure up (the point of my learning is up to my teacher, not me). My learning is all about the grades I get and how others see me.	Assessment • learning from mistakes; improvement	Do you have the right to judge another person? What is the fundamental difference (if any) between testing a product and testing a person? Can you afford to have a doctor who learns from his mistakes? Or do you want a doctor who is a doctor because he didn't make any mistakes (passed, in some sense)?

The Compass of Higher Education

The **Compass of Higher Education** provides a concept map which describes the post-transformation state of education — *Process Education in practice*. An detailed breakdown of the Compass can be found on the Pacific Crest Learning Objects page: www.pcrest.com/LO



Note that there are more fundamental processes such as "communicating" or "processing information" that underlie many, if not all, of the processes in the outer ring. While these fundamental processes are indeed critical to the larger and higher-level process clusters, to keep this concept map from being overwhelmingly complex, only the process clusters are shown. If you are interested in a deeper examination of the fundamental processes, the Classification of Learning Skills (*Faculty Guidebook* modules 2.3.3, 2.3.4, 2.3.5, and 2.3.6) provide an excellent place to begin.

The future direction of education is the goal of Process Education. The term Process EducationTM was first used in the early 1970's and referred to the process of educating students rather than the end product of that education. In 1994, Pacific Crest used the idea of Process Education as a launching board to develop a philosophy that encompassed and impacted each of the key dimensions of education as shown the in Transformation of Education table.

Process Education™

Process Education is a performance-based philosophy of education which integrates many different educational theories, processes, and tools in emphasizing the continuous development of learning skills through the use of assessment principles in order to produce learner self-development.

This philosophy can be expressed through eight guiding principles that address the dimensions of education:

FACULTY PERFORMANCE PRINCIPLES

A Process
Educator
fully accepts
responsibility
for facilitating
student
success.

In a quality learning environment, facilitators of learning (teachers) focus on improving specific learning skills through timely, appropriate, and constructive interventions.

FACULTY PERFORMANCE PRINCIPLES

Mentors use specific methodologies that model the steps or activities they expect students to use in achieving their own learning goals.

A Process Educator continuously improves upon existing theories, processes, and tools using active classroom observation and research.

STUDENT PERFORMANCE PRINCIPLES

Every learner can learn to learn better, regardless of current level of achievement; one's potential is not limited by current ability. Although everyone requires help with learning at times, the goal is to become a capable, self-sufficient, life-long learner.

STUDENT PERFORMANCE PRINCIPLES

An empowered learner is one who uses learning processes and self-assessment to improve future performance.

To develop expertise in a discipline, a learner must not only develop a specific knowledge base in that field, but must also acquire generic, life-long learning skills that relate to all disciplines.



Exploring Educational Transformation

Learning Skills

identifying assumptions, checking perceptions, being open

Why?

Over the last 20 years, there have been many efforts to transform and improve learning, teaching, instructional design, assessment, and other educational processes, across the educational spectrum and at all instructional levels. The Transformation of Education table provides a perspective from which current or traditional practices (including some of the sociocultural and even personal assumptions that encourage those practices) as well as potential future direction of practices may be viewed.

Learning Objectives

- 1. Understand the dimensions of education as portrayed in the table and apply these to your educational experiences.
- 2. Appreciate the relationship between current tendencies and the need/desire for movement towards a future direction ("shifting education from the red to the green").
- 3. Appreciate the common affective responses that accompany the shift from current practices.
- 4. Begin to uncover and appreciate the assumptions (personal, social, and cultural) that underlie current tendencies and work against change.

Performance Criteria

- 1. Ability to effectively explain the Transformation of Education to a peer.
 - Attribute 1 Components are identified and articulated
 - Attribute 2 Relationships are understood and articulated
- 2. Embrace the Transformation of Education table as a framework for analyzing student, educator, and/or organizational performance, change, and pushback
 - Attribute 1: Contextual and practical identification of one dimension of education (including the assumptions behind the practice) that will engage others
 - Attribute 2: Compelling question about the Transformation of Education for further discussion throughout the institute
 - Attribute 3 Growth and/or transformation potential is outlined

Plan

1. Working with a peer, analyze the Transformation of Education table available both online (www.pcrest2.com/transformation) as well as on the preceding pages of your handbook.

- 2. Answer the Critical Thinking Questions.
- 3. Produce a discovery, based upon your personal and collective educational experience, that demonstrates some aspect of the table. Teams should be ready to share this with the group in general.
- 4. Develop an inquiry question you would like other teams or your facilitator to answer.

Critical Thinking Questions

1.	elect three dimensions and give examples of the current tendency in practice (i.e., what does that	at
	ractice LOOK like) as well as the future direction.	

2. In which three dimensions is change most critical in order to empower students? W	2.	In which three	dimensions i	is change most	critical in order to	empower students?	Why
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- 3. In which three dimensions is change most critical in order to empower educators? Why?
- 4. Which five dimensions are currently most important for your school? Why? For each of those dimensions, identify at least one assumption which is either encouraging or discouraging transformation in that dimension.



Criteria for Key Performance Areas

Pacific Crest has designed its Faculty Development Program to grow performance in not only faculty but also in staff and administration; our goal is to produce quality performers in higher education across 16 key performance areas.

The Activity Design Institute is particularly focused on development in the performance areas of **Problem Solver**, **Facilitator**, and **Designer**.

- **Self-Grower**: Consistently self-assesses in order to selfmentor one's own performance and growth while increasingly challenging oneself and mentoring others.
- **Servant Leader**: Cultivates a clear vision of a desired future and ably shares through understandable stories; develops plans others can follow and models behavior for others while conveying belief in their ability and helping them succeed in realizing this vision.
- **Change Agent**: Proactively convinces others that a particular project/effort is worthwhile and will be successful; persists and takes risks when facing difficulties that would deter most people.
- **Professional Developer**: Views the development and empowerment of people as the engine for change, both individually and on the organizational level; realizes goals in the strategic plan; develops and facilitates effective programs to achieve these ends.
- **Problem Solver**: Ably identifies and defines problems frequently not seen by others; identifies issues and clarifies assumptions necessary to solve the problem; and effectively closes the gap between expectations and reality by using previous solutions to build upon past successes.
- **Technologist:** Constantly monitors state-of-the-art technologies; learns quickly, selects appropriate tools; increases performance by creatively applying technology in innovative ways.
- **Collaborator:** Values the synergy of relationships and teams; plays a variety of roles effectively while helping others perform their role effectively; compromises self for the betterment of all.
- **Teacher:** Uses a learner-centered approach to help learners prepare learning plans; cultivates productive learning communities; bonds with learners; helps learners meet their intended outcomes through the use of embedded assessment.

- **Facilitator:** Inventories and monitors collective needs; helps synthesize a clear set of outcomes; focuses on process rather than content; shares ownership in making decisions; and constantly strives for improved quality by strengthening the process.
- **Life-long Learner:** Constantly seeks additional knowledge by systematically using professional development plans; leverages experts and resources; assesses own learning performance; and validates own learning.
- **Researcher**: Identifies and states quality research questions by operating from a consistent inquiry mindset; uses appropriate methods; effectively articulates findings to a community of scholars.
- **Measurer**: Identifies critical qualities; creates performance criteria; identifies best items to measure; effectively times when and how to measure with appropriate accuracy and precision.
- Assessor: Focuses on the assessee's needs; collaboratively designs an assessment process; stays focused on chosen design through careful observation; analyzes the data for meaning; uses interactive feedback to solidify strengths; offers clear action plans; shares insights to produce significant understanding without being judgmental.
- **Evaluator**: Knows where value is essential; designs the appropriate times for determining whether or not value is being produced by setting clear expectations and standards; uses unbiased judgments to reward performance.
- **Designer**: Clearly defines desired results; creates precise dimensional learning outcomes; defines the activities and processes used to produce the results; identifies ways to embed assessment in order to increase quality; produces an evaluation system to assure desired results.
- *Mentor*: Enters into a defined relationship with respect for the potential of the mentee; plays the role of coach and advisor by helping establish the mentee's personal goals; identifies activities and means to grow performance to achieve the desired results within a specific time period.

Mapping between Key Performance Areas and Pacific Crest Institutes

Each of Pacific Crest's Faculty Development Institutes focuses upon at least three key performance areas:

Institute	Area 1	Area 2	Area 3
Teaching Institute	Teacher	Learner	Collaborator
Learning to Learn Camp	Mentor	Assessor	Facilitator
Advanced Teaching Institute	Researcher	Facilitator	Self-grower
Research on SoTL Institute	Researcher	Measurer	Collaborator
Chairperson's Institute	Servant Leader	Change Agent	Professional Developer
Program Assessment Institute	Designer	Assessor	Measurer
Assessment Institute	Assessor	Self-grower	Evaluator
Performance Measures Institute	Measurer	Researcher	Evaluator
Program Design Institute	Designer	Collaborator	Problem Solver
Course Design Institute	Designer	Teacher	Evaluator
Activity Design Institute	Designer	Facilitator	Problem Solver
Interactive Learning Systems Institute	Technologist	Learner	Teacher
Designing Online Classes Institute	Designer	Technologist	Facilitator
Facilitating Online Learning Institute	Facilitator	Technologist	Teacher
Designing Learning Objects Institute	Designer	Technologist	Learner
Leadership Institute	Servant Leader	Change Agent	Problem Solver
Faculty Development Institute	Professional Developer	Servant Leader	Change Agent
Strategic Planning Institute	Measurer	Collaborator	Designer
Student Success Institute	Mentor	Self-grower	Teacher
Facilitator's Institute	Facilitator	Professional Developer	Mentor

Recommended Developmental Sequencing

Pacific Crest has designed its Faculty Development Program to grow performance of faculty, staff, and administration in higher education to produce quality performers. Below is our suggested sequencing of Faculty Development Institutes, in order to maximize this growth.

Institutional Development

Professional Development Intellectual Development

Assessment Institute

Teaching Institute

Teaching Institute

Program Assessment Institute

Faculty Development Institute

Course Design Institute

Performance Measures
Institute

Advanced Teaching Institute

Activity Design Institute

Strategic Planning Institute

Course Design Institute

Interactive Learning Systems Institute

Leadership Institute

Designing Online Classes Institute Designing Learning
Objects Institute

Chairperson's Institute

Facilitator's Institute

Research on the Scholarship of Teaching and Learning Institute

Program Design Institute

Facilitating Online Learning Institute

Learner Development

Self Development

Student Success Institute

Assessment Institute

Mentoring Institute

Activity Design Institute

Learning to Learn Camp

Teaching Institute

Assessment Institute

Student Success Institute

Mentoring Institute

Learning to Learn Camp

Section 4

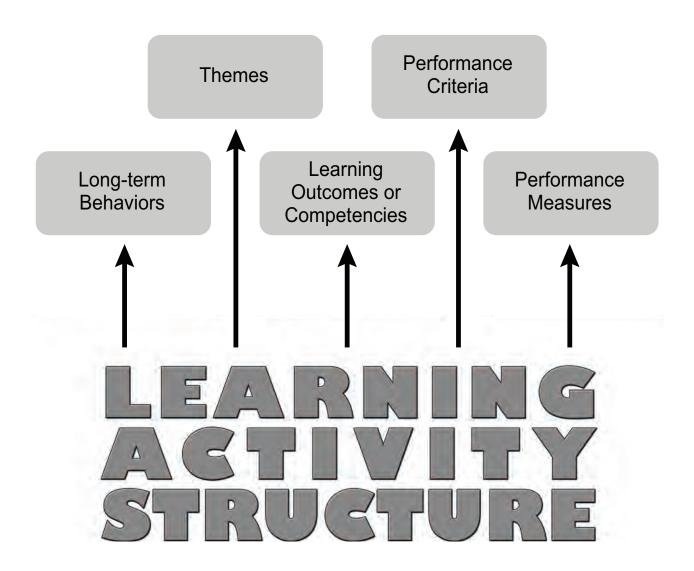
Course Design for the Activity Design Institute

Activity Design and Critical Areas of Course Design Course Design Template: Activity Design Institute

Activity Design and Critical Areas of Course Design

The diagram below illustrates that an activity should align itself with five critical areas of the course design.

- An activity's performance criteria should support the **performance criteria** of the course.
- An activity should be designed so that the learner increases his or her performance in specific **measures** in the course.
- An activity should be designed to support changing the **long-term behaviors** of learners.
- An activity should be connected to at least one **learning outcome**.
- An activity should support the development of **course themes**.



Course Design Template: Activity Design Institute

Vision for the Activity

Which of the course themes, long term behaviors and learning outcomes do I want to work on in this activity?

Step 1: Long-term Behaviors

- 1. Consistently designs learning activities that build robust knowledge and learning skills by transferring learner ownership from the teacher to the student.
- 2. Varies activity types in order to increase engagement of learners with different learning styles.
- 3. Efficient in planning and integrating activity design with activity facilitation.
- 4. Embeds all forms of assessment in the design of activities to improve learning skills, level of learning, performance in existing activities, and others areas of the learning experience.
- 5. Incorporates activity design features that support classroom research without compromising impact of teaching/learning activities.

Step 2: Course Context

Course Intentions

- 1. Sell activities books by making faculty more appreciative of the value of activities.
- 2. Locate new authors for constructing materials for Pacific Crest.
- 3. Stimulate interest and ability to use the Transformation of Education and Compass for Higher Education and the underlying glossary as a framework to articulate processes of instructional design, assessment, and facilitation of learning.

Broad Learning Goals

- 1. Provide a clear and compelling model for course and activity design.
- 2. Develop comfort in faculty with a top-down curriculum design philosophy and understand that activities provide the evidence for realization of the overall design.
- 3. Advance skills in activity design by applying tested methodologies in creating three activities.
- 4. Create activities that contribute to the development of a set of transferable learning skills.
- 5. As a by-product of instructional design, create a facilitation plan that can help others implement a learning activity with repeatable, high quality outcomes.
- 6. Collaborate with colleagues on a project that will extend beyond event.
- 7. Empower a local community of scholars that will support one another in development of learning activities and will routinely use peer review by fellow faculty to upgrade and revise these said activities.
- 8. Appreciate that a high-quality course is never stagnant and can always be improved through incremental integration of high-quality, high-return learning activities in the existing curriculum.
- 9. Generate excitement about using and adapting Process EducationTM activities developed by others.

Step 3: Learning Outcomes

Competencies	Write directed questions to build foundational knowledge. Write convergent questions to build comprehension and meaning of the knowledge item. Write divergent questions to test boundary conditions and solidity of the knowledge. Develop motivating "why' statements that engage learners. Write performance criteria that clarify expectations for the learning experience that align with course learning outcomes. Produce quality facilitation plans.
Movement	Increase proficiency in assessing activities to strengthen level of learning, enjoyment of experience and learning skills, and decrease the level of noise for learners. Increase creativity in designing learning experiences with different activity types.
Achievement	Produce a publishable curriculum product that others are interested in adopting.
Experience	Participants will analyze and assess a variety of activities from different disciplines to understand and value the impact that active learning has on overall learning. Participants will work in design teams and enjoy collaborating with others for design, assessment and improvement and see the added value of team efforts in these processes. The iteration of the design process under different conditions will expand the design creativity including knowledge forms, methodologies, models, stories, skills, use of technology, on-line, collaborative, and team teaching. Participants will understand the relationship between active learning, student assessment of their own learning and student ownership of learning. Participants will also consider the use of activity design to structure classroom research efforts.
Integrated Performance	A designer needs to produce an effective activity that produces level 3 or 4 knowledge by exposing all students to a variety of learning experiences while embedding assessment to improve specific learning skills by: 1) Producing motivation 2) Setting clear expectations 3) Identifying learning skills to be improved 4) Writing quality inquiry questions 5) Building methodologies 6) Constructing models 7) Providing relevant skill exercises 8) Integrating problem solving 9) Enhancing learning through technology 10) Testing effectiveness with assessment to improve its design

Step 4: Knowle	dge Table (to be re	ead by column, not r	ow)	
Concepts	Processes	Tools	Contexts	Ways of Being
Bloom's Taxonomy Levels of Knowledge	Course design	Course design template	Process-Oriented Guided-Inquiry activities (guided discovery)	Facilitator - student centered - learning centered
Experiential learning	Activity design	Activity assessment form	Reading	Designer
Activity types	Activity assessment	Facilitation planning template	Teams/Base groups	Assessor
Learning outcomes (5 types)	Facilitation planning	Activity design template	Peer assessment	Collaborator
Forms of knowledge	Constructing methodologies	Activity sheets	Large classes	Planner
Learning skills	Writing and sequencing sets of inquiry questions	Knowledge table	Projects	Action researcher
Active learning	Developing learning models	Activities table	Problem solving	Innovator
Growth/development	Elevating knowledge from Level 1 to 3	Classification of learning skills	Self-study	Documenter
Learning objects	Disciplinary processes	Cooperative learning roles	Laboratories	Discipline expert
Critical Thinking Questions (3 types)	Problem solving	SII method	Homework	Problem Solver
Disciplinary knowledge	Peer coaching	Course textbooks	Simulations	
Learning models - Concept models - Methodologies - Case studies - Profiles		Course syllabi	Foundation courses	
Performance criteria		Disciplinary tools	Advanced courses	

Step 5: Themes for the Course

Analyzing existing activities

Designing new activities

Collaboration

Planning to facilitate an activity

Assuring alignment in program, course, and activity outcomes

Step 6: Methodologies

Activity Design (primary)

Facilitation (secondary)

Assessment (secondary)

Course Design (secondary)

Step 8: Learning Skills

Cognitive: identifying assumptions, ensuring compatibility, validating completeness, strategizing,

envisioning, subdividing

Social: goal setting, planning, achieving consensus, checking perceptions

Affective: being playful, seeking assessment, challenging personal standards, being open

Step 17: Performance Criteria

Designing:

Attributes: Client focused, blends process & content, systems thinker, cleverly integrates solutions to

sub-problems, documenter

Designs impactful activities that are learner centered, aligned with course design, engaging and effective, diverse in learning styles, effectively using technology, and embeds critical thinking and growth in learning skills to enhance learning

Facilitating:

Attributes: Outcome oriented, values process over content, develops shared ownership, problem

solver, aware/on top of it

Produces facilitation plans that project learning outcomes, prepares students for success, effectively sets up the activity, forecasts the learning issues and skills to be improved, plans interventions, brings closure on both content and process

Problem Solving:

Attributes: Identifies problems, defines problems, identifies key issues, identifies assumptions, reuses

solutions

Constantly is seeking out the issues and problems that students confront with learning, defines the important ones into problem statements, explores assumptions, and works through a solution that conforms to the desired improvements

Step 18: Performance Measures

Design of an activity

Critical thinking questions

Facilitation plans

Models of knowledge

Step 19: Assessment / Evaluation System

Assessment mindset

Use of SII Assessment

Peer review of work products

Form for SII Assessment with 3 Strengths, 3 Improvements and 3 Insights

Step 20: Course Activities	e Activities						
Activity Name Step 7	Knowledge Table Item Step 9	Theme Step 12	Activity Type Steps 9 & 10	Learning Skills Steps 8 & 14	In or Out of Class Step 11	Time	Purpose Step 7
Transformation of Education	Concepts: - Transformation of Education - Compass of Higher Education	Process Education	Group exploration of a model; cooperative learning	Identifying assumptions, checking perceptions, being playful		60 min	Provide an understanding of the components of Process Education within higher education
Overview of Course Design	Tools - course design template	Assuring alignment	Interactive lecture	Ensuring compatibility, validating completeness, planning		30 min	Build vocabulary for course and activity design, adding meaning to event agenda
Writing Personal Outcomes	Ways of being - designer - facilitator - problem solver	Designing New Activities	Personal reflection	Goal setting, challenging personal standards		15 min	Reframe personal outcomes against start-up activities
Constructing Team Objectives	Concepts: - Learning Outcomes Tools: - Team roles	Team Building	Planning	Goal setting, achieving consensus, being open		45 min	Form viable project teams for collaboration in activity design
Assessing an Existing Activity	Tools - activity sheet - activity assessment form	Analyzing Existing Activities	Group Assessment against criteria	Achieving consensus, seeking assessment, challenging personal standards		30 min	Try out tool for obtaining feed-back on activity design from colleagues

Activity Name Step 7	Knowledge Table Item Step 9	Theme Step 12	Activity Type Steps 9 & 10	Learning Skills Steps 8 & 14	In or Out of Class Step 11	Time	Purpose Step 7
Generating a Knowledge Table	Concepts - knowledge forms - learning skills	Analyzing Existing Activities	Contest	Identifying assumptions, checking perceptions		30 min	Inventory content for activity design
Identifying Learning Skills	Concepts - cognitive domain - social domain - affective domain	Designing New Activities	Using research data to prompt debate/discussion	Ensuring compatibility, envisioning, checking perceptions		30 min	Obtain strategic short list of learning skills to weave in activity design as well as its facilitation
Methodology for Activity Design	Processes - methodology for activity design	Designing new activities	Group Consulting	Identifying assumptions, strategizing, subdividing, planning		90 min	Clarify purpose and sequencing of steps in method
Conceptualizing Activity Design & Implementation	Concepts - designing POGIL activities Tools - Activity Design Criteria - Activity Design	Thinking through Activity Planning and Facilitation	Group Consulting	Ensuring compatibility, identifying assumptions, strategizing, subdividing		30 min	Understand the process of activity design in order to appreciate how the steps of the process support one another and fit together
Pre-planning an Activity	Processes - developing learning models	Designing New Activities	Project work	Strategizing, envisioning, subdividing		90 min	Generate robust learning model as the basis for activity design
Core Elements for an Activity	Processes - writing and sequencing critical thinking questions	Designing New Activities	Project work	Goal setting, planning, subdividing		90 min	Increase proficiency in writing three types of key questions

Activity Name Step 7	Knowledge Table Item Step 9	Theme Step 12	Activity Type Steps 9 & 10	Learning Skills Steps 8 & 14	In or Out of Class Step 11	Time	Purpose Step 7
Enhancing an Activity	Contexts	Analyzing Existing Activities	Project work	Being playful, ensuring compatibility		60 min	Enhance activity using teaching experience and lessons learned from exemplars
Preparing an Activity Sheet	Tools - Activity sheet	Planning to facilitate an activity	Project work	Strategizing, validating completeness		30 min	Package a learning activity for effective and efficient use by students
Creating a Facilitation Plan	Tools - facilitation plan	Planning to Facilitate an Activity	Project work	Envisioning, challenging personal standards, checking perceptions		60 min	Formulate an instructor's guide that strengthens connection between activity content & process
Assessment of Process Documentation	Processes - assessment - peer coaching	Collaboration	Round robin assessment with assessee feedback to assessors	Validating completeness, ensuring compatibility, seeking assessment		60 min	Revisit activity design criteria to measure growth of self/ peer skills in activity design
Implementation Planning	Ways of Being - designer - facilitator - problem solver	Designing New Activities	Individual consulting	Challenging personal standards, planning		30 min	

Section 5

Writing Personal Outcomes

Reflective Activity: Developing Personal Outcomes



Developing Personal Outcomes

Learning Skills

goal setting, challenging personal standards

Why?

Any learning experience is more valuable when the learner is able to personally assume ownership for the learning. Each of you made the decision to participate in this institute for reasons that met some personal need. You have had the opportunity to do some preparatory reading and thinking about what this institute is to entail. In order to meet your personal goals for the institute, it is time to explicitly state and publicly share your desired learning outcomes for the institute. Once these are collectively shared, the facilitators have the opportunity to modify the agenda to assure that the institute better meets the needs of those involved in this particular event.

Learning Objectives

- 1. Understand the general learning outcomes for this event.
- 2. Anticipate that which is to occur throughout the learning experience.
- 3. Assess personal needs and wants against that which is planned for the entire group.
- 4. Articulate your personal learning outcomes.

Performance Criteria

- 1. A minimum of two personal outcomes are identified.
- 2. Outcomes are clearly stated and are understood by others present.
- 3. Outcomes are consistent with the intentions and parameters of this event.
- 4. Outcomes are realistic within the time frame available.

Plan

- 1. Review the learning outcomes, the agenda and the table of contents for the institute.
- 2. Answer the Critical Thinking Questions
- 3. Assess your own knowledge, skills and needs related to that which you anticipate happening.
- 4. Write a minimum of two personal learning outcomes for the institute.
- 5. Determine what you will do to reach these outcomes.

Critical Thinking Questions

- What are the learning outcomes for this institute?
 How do you envision these outcomes being realized?
 Based upon what you know, which of these outcomes align with your personal needs for learning?
 As you consider that to be addressed, are there areas that you view as being challenging for you?
- 5. What are the things that you will personally work on to elevate your level of performance as you participate in this event?

6. What kinds of things do you want the learning group to understand about your goals in order that they may help you in meeting them?

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Section 6

Team Formation and Outcomes

Faculty Guidebook: 2.4.5 Learning Outcomes
Forming Teams and Performance Criteria for Team Roles
Criteria for Reflector and Recorder Reports

Team Activity: Constructing Team Outcomes



2.4.5 Learning Outcomes

Steven W. Beyerlein (Mechanical Engineering, University of Idaho), Denny Davis (Bioengineering, Washington State University), and Daniel K. Apple (President and Founder, Pacific Crest)

Learner performance is more likely to improve if one is able to precisely define what is to be achieved along with how this performance can be documented at the end of a learning experience. This module contrasts five different types of learning outcomes that are common in higher education: competencies, movement, accomplishments, experiences, and integrated performance. Each of these outcomes addresses a different aspect of learning. Each is best suited to different educational methods and requires collecting different evidence to demonstrate that the outcome has been achieved. A competency is a collection of knowledge, skills, and attitudes needed to perform a specific task effectively and efficiently at a defined level of performance. Movement is documented growth in a transferable process or learning skill. Accomplishments are significant work products or performances that transcend normal class requirements and are externally valued or affirmed by an outside expert or client. Experiences are interactions, emotions, responsibilities, and shared memories that clarify one's position in relation to oneself, a community, or discipline. Integrated performance is the synthesis of prior knowledge, skills, processes, and attitudes with current learning needs to address a difficult challenge within a strict time frame and set of performance expectations.

Need for Learning Outcomes

Adoption of a learner-centered approach to teaching requires a supportive environment and focused attention to what students should be able to do at the end of a learning experience (Fink, 2003). Good instruction begins with a statement of intentions or objectives. However, instructional success can only be measured by the level of behaviors that are elicited in response to well-defined situations at the conclusion of an instructional period (Mager, 1997). These can be formalized in measurable learning outcomes that can inform formative assessments, guide instructional methods, serve as the basis for course evaluation, and generate data needed for program accreditation.

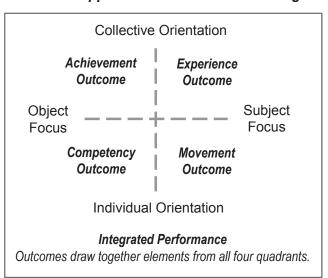
The modern workplace demands a variety of cognitive, social, and affective behaviors that need to become more and more sophisticated over time (SCANS, 1991). Over the last decade, accreditation organizations have responded by defining a much more comprehensive set of student learning outcomes that must be rigorously demonstrated for program accreditation (ABET, 2004). These learning outcomes are subjective as well as objective in nature, and are individual as well as collective in participation. Skill listings in the Cognitive Domain (2.3.4), Social Domain (2.3.5), and Affective Domain (2.3.6), levels of knowledge outlined in 2.2.1 Bloom's Taxonomy—Expanding its Meaning, and knowledge types described in 2.3.9 Forms of Knowledge and Knowledge Tables provide a rich set of data for constructing a broad spectrum of learning outcomes. By recognizing different types of learning outcomes, educators are better equipped to select instructional methods and to align assessment and evaluation systems (Wiggins & McTighe, 2005).

Types of Learning Outcomes

Learning is a social enterprise that contains elements that can be mapped on two axes (Wenger, 1998). One axis is defined by what is learned (object) versus who is involved in the learning (subject); the other axis is defined by whether the learning has more of an individual or a collective orientation. When these axes intersect, as shown in Figure 1, four different regions emerge that suggest distinctive educational activities and outcomes.

Figure 1 Types of Learning Outcomes

Mapped to Axes of Social Learning



Competency outcomes focus on the level of mastery of specific skills and knowledge across a wide range of contexts. These outcomes are content-laden but depend on knowledge construction and deconstruction by individuals. Hence, competency development must be sensitive to needs associated with different learning styles. Movement outcomes focus on awareness of issues involved in improving the use of learning skills and learning processes in different situations over a period of time. Self-assessment of the learning process and awareness of personal development are both useful for determining movement outcomes. Experience outcomes are often shared among

groups of people, and they frequently serve to clarify goals, roles, and responsibilities within an organization and within oneself. These outcomes involve considerable individual and group processing and help build professional as well as personal connections within a community. Accomplishment outcomes are significant additions to the practice of the discipline and have value to a wider audience. These can be innovations in knowledge, practice, or creative work, but they must have value beyond the classroom. Integrated performance outcomes stress how well expertise can be drawn together from all quadrants (of Figure 1) in response to a complex challenge.

All learning outcomes for a course share some common characteristics that contribute to an effective learning experience. They must be stated concisely to facilitate understanding and must capture major performance expectations. They must be specific enough to support measurement and be achievable within the time frame available, considering the developmental level of the learners. They should be aligned with the long-term behaviors expected within a program and be motivating to learners so that they take responsibility for specific required actions. Finally, learning outcomes are most compelling if they are defined within a specific application or context.

Each of the five learning outcomes can be distinguished by the type of performance involved, the conditions under which these performances are interpreted, and the challenges associated with measurement of the performance. Table 1 contrasts the five types of learning outcomes with respect to these three areas. More detailed discussion about unique attributes of each type of learning outcome appears in subsequent sections of this module.

Competency Outcomes

Competency outcomes are tasks that learners must perform at a prescribed level. These performance levels are often referenced to disciplinary standards and/or accreditation criteria. Competency outcomes are snapshots of what learners can do at a specific point in time, and they are relatively easy to measure. Special attention should be given to exactly what levels of knowledge are expected so that these outcomes reach the appropriate level in Bloom's taxonomy. Examples of competency outcomes are given below.

Rewrite a paragraph using active rather than passive voice. (English Composition)

Identify Piaget's stages of childhood development and give an example of several behaviors that are typical for each stage. (Psychology)

Find all real positive roots of a second-order polynomial using the quadratic formula. (College Algebra)

Use a decision matrix to defend a design decision within the context of multiple alternatives, customer requirements, and resource limitations. (Capstone Project Course)

Within five minutes, produce a written assessment that uses the SII model format which includes meaningful analysis. (Faculty Development Workshop)

Movement Outcomes

Movement outcomes focus on personal and professional development. They prescribe a desired direction and magnitude of growth that extend well beyond the present capabilities of all learners. Movement outcomes require multiple samplings over time to document whether real growth has occurred. Several examples of movement outcomes are given below.

Increase the effectiveness of word choice in one's own writing. (English Composition)

Increase the quality of reflection and self-assessment in investigating one's life vision. (Psychology)

Interpret simple word problems into symbolic equations with greater speed and accuracy. (College Algebra)

Manage project knowledge, resources, and the work environment more effectively to design a quality product in a timely manner and within budget. (Capstone Project Course)

Strengthen the use of the assessment process by elevating SII reports at least one level according to the holistic rubric for assessor performance. (Faculty Development Workshop)

Experience Outcomes

Experience outcomes capture changes in attitudes, values and behaviors that result in a life-changing experience. They should reveal awareness and critical analysis of the causes and impacts of personal changes in the learner. When one processes the experience it should produce new understanding that can be shared with others through purposeful reflection and self-assessment. Examples of experience outcomes are given below.

Practice accepting and giving peer feedback in order to improve writing assignments, and use this feedback to make more valuable revisions. (English Composition)

Engage in repeated, intense learning exercises within cooperative learning teams leading to the study of different learning strategies and improved individual and team learning through self-assessment. (Psychology)

	Competency	Movement	Experience	Accomplishment	Integrated Performance
Targeted Performance	disciplinary knowledge and methods	transferable skills and processes	attitudes, values and meaningful context	work product that can be placed on a resume	knowledge, skills, and processes used expertly in a very meaningful context
Situational Issues	disciplinary standard	unbounded continuum	critical analysis; meaningful; life changing	archival contribution	real-world application
Measurement Issues	snapshot of performance	trend sampling	reflective thinking	third party evaluation of product quality	focused challenge

Serve as a tutor once a week throughout the semester in a math laboratory at a local high school advancing your confidence in learning mathematics. (College Algebra)

Gain appreciation of professional practice through interactions with clients, mentors, team members, and support staff in a yearlong product development project, documenting issues and discoveries in a reflective journal that illustrates formation of a personal design philosophy. (Capstone Project Course)

Experience a culture in which the assessment mindset is valued as a tool for challenging and supporting student achievement through a productive learning environment. (Faculty Development Workshop)

Accomplishment Outcomes

An example of an accomplishment outcome would be a majorworkproductorcreativeperformancethatissignificant within a disciplinary field. They usually represent clear endpoints and can often be archived for future reference or study. When measuring accomplishment outcomes, one can eliminate instructor bias by getting outside affirmation from other faculty, alumni, or practitioners in a field. Often these outcomes can be evaluated and celebrated at the same time in a public display. Frequently they can also be listed on a student's resume documenting his or her ability to perform in specific areas. Examples of accomplishment outcomes are given below.

Write a poem that can be published in the campus literary magazine. (English Composition)

Create and present a poster describing the benefits of a campus support group to which you belong for use in freshman orientation. (Psychology)

Place in the top 10% at a Student Math League competition. (College Algebra)

Produce a design product that impresses a client, your peers, and the general public at a year-end design show and wins a competition while at the same time meeting key functional performance specifications so that your product is used by your client. (Capstone Project Course)

Outline an assessment system for a course that eliminates three evaluation exercises and replaces them with assessment practices that promote desired student learning outcomes and can be used as part of an accreditation visit. (Faculty Development Workshop)

Integrated Performance Outcomes

Integrated performance outcomes draw on previous types of learning and experiences from multiple sources. They require extension and transfer of knowledge, skills, and perspectives in a professional environment. This type of outcome must be measured in a challenging and compelling situation that ensures peak performance on the part of the learner in a relatively short period of time. Integrated performance can be studied at the beginning of a course as a pre-assessment activity or at the end of a course as a summative evaluation. Integrated performance outcomes are especially efficient and effective in answering questions connected with program assessment. Examples of integrated performance outcomes are given below.

Turn public opinion in your direction by writing a 500-word persuasive essay for the city's editorial page challenging a recent news item that you felt was shallow or one-sided. (English Composition)

Contrast the theories presented in this course to explain why the motivation to become president is different for each of the primary candidates. (Psychology)

Use mathematical skills developed in this course to formulate, analyze, and report quantitative results related to a scientific experiment in your lab course. (College Algebra)

Table 2 Research Questions, Learning Activities, and Assessment Tools for Learning Outcomes

	Competency	Movement	Experience	Accomplishment	Integrated Performance
Classroom research question	What can the learner do at what level in a specific situation?	What does increased performance look like?	How has this shared experience changed the learner?	How well does student work compare with work products of practitioners in the field?	How prepared are students to respond to a real-world challenge?
Common learning activity	guided-discovery; active learning	study of processes; use of tools	team building; contests	project work	role playing; problem solving
Common assessment tool	exams with scoresheets	self-growth papers	personal interviews; focus groups	judging work products	panel of mentors or colleagues

Display professionalism in forming client relationships, assuming team responsibilities, achieving consensus, fulfilling commitments, applying prior knowledge, and conducting self-directed learning. (Capstone Project Course)

Plan and facilitate a team-based learning exercise that will generate insights about information processing, critical thinking, problem solving, communication, teamwork, assessment, and personal development from the perspective of facilitators, participants, and peer coaches. (Faculty Development Workshop)

Using Learning Outcomes

Learning outcomes for a course should be small in number but consistent with the long-term behaviors supported by the course. Outcome types should be selected based on the behavior, situation, and performance level desired as suggested by Table 1. Regardless of type, learning outcomes should be relevant, concise, measurable, achievable, motivating, aligned with long-term objectives, and framed in a meaningful context. Each type of outcome answers different classroom research questions, is supported by different types of learning activities, and is aligned with different assessment tools as shown in Table 2.

Concluding Thoughts

Strong performers take a keen interest in increasing the quality of their learning outcomes, and they desire feedback on how to improve in the areas that they feel are important. Educators can strive to expand the diversity and depth of learning outcomes for each course to better meet the program expectations by avoiding learning outcomes of only one type, emphasis on low levels of knowledge, and

disconnection from follow-on courses. One great way for educators to start a semester is to remind themselves and their students of the major areas for content mastery and personal growth in their courses. They can then monitor their progress as the semester unfolds. By matching the most appropriate type of learning outcome to the desired area for performance improvement, both learners and teachers will better visualize performance expectations in the immediate course and in future courses.

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Forming Teams

The art of forming effective teams should be systematically addressed when participants share cooperative learning experiences. Because cooperative learning and functioning within teams is a key component of this course, it is important to become familiar with both the consideration of various roles when designing teams as well as the performance criteria of the respective roles. Excerpted materials from module 3.4.2 of the Faculty Guidebook, "Designing Teams and Assigning Roles," are provided to give the essential background material.

Because the workplace has become much more team-oriented over the past two decades, it is important that students learn to work well in teams. Students who participate in team environments are much better prepared to succeed both in further education, as well as on the job, than are those without teaming experience. Although it is not yet common for business or industry to employ formal process-oriented roles for team members, graduates who have used roles frequently in undergraduate courses realize that the use of roles would dramatically improve team performance.

Why Roles are Important

- Using roles helps team members to become interdependent and to be individually accountable for team success
- It helps them to increase their learning skills, and speed up the four stages of team development: forming (goal setting), storming (conflict resolution), norming (problem-solving), and performing
- Roles should be rotated frequently so that each student has the opportunity to practice each role and to realize that effective learning requires that teams use all of the roles simultaneously. Rotating roles discourages dominance by one person and gives all students opportunities to practice social, communication, and leadership skills.

Performance Criteria for Team Roles

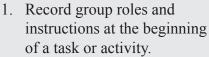
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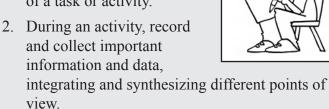
- 1. Facilitate the team process, keeping it enjoyable and rewarding for all team members.
- 2. Make sure each member has a role and is performing within that role.
- 3. Ensure that all team members can articulate and apply what has been learned.

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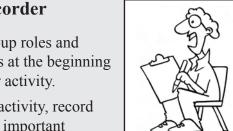
- 4. Manage time, stress, and conflict.
- 5. Accept accountability for the overall performance of the team.
- 6. Contribute to the group as an active learner.

Recorder





- 3. Document group decisions and discoveries legibly and accurately.
- 4. Accept accountability for the overall quality of the Recorder's Report.
- 5. Control information flow and articulate concepts in alternative forms if necessary.
- 6. Contribute to the group as an active learner.



Spokesperson

- 1. Speak for the team when called upon to do so.
- 2. Ask questions or request clarification for the team.
- 3. Make oral presentations to the class for the team.
- 4. Use the Recorder's journal to share the team's discoveries and insights.
- 5. Collaborate periodically with the Recorder.
- 6. Contribute to the group as an active learner.

Technology Specialist

1. Use the available technological tools for the team activity.



- 2. Listen, converse, and collaborate with team members; synthesize inputs, try suggestions and/or follow directions for the technology.
- 3. Retrieve information from various sources; manage the available resources and information.
- 4. Help team members understand the technology and its use.
- 5. Be willing to experiment, take risks, and try things.
- 6. Contribute to the group as an active learner.

Planner

1. Review the activity, develop a plan of action, and revise the plan to ensure task completion.



- 2. Monitor the team's performance against the plan and report deviations.
- 3. Contribute to the group as an active learner.

Reflector

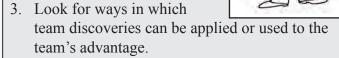
1. Assess performance, interactions, and the dynamics among team members, recording strengths, improvements, and insights.



- 2. Be a good listener and observer.
- 3. Accept accountability for the overall quality of the Reflector's journal.
- 4. Present an oral Reflector's Report positively and constructively if asked to do so.
- 5. Intervene with suggestions and strategies for improving the team's processes.
- 6. Contribute to the group as an active learner.

Optimist

- 1. Focus on why things will work.
- 2. Keep the team in a positive frame of mind.



4. Contribute to the group as an active learner.

Timekeeper

- 1. Observe the time resource for the activity and/or record the time allocation announced by the facilitator.
- 2. Keep track of the elapsed time for various tasks and notify the Captain when the agreed-upon time has expired.
- 3. Contribute to the group as an active learner.



Skeptic

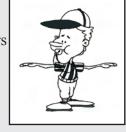
- 1. Question and check the assumptions that are being made.
- 2. Determine the issues or reasons why quality is not being met at the expected level.



- 3. Be constructive in helping the team improve performance.
- 4. Contribute to the group as an active learner.

Conflict Resolver

- 1. Make sure that team members are respectful to each other.
- 2. Assure that each team member is heard and acknowledged, and assure that issues between people do not go ignored.



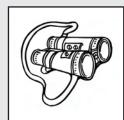
- 3. Check that decisions made by the team are consistent with the team's desired outcomes.
- 4. Contribute to the group as an active learner.

Criteria for a Written Reflector's Report

- concise
- clear
- accurate
- cites specific examples to convey meaning
- refers to key skills used by the team
- provides supporting documentation
- documents affective issues
- prioritizes most important information
- focuses on areas identified in the performance criteria

Spy

1. Eavesdrop on other teams during an activity to gather information and seek clarification of direction.



- 2. Relay information that can help the team perform better.
- 3. Contribute to the group as an active learner.

Criteria for an Oral Reflector's Report

- speaks loudly and clearly enough for all others to hear
- presents information within 30 seconds (unless specified otherwise)
- identifies one strength of the team's performance and explains why it is a strength
- identifies one area for improvement that the team can focus on and explains how the team can improve
- provides one insight gained about the learning process and explains the significance of the insight

Criteria for a Written Recorder's Report

- records accurate information
- identifies the team's most important discoveries
- summarizes the processes used by the team and identifies the context
- identifies the concepts and tools used by the team



Constructing Team Outcomes

Learning Skills

performing within a role, team goal setting

Why?

Working within a base group or team is an integral part of all Pacific Crest Institutes. The process of constructing team objectives serves to focus attention above and beyond the scope of what can be accomplished and gained by individual participants. The integration of individual objectives into team objectives sets a direction for the team and helps facilitate the process of team building.

Learning Objectives

- 1. Share personal objectives for the Institute.
- 2. Create team objectives with measurable outcomes to increase cooperation and begin creating a friendly, trusting learning environment.

Performance Criteria

- 1. A synthesized list of your team's three main objectives and associated outcomes
 - Attribute 1: Team objectives represent input from all team members
 - Attribute 2: Team outcomes are action-oriented and measurable
- 2. Ability to follow and meet requirements for performance within your team role
 - Attribute 1: Captain directs the team to complete the plan within the given time constraints
 - Attribute 2: Recorder captures team objectives and outcomes for inclusion in the e-journal for the institute

Resources

Reflector and Recorder forms (see the pages directly following this activity)

Plan

- 1. Assign one of the following roles to each team member: Captain, Recorder, Reflector, and Spokesperson.
- 2. Review the background material on learning outcomes.
- 3. Review your individual learning outcomes for the Institute.
- 4. As a group, synthesize your individual learning outcomes to come up with the three most important team outcomes that can be shared by the Spokesperson with the rest of the Institute participants. The models provided below are intended to help as you establish your learning outcome and the means of measuring accomplishment. Record your team learning outcomes for your personal reference.

Models

Models of Learning Outcomes Provided as Samples

Team Outcome: be able to define and articulate the philosophy of Process EducationTM

Measurable outcome: a one-page written discussion, where half the page presents a general discussion

and definition of Process Education and the other half of the page provides six examples illustrating the implementation of Process Education in different

contexts

Team Outcome: better understand the process of facilitating a process-oriented activity

Measurable outcome: a documented facilitation plan for an activity

Team Outcome: improved knowledge and methods for active learning

Measurable outcome: identify and articulate five techniques or methods; for each, present an articulation

of the following: What is the technique or method? How do you implement the technique or method? What value does the technique or method have? How will

you measure or document the value of this technique or method?

Team Outcome: learn how to better motivate students toward becoming self-growers

Measurable outcome: identify three issues related to motivating students and provide at least one

supporting strategy to address each issue

Team Outcome: obtain strategies and techniques for shifting ownership of the learning process

from teacher to learner

Measurable outcome: observe, identify, and document four techniques modeled by the facilitator

during the Institute

Exercises

- 1. Each evening, assess the day to determine your personal progress toward meeting your objectives. Put together a plan for the next day to accomplish your remaining objectives.
- 2. Find a fellow participant to collaborate with in order to accomplish your respective individual objectives.

Activity End



Name Team Date Activity	Recorder's Report
Before the activity	
Record the basic agenda or plan as outlined by the team lead	der:
During the activity	
Important information to be documented:	

During the act	ivity
Important information	n to be referenced. Where did you get key information?
At the end of t	he activity
State the three most in	nportant discoveries learned from the activity along with the significance of each and how each can be applied.
1	
2.	
0	
3.	
	Strengths:
Instructor	Areas for Improvement:
Feedback	

Name	
Team	 Reflector's Report
Date	Reflector 3 Report
Activity	

Team	Reflector's Repor
Date	
•	
Team Performance	
Our team's greatest strength and why:	
Our team's greatest area for improvement and h	ow the improvement can be made:
An insight gained about learning during this active	<i>y</i> ity:
Individual Performance	
Name:	Team Role:
Strength:	
Area for Improvement:	
Name:	Team Role:
Strength:	
Area for Improvement:	
Name:	Team Role:
	Team Role:
Strength:	
Strengths:	

Instructor Feedback

Areas for Improvement:

Insights:

Section 7

Assessing Learning Activities

Faculty Guidebook: 2.4.17 Assessing Learning Activities

Sample Activity 1, Knowledge Form = Concept Model

Sample Activity 2, Knowledge Form = Process

Sample Activity 3, Knowledge Form = Tool

Sample Activity 4, Knowledge Form = Contexts

Sample Activity 5, Knowledge Form = Way of Being



2.4.17 Assessing Learning Activities

by Jenny Loertscher (Chemistry, Seattle University) and Vicky Minderhout (Chemistry, Seattle University)

Faculty members can elevate their skills in instructional design and classroom facilitation by assessing learning activities. If they assess before implementation, faculty collect data to help anticipate and respond to student learning needs. If they assess the impact of learning activities after implementation, they gather data they can use to improve course design as well as future implementations of the activity. This module presents two flexible tools for soliciting feedback from faculty peers and/or students about activity design and impact. The tools serve as catalysts for meaningful dialogue about continuous improvement in teaching/learning related to a specific course.

Benefits of Assessing Activities

Assessment of instructor-designed learning activities is important in improving student learning and faculty teaching skills (Dick, Carey, & Carey, 2004; Angelo & Cross, 1993). Once instructional activities are designed using principles such as those given in 2.4.13 Overview of Learning Activities and 2.4.14 Designing Process-Oriented Guided-Inquiry Activities, the collection of assessment data provides direction for revising the materials and improving the effectiveness of instruction. Assessment guides faculty as they refine the design of an activity to better address student learning needs, uncover issues in knowledge construction, promote more effective facilitation, and document the impact of an activity on student learning. The process of activity assessment encourages faculty to communicate with students about their learning and with collaborating faculty about activity design. Therefore, conducting activity assessment pro-motes constructive dialog, advances joint ownership of teaching and learning, and builds instructional design skills.

Activity Assessment Tools

The two tools provided in this module assess activity design and impact. The activity design assessment tool focuses on the structure and content of an activity and can be used either before or after implementation of the activity. The activity impact assessment tool examines the student learning gains resulting from an activity. These flexible tools are appropriate for use by a wide variety of people in diverse settings including faculty at the instructor's home institution, faculty at another institution, learning and curriculum specialists, and students (4.1.3 Mindset for Assessment, 4.1.5 Moving Toward an Assessment Culture, and 4.1.11 Peer Coaching). If possible, teachers, learners, content experts, and/or teaching experts should assess an activity in order to contribute various perspectives.

Activity Design Assessment Tool

The activity design assessment tool is formatted to be used by either instructors or experienced students. Experienced students are those who have completed the course in which the assessed activity is typically used. Such students provide a learner perspective that is unencumbered by the personal involvement or inhibitions about providing honest feedback that may characterize students currently enrolled in the course. The questions in the activity design tool prompt assessors to consider the sequencing of questions/tasks and the appropriateness of featured content in light of stated learning outcomes.

Faculty can use the activity design tool at different times. Immediately after writing an activity, but before its first implementation in their classroom, faculty may ask for outside feedback to assess whether the newly designed activities include the conceptual and structural framework necessary to help students achieve the desired learning outcomes. Faculty may also ask for help after classroom implementation when experience anchors the feedback. Finally, the design tool can be used to collect feedback from colleagues who are implementing the same activity at other institutions. For those who are interested in developing new textbooks and workbooks, it is important to validate activities in multiple classrooms with multiple instructors.

After collecting feedback from assessors, faculty need to synthesize findings before making changes in the design of an activity. Tallying the scores for each question provides a quick overview of assessor opinions, allowing the instructor to readily identify aspects of the activity that are strong, those that need improvement, and those that elicited more complex and varied responses. Reading the assessor's written comments permits the instructor to compare assessor responses to his or her own classroom observations. Any changes the instructor makes in the activity based on this data should be consistent with established learning outcomes and should reflect disciplinary integrity. Finally an instructor should plan how she or he will assess the effect of any changes on student learning. Assessments may include student answers to critical thinking questions, student conversations within groups, performance on homework, or performance on exams.

Activity Impact Assessment Tool

The activity impact assessment tool is designed to be used primarily by novice students, those encountering an activity for the first time. The questions in this tool are much more learner-centered than in the activity design tool and reflect the fact that novices may have neither the experience nor the distance needed to critically analyze the relationship between activity structure and its success in meeting learning outcomes. Although the questions in this tool are written from a student perspective, the form could also be completed by a course instructor or third party observers who record the student behavior that they see during the activity.

The impact tool should always be used after the completion of the activity, although the exact timing depends on whether an instructor wishes to assess a single class activity as a free-standing entity or as part of an instructional unit that also includes preparatory and follow-up assignments. Once data has been collected, faculty should follow a process similar to that described for the activity design assessment tool to analyze data and apply findings to improve instruction.

Triangulation of Findings

The assessment tools in this module provide a format for collecting data on activity design and impact, but they may be most useful when supplemented with additional information. For example, follow-up conversations with faculty or student assessors are often effective in collecting more detailed information and insights. If faculty assessors have used the activity in their own classes, a follow-up conversation provides them an opportunity to talk about the context in which they used the activity, including class size, class length, and learning objectives for the course. Some faculty may wish to use student performance data as part of the assessment process, and these data could be pooled across multiple classes.

Concluding Thoughts

Activity assessment should not be viewed as an isolated practice, but rather as an integral part of active, engaged teaching and learning. Regularly assessing activity design and impact helps instructors gain skill in self-assessment which they can then use to make improvements in other aspects of their professional lives. When one engages other faculty as assessors it promotes course-centered communication with peers, strengthens professional relationships, and builds community. Finally, involving students in the assessment process builds professional skills that they will need for future career success.

References

Angelo, T.A., & Cross, K.P. (1993). Classroom assessment techniques: A handbook for college teachers. San Francisco: Jossey-Bass.

Dick, W. O., Carey, L., & Carey, J. O. (2004). *The systematic design of instruction*. Boston: Allyn & Bacon.

Activity Design Assessment

Activity	Title:						
Complete	e all applicabl	le sections					
Scores:	5 exemplary	4 adequate	minor re nee	visions	2 major revisions needed	1 off target	NA not applicable
			Score		Comments	and Example	s
	s on target withing outcomes.	reference to					
	learning outco d with course						
	y elicits develo ation of conce						
4. Activit	y elicits clear a edge.	articulation of					
5. Quest seque	ions are logica nced.	ally					
6. Activit	y includes effe imple.	ective model					
_	ned student propriate.	eparation					
•	uate preparation						
		of this activity			they be made?		

What insights do you have about learning as it relates to the activity?

Activity Impact Assessment

When completing this, focus only on the activity you completed in class today.

Activity Title:

Scores:	5 a great deal	4 a lot	3 some	•	2 a little	1 not at all	NA not applicable
			Score		Com	ments and E	xamples
1. The reading a helped prepare	nd assignment e me for the ac						
The activity he the stated lear which ones).	elped me achiev rning objectives						
3. The activity im understanding	•						
4. The activity im solving and/or	proved my prob critical thinking						
5. The activity im communicatio							
6. My group was activity question		· all					
7. The activity pr follow-up hom		for					
8. I feel confiden materials.	t that I can lear	n the					
9. I encourage the this activity.	ne continued us	e of					

List two strengths of this activity and state the reasons for your answers:

List two improvements you would suggest and describe how they could be made:

What insights do you have about learning as it relates to the activity?

ACTIVITY 17

Electromagnetic Radiation

WHY?

Electromagnetic radiation, which also is called light, is an amazing phenomenon. It carries energy and has characteristics of both particles and waves. We can see only a small region of the electromagnetic spectrum, which we call *visible light*. The absorption and emission of electromagnetic radiation by atoms and molecules are powerful tools used to probe molecular structure and chemical reactions. They form the basis of medicine's magnetic resonance imaging and are intrinsic to many analytical techniques used to monitor the environment and manufacturing processes. Radio and television, cell phones, microwave ovens, and compact discs all utilize electromagnetic radiation.

LEARNING OBJECTIVE

• Characterize electromagnetic radiation

Success Criteria

- Interrelate the wavelength, frequency, momentum, and energy associated with electromagnetic radiation
- Identify the different regions of the electromagnetic spectrum

INFORMATION

During the nineteenth century, research in the areas of optics, electricity, and magnetism provided convincing evidence that electromagnetic radiation consists of two oscillating waves. One wave corresponds to an electric field, and the other wave corresponds to a magnetic field. In a vacuum, these fields oscillate perpendicular to each other and perpendicular to the direction the wave is moving. A wave is characterized by its amplitude, frequency, and wavelength. The model shows a diagram of an electromagnetic wave.

The Greek letter nu, v, is used to represent frequency (cycles/s). Be careful to distinguish it from the English vee, v. Frequency is measured in hertz (Hz), which is expressed in cycles or oscillations per second.

The Greek letter lambda, λ , is used to represent wavelength.

During the twentieth century, scientists discovered that electromagnetic radiation also had properties normally associated with particles. This discovery led scientists to believe that electromagnetic radiation consists of particles called photons. A photon has a momentum, a specific amount of energy, and a wavelength and frequency associated with it. Thus, the properties of particles (momentum and a specific energy) and the properties of waves (wavelength and frequency) are blended together.

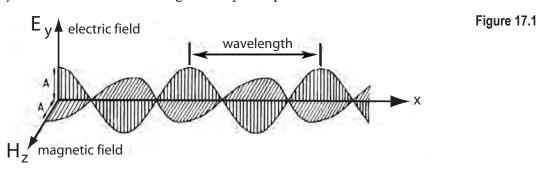
The wavelength and frequency of electromagnetic radiation extend essentially from 0 to infinity. The electromagnetic spectrum is viewed as split into different regions. These regions are determined by the nature of instrumentation (sources, wavelength selectors, and detectors) used in the different regions. The model includes a chart of the electromagnetic spectrum.

Model: Properties of Electromagnetic Radiation

The diagram shows an *electromagnetic wave* with the magnetic field oscillating parallel to the z-axis, the electric field oscillating parallel to the y-axis, and the wave moving along the x-axis. The x, y, and z-axes are perpendicular to each other.

The *wavelength* is the distance between any two corresponding points, e.g., from one maximum of the electric field to the next.

The *frequency* is the number of wavelengths that pass a point on the x-axis each second.



The chart shows the different spectral regions of the electromagnetic spectrum and indicates the approximate frequencies and wavelengths for each. The boundaries between the regions are diffuse.

Frequency (Hz)	Spectral Region	Wavelength (m)
10 ²¹	gamma rays	0.3 pm
1018	hard x-rays soft x-rays	——— 0.3 nm
1015 ———	vacuum ultraviolet ultraviolet visible	300 nm
1012	infrared far infrared	300 μm
10 ⁹ ——	microwave	30 cm
106	radio wave	300 m
		_ 555

Figure 17.2

v = frequency λ = wavelength p = momentum c = speed of light $= 2.9979 \times 10^8$ m/s h = Planck's constant

Definitions

Photon Properties

 $= 6.6261 \times 10^{-34} \,\mathrm{J}\,\mathrm{s}$

energy = $E_{photon} = hv$ momentum = $p = h / \lambda$ frequency = $v = c / \lambda$

KEY QUESTIONS

1.	In the model, what is the equation showing the relationship between the energy (E) of a photon
	and the frequency of light (v) ?

- 2. What is the equation showing the relationship between the frequency (v) and wavelength (λ) of light?
- 3. What is the equation showing the relationship between the momentum of a photon (\mathbf{p}) and wavelength (λ) ?
- 4. If two waves are traveling at the same speed along the x-axis, will the one with the longer wavelength have the larger or smaller frequency? Explain in terms of the number of wavelengths that pass a given point on the x-axis in 1 second.
- 5. Is the energy of a photon proportional or inversely proportional to its frequency?
- 6. Is the momentum of a photon proportional or inversely proportional to its wavelength?
- 7. Which region of the electromagnetic spectrum has the shortest wavelengths?
- 8. Which region of the electromagnetic spectrum has photons with the lowest energy?
- 9. From what regions of the electromagnetic spectrum have you used or encountered photons? Identify the context.

EXERCISES

- 1. In the model, draw a line connecting two points on the magnetic field wave that are separated by one wavelength.
- 2. The laser in a compact disc player uses light with a wavelength of 780 nm.
 - a) Calculate the frequency of this light.

- b) Calculate the energy of a single photon of this light.
- c) Calculate the momentum of a single photon of this light.

- 3. Radiation with a wavelength of 100 nm can be used to remove electrons from atoms and molecules. Identify the region of the spectrum corresponding to this radiation.
- 4. Radiation emitted when excited states of nuclei decay has a frequency of approximately 10²¹ Hz. Identify the region of the spectrum corresponding to this radiation.
- 5. Identify which uses photons with the higher energy: a microwave oven or a radio.

RESEARCH

In different regions of the electromagnetic spectrum radiation is produced and detected in different ways and has different applications. If you are familiar with these different properties and characteristics, you will be able to assess safety issues, understand the limitations and opportunities in various applications, and identify new applications. You can find information on spectroscopy on the Internet and in library books on the subject.

Each team should prepare a report to the class on one region of the electromagnetic spectrum. This report should address the following items.

- An object about the size of one wavelength of this radiation.
- A laboratory source of the radiation.
- A method for obtaining tunable monochromatic radiation.
- A device that can detect the radiation.
- The effect on a molecule when it absorbs the radiation.
- Documented effects of the radiation on the human body.
- How the radiation is being used in modern research.

ACTIVITY 5.1



Analyzing the Problem Solving Methodology

Learning skills: believing in oneself, persisting, validating

WHY



The Problem Solving Methodology is a tool to help you improve your proficiency at the process of problem solving. Without a methodology, most people are more easily lost and ineffective when it comes to solving difficult problems. Having a common methodology to use in problem solving contexts increases your confidence and the quality of solutions and decisions you make. This activity will help you understand the Problem Solving Methodology you read about in Chapter 5.

LEARNING OBJECTIVES



- 1. Gain a better understanding of the Problem Solving Methodology and how it can be used to develop proficiency with the process of problem solving.
- 2. Learn to apply the Problem Solving Methodology to the solving of problems by analyzing it in the context of the given example.

Performance Criteria



Criterion #1: your team's discoveries about the Problem Solving Methodology

Attributes:

- a. demonstrate that you can follow the application of the methodology and are ready to apply it
- b. unique from other teams' discoveries

Criterion #2: the connections made between the case study and the Problem Solving Methodology Attributes:

- a. answers to the Critical Thinking Questions are complete
- b. you can provide a justification for your answers to the Critical Thinking Questions

Plan



- 1. Read about the Problem Solving Methodology in Chapter 5 of Foundations of Learning.
- 2. Examine the case study about problem solving presented in this activity.
- 3. Answer the Critical Thinking Questions.
- 4. This activity may be completed either individually or in groups.

Problem Solving Methodology Case Study

Scenario: Three students are going to share a two-bedroom apartment for the school year. The rent is \$700 per month, and the size of the apartment is 1,720 square feet. The students need to figure out an equitable way to choose rooms and then assign rent for each person.

Problem statement:

Determine who gets which bedroom and how much each person should pay toward the total rent of \$700.

Key issues:

The following are issues that should be considered:

Does each student need or want his own room?

Can another room be converted to a bedroom?

Are some rooms better (worth more) than others?

What characteristics should be used to place a value on each room?

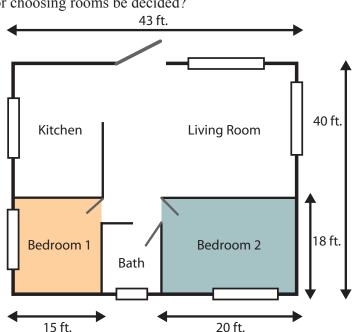
What is the value of a private room?

What is the value of the common area (the non-bedroom space)?

How much rent can each student afford?

Do two people want to share a room?

How should the order for choosing rooms be decided?



Information:

Summarize the information that is known.

The two bedrooms are 270 square feet and 360 square feet.

The total area of the apartment is 1,720 square feet (40 ft \times 43 ft).

Total house area = common area + large bedroom + small bedroom

 $1.720 \text{ ft}^2 = 1.090 \text{ ft}^2 + 360 \text{ ft}^2 + 270 \text{ ft}^2$

The monthly rent is \$700.



Knowledge Form: Process

Assumptions

Every square foot of space has the same value.

Students have an equal share and financial responsibility for the common area.

A private room is worth \$50 more per month.

Only two rooms can be used as bedrooms.

Two students will share the larger bedroom.

Room assignments will be made first by choice, then by a random drawing.

Any two students could share a room.

Sub-problems:

The following sub-problems were identified:

- 1. What is the cost of each room per month?
- 2. How should rooms be chosen?

Model for cost of each room:

Here is the model developed using the stated information and assumptions:

The one student with a private room will pay \$50/month premium for that room. This leaves \$650 per month in rent to be paid for the remaining area of the house by all three students.

Since every one of the 1,720 square feet of the house has equal value, the cost per square foot will be \$650 divided by 1,720 square feet = \$0.3779 per square foot (this figure can be used to calculate the financial worth of the square footage of each bedroom as well as the common area).

Each person will be responsible for one third of the cost of the common area. The two people who share the larger bedroom will each be responsible for half of the cost of this bedroom. The person who has the private room will be responsible for the value of the entire bedroom and pay a \$50 premium for the privacy.

Model for choosing:

Students choose the room they want in writing. A person who chooses a room that is not chosen by the other students gets that room. When there is competition for the same room, a random drawing selects the student who will get the room. Those students not assigned will choose again and go through the steps until all the room positions are assigned.

Integration:

Calculate the cost of each bedroom plus the common area.

```
Small bedroom with an area of 270 ft<sup>2</sup> cost/month = 270 ft<sup>2</sup> × 0.3779 dollars per ft<sup>2</sup> = $102.03

Large bedroom with an area of 360 ft<sup>2</sup> cost/month = 360 ft<sup>2</sup> × 0.3779 dollars per ft<sup>2</sup> = $136.04 cost/month per student for the large bedroom = $136.04 divided by 2 = $68.02

Common area = total house area minus total bedroom area common area = 1,720 ft<sup>2</sup> – 270 ft<sup>2</sup> – 360 ft<sup>2</sup> = 1090 ft<sup>2</sup>

Cost of the common area = common area times cost per square foot cost/month = 1090 ft<sup>2</sup> × 0.3779 dollars per ft<sup>2</sup> = $411.92 cost/month per student for the common area = $411.92 divided by 3 = $137.31
```

Knowledge Form: Process

Monthly cost per room

The two persons sharing the larger bedroom each pay the following amount each month: \$137.31 (common area) + \$68.02 (share of the large bedroom) = \$205.33

The person with the small bedroom pays the following amount each month: \$137.31 (common area) + \$102.03 (small bedroom) + \$50.00 (private room) = \$289.34

All three students choose the single room. A random drawing is held and a name is drawn. This person takes the small bedroom leaving the two other students to share the larger bedroom.

Validation:

Does the sum of the rents equal \$700?

\$205.33 + \$205.33 + \$289.34 = \$700 (yes, the sum of the individual rents are validated)

Are the rents equitable? The person with the small bedroom feels that the private room is not worth the extra cost of nearly \$100 per month. All three feel that they would have lowered the premium if they had considered that the person in the private room would be paying a premium for privacy **and** for the additional cost for more space. However, since both students in the large bedroom would gladly pay the extra money for the private room, the person in the small bedroom decides not to give up the room even under the current cost arrangements. All agree to keep things as they are.

Were the assumptions valid? All three students agree that the assumptions were valid. However, they were surprised at how long the process took.

Generalization:

All three students realize that they could generalize this method for any number of students and any number of rooms. After subtracting the monthly "privacy premiums" from the rent, the cost per area can be figured. Then the cost per bedroom and the cost for the common area can be calculated. The cost of the common area is evenly divided by the number of tenants (unless agreed upon otherwise). The cost of each bedroom is evenly divided by the number of roommates.

Communication:

The students share the generalized solution and its effectiveness with their friends.

CRITICAL THINKING QUESTIONS



1. Why do the students have to make assumptions rather than finding out all information?

2. How did the students determine the values for each of the following? Where was the information obtained?

Cost per square foot:

Cost for common area:

Cost for each student:

3. What assumptions made by the students do you question? Why? What assumptions were never used in solving the problem?

Knowledge Form: Process

4. Why is it important to build and use models when problem solving? Do you agree with the models the students created? Why or why not?

5. What are some other key issues that the students could have considered for this problem? Which key issues were never used in solving the problem?

6. Do you feel the students made the correct decision? Why or why not? If not, describe an alternative model.

Section 3

Tools of Biochemistry

PRE-ACTIVITY ASSIGNMENT

- Make a reading outline for those sections in your text that discuss biochemical techniques. Also read the "Tools of Biochemistry Resources" handout. As you make your reading outline, be sure to include all of the items listed below.
 - Gel Electrophoresis -Determining the MW and number of subunits in a protein.
 - SDS and Native gels and reducing agents like DTT (dithiothreitol) and 2-ME (2-mercaptoethanol)
 - Isoelectricfocusing
 - Chromatography
 - o Gel filtration
 - Ion Exchange
 - Hydrophobic interaction
 - Affinity Chromatography
 - Amino acid Analysis
 - How to sequence a protein
 - Protein assays
 - Immunological methods. These methods use antibodies. Antibodies are proteins that bind other proteins with high specificity and high affinity.
 - ELISA
 - Western Immunoblotting

Below is a link to an animation about affinity chromatography.

http://www1.gelifesciences.com/aptrix/upp00919.nsf/Content/AD018C9E293F99BEC1256E92003E8 65A?OpenDocument

2. Watch the animation and make a sketch of the graph shown. Omit the red line from the graph. This line shows a characteristic of the buffer and does not represent measurements one would make in the lab. Be sure to label the axes of your graph. What is being detected in the broad gray peak? What is being detected in the narrow blue peak?

PRE-ACTIVITY RESOURCES

Assay of Proteins

Total (non-specific) Protein Determination

These assays are performed to determine or estimate the amount of ALL protein in a given sample.

- 1. UV Absorption Proteins have a characteristic absorption between 275-280 nm due to the presence of tyrosine and tryptophan residues. Extinction coefficients, however, vary by as much a 10-fold depending on the number of these residues in the protein. An average extinction coefficient can be used to get an estimate of the amount of protein present. The Abs_{280nm} is often used to obtain an elution profile (absorbance versus elution volume) during isolation procedures, especially during chromatographic procedures, since the method is quick, easily automated, and non-destructive. A disadvantage to this method is that other biomolecules, such as nucleic acids, also absorb in this region and can complicate the measurements.
- 2. **Colorimetric Reactions** Several reagents have been developed that bind or complex with proteins to form colored products that can be measured spectrophotometrically. As an example, the *Biuret* reagent takes advantage of a deep blue complex formed between copper (II) and four nitrogen atoms of the protein backbone. The complex has an absorption maxima at 595 nm. Protein concentrations can be determined through comparison with standard curves prepared from a common protein such as bovine serum albumin. Each method has substances, often found in biological preparations, that can interfere with the analysis.

Specific Protein Determinations

For any purification or characterization of a <u>specific</u> protein, some method must be found to quantitatively detect its presence. With a few exceptions, most proteins make up only a very small percentage of the entire protein in the source tissue. In addition, the protein of interest is very similar to all the other proteins in the tissue. Therefore, an assay for a given protein must be specific for the protein of interest and be sensitive enough to detect the protein at low concentrations. It would also, hopefully, be convenient enough that it could be used at each step of the purification process. The following descriptions are of methods that take advantage of some specific characteristic of a protein that makes it unique, identifiable, and quantifiable.

- 1. Enzyme Activity As we will see, enzymes are proteins with catalytic activity. An assay for an enzyme that catalyzes a reaction with a readily detectable product can be easily developed. The enzyme reaction may generate a reaction product with a characteristic spectroscopic absorption or fluorescence that can be quantified. If the reaction generates or consumes acid, the reaction can be quantified through titration or by following pH changes. In addition, if a product is itself not easily measured, it may serve as a reactant for another enzyme catalyzed reaction whose product may be easily identified. These <u>coupled enzymatic</u> reactions are common.
- 2. Binding Assays Some proteins, such as receptors, are often assayed because of their ability to bind to specific ligands. In one method, a radioactive or fluorescent ligand is produced, incubated with the protein-containing solution, which is then passed through a protein retaining filter. The amount of radioactivity or fluorescence retained on the filter is proportional to the amount of protein. In a competitive binding assay, a sample of the protein in question is made radioactive and a known amount is incubated with a limited amount of the ligand. The sample with the unlabeled protein is introduced and competes with the labeled protein for ligand. Analysis of the amount of bound and unbound radioactive protein and knowledge of the binding characteristics of the protein-ligand can be used to determine the amount of protein in the sample.

Sample Activity 3 Knowledge Form: Tool

- 3. Immunological Techniques These techniques employ antibodies, proteins produced by an animal's immune system that bind other proteins with <u>specificity and high affinity</u>. This characteristic leads to methods that are both specific and sensitive. Two common immunological techniques are enzyme-linked immunosorbent assay (ELISA) and Western blot. ELISA is a specific and quantitative assay for a specific protein. Western blots are generally not used in a quantitative manner, but for examining presence of a specific protein.
- 4. Bioassays Many proteins, like hormones, have specific biological effects. The effects on a standard tissue, cell, or whole organism can be observed and often quantified. These assays often require extensive development, may take considerable time to incubate, and give results that are less than reproducible because of the complex behavior of the living systems. Because of these factors, they can also be expensive.

Amino Acid Analysis

Analysis of the total amino acid composition is typically performed prior to sequencing of a protein. To do so the protein is subjected to complete hydrolysis in acid. The identification and quantification of the individual amino acids is conducted by an instrument that separates amino acids by chromatography and derivitizes them with an easily detected tag (usually fluorescence). The chromatography is typically cation exchange with a pH gradient starting from low to high. Each amino acid has a characteristic elution volume that allows identification and it is quantified by the absorbance or fluorescence intensity of the peak.

IN-CLASS ACTIVITY

Why

In order to understand biomolecules, biochemists often need to isolate these molecules from the biological medium and, once isolated, to characterize them chemically. Many techniques are available to accomplish these tasks. In addition, biochemists have found ways to chemically synthesize some biomolecules. In understanding these techniques and procedures you will gain a better understanding of the nature of biomolecules, their functions, and how biochemists manipulate them to gain additional understanding of them.

Outcomes

- 1. Describe the molecular basis for some techniques used to isolate and characterize biomolecules in general, and proteins and amino acids specifically.
- 2. Select proper techniques or sequence of techniques to accomplish a given isolation or biomolecular characterization.
- 3. Produce a procedural flow chart for the progression of events required for sequencing a protein.

Resources for the Instructor

 A computer lab or at least a room in which a or several computers is (are) available for viewing internet animations

Plan

- 1. Form Protein Teams. Assign group roles.
- 2. Answer the Critical Thinking Questions.
- 3. Prepare your team "Biochemical Toolkit."

Critical Thinking Questions

- 1. Which technique(s) could you utilize to separate two proteins that (a) differ greatly by size, (b) differ by pl, and (c) that have similar physical characteristics (e.g. size and pl), but have very different functional characteristics? In each case briefly describe how the separation would be accomplished.
 - (a)
 - (b)
 - (c)
- 2. On the computer go to the link http://bcs.whfreeman.com/biochem5/cat_040/ch04/ch04xd02.htm Click on the link entitled "SDS-PAGE Animation" and watch the animation.
 - a. One of the proteins in the animation contains subunits. How are these subunits associated with each other in the intact protein?

3.

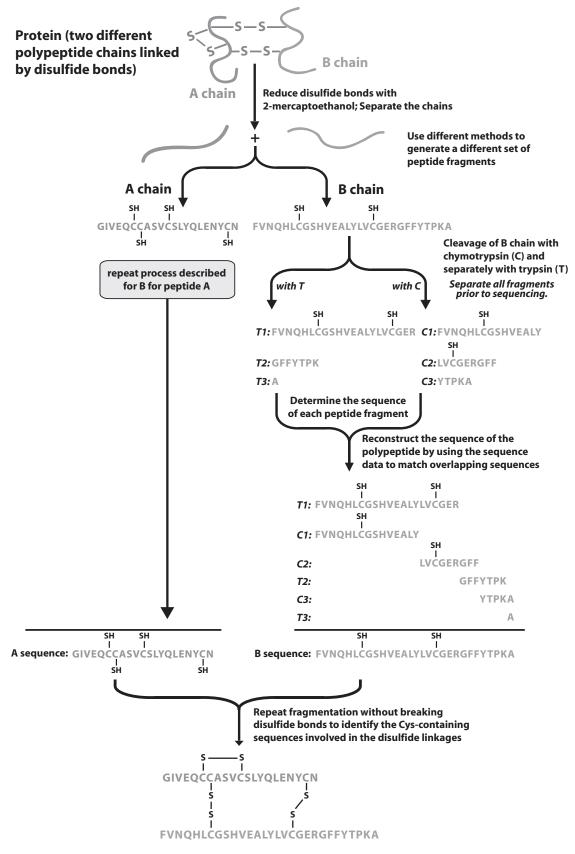
4.

Knowledge Form: Tool

b.	Imagine a different protein with subunits. This 100kD protein has two subunits (70kD and 30kD) joined by two disulfide bonds. Draw the gel electrophoresis pattern for SDS-PAGE with a lane that includes 2-mercaptoethanol (2-ME) and one lane without 2-ME. Be sure to include a molecular weight (MW) marker lane. Note: 2-ME is one of two commonly used reducing agents. The other is DTT (dithiothreitol).
Во	th SDS-PAGE and gel filtration chromatography are used to separate proteins based on size. On the
	mputer go to the link
	p://www1.gelifesciences.com/aptrix/upp00919.nsf/Content50C849D0D5B16BA0C1256E92003E8 B?OpenDocument
Cli	ck on the link entitled "Gel Filtration." Watch the animation. Imagine you have a mixture of proteins:
a.	If your experimental goal is to determine as accurately as possible the molecular weight of proteins in the mixture, would gel filtration or SDS-PAGE be preferable? Why?
b.	If your experimental goal is to collect each intact protein for further analysis, would gel filtration or SDS-PAGE be preferable? Why?
wa is k	fer to your answers to Question 2 on the assignment about affinity chromatography. What measurement s taken in the laboratory to generate these plots? What is being detected in the broad gray peak? What being detected in the narrow blue peak? How would a scientist wishing to isolate a particular protein use to information given in the plot?

Knowledge Form: Tool

- 5. What techniques can be used to determine the amount of a specific protein in a sample? What characteristic(s) of the protein does each technique take advantage of?
- 6. Refer to the figure below.



Knowledge Form: Tool

7. Prepare a procedural flowchart showing how you would determine whether a protein has any subunits BEFORE beginning the procedures shown in the figure.

8. Discuss the flowchart in the figure on the previous page so that all group members have a basic understanding of the procedures it describes. Be sure to discuss the reason why overlapping peptide fragments are generated and how this fact can be used in sequencing.

Knowledge Form: Tool

- 9. If your instructor chooses, you will have a follow-up activity that asks your group to use your biochemical toolkit to solve problems requiring the use of these techniques. Before that activity, work as a group to create a comprehensive biochemical toolkit. You may divide tasks for this assignment, but each group must arrive at the activity with one complete toolkit. Not all group members must research all tools for this assignment, but ultimately, all individuals will be responsible for understanding all tools for exams. For the upcoming activity, your toolkit should include:
 - the name of the tool (technique)
 - how the tool works (the conceptual framework for the technique)
 - what the tool can be used for

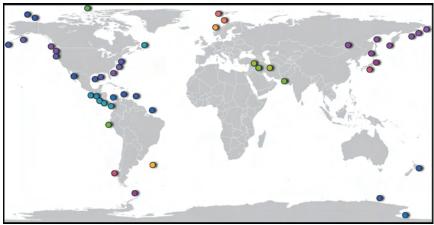
The toolkit should include reference to all of the following:

- Gel Electrophoresis
 - SDS and Native gels and reducing agents like DTT (dithiothreitol) and 2-ME, (2-mercaptoethanol)
- Isoelectricfocusing
- Chromatography
 - Gel filtration
 - Ion Exchange
 - Hydrophobic interaction
 - Affinity Chromatography
- Amino acid Analysis
- How to sequence a protein
- Protein assays
- Immunological methods. These methods use antibodies. Antibodies are proteins that bind other proteins with high specificity and high affinity.
 - ELISA
 - Western Immunoblotting



MINING METHYL HYDRATE: FIRE FROM ICE!

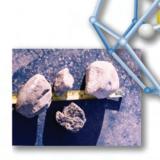
There are vast quantities of fossil hydrocarbons trapped at a low temperature and high pressure in cages of frozen water under sediment at the bottom of the oceans. The water cage in which methane, CH₄, is trapped is known as *methane hydrate*. With appropriate recovery technologies, these compounds, which are called *clathrates*, could be mined for use as fuel. The locations of methane hydrate reserves are shown on the map in Figure 1. Figure 2 shows a sample of methane gas burning as the clathrate melts. The inset is a model of the ice/methane crystal structure.



In this activity you will use the properties of methane hydrate, phase diagrams, and heating curves to answer questions about the conditions under which this compound exists and how it can be recovered in mining operations.

Figure 1 Map Showing the Location of Methane Hydrate Reserves

Figure 2 Clathrates, the Structure of Methane Hydrate, and Methane Burning as it is Released





Prerequisite Knowledge

Before beginning this activity, you should be able to

- Convert between different units of pressure and temperature
- Describe the different parts of a phase diagram
- Relate heating curves to the relevant quantitative calorimetric and thermochemical information for heating a substance and causing a phase transition

APPLYING YOUR NEW SKILLS

After completing this activity, you should be able to

- Identify regions of stable phases and the pressures and temperatures at which phase transitions occur on a phase diagram
- Use phase diagrams to analyze strategies involving phase changes for storing and recovering materials under specified conditions of temperature and pressure



Table 1 Properties of Methane Hydrate

Molecular formula	(CH ₄) ₈ (H ₂ 0) ₄₆
Enthalpy of decomposition	54 kJ/mol
Specific heat capacity	2.1 J/g deg
Density	0.9 g/cm ³

Figure 4 Methane Hydrate Phase Diagram, Pressure vs. Temperature

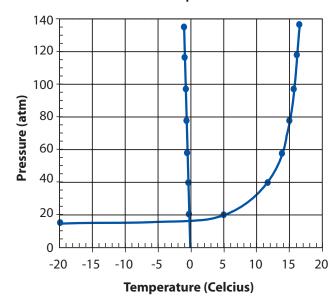


Figure 3 Methane Hydrate Phase Diagram, Ocean Depth vs. Temperature

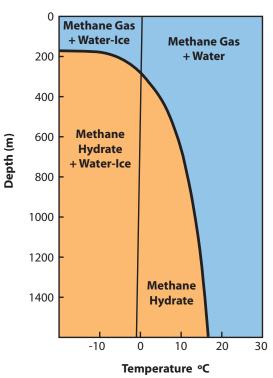


Figure 5 Variation in Ocean Water Temperature with Depth

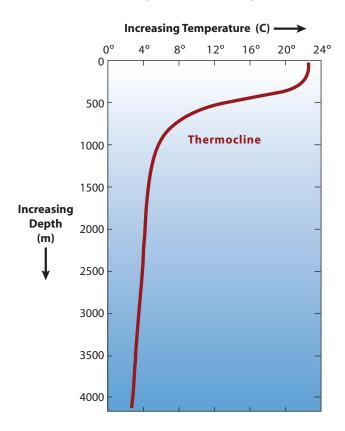
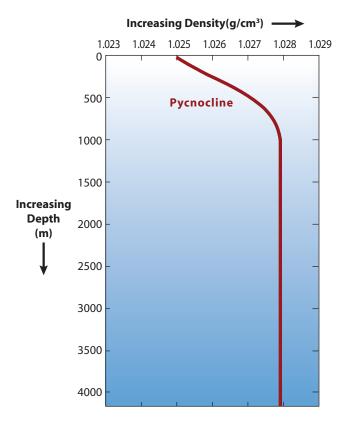


Figure 6 Variation in Ocean Water Density with Depth





THE PROBLEM

As a chemical engineer working with a mining company, your task is to answer and justify your answers to several questions posed by management about methane hydrate deposits reportedly found by a contract explorer for your company on the Blake Ridge at a depth of 1000 m off the shores of South Carolina. These questions are listed in the next section. Some helpful information is provided in the previous section.

The phase diagrams in Figures 3 and 4 show the values of water depth, pressure, and temperature under which solid methane hydrate can exist. The boundary lines correspond to points between phases. Figure 5 shows how the temperature of ocean water varies with depth, and Figure 6 shows how the density of ocean water varies with depth.

The enthalpy of combustion in Table 1 tells you how much energy is required to decompose 1 mole of methane hydrate into methane gas and water, and the specific heat capacity in Table 1 tells you how much energy is needed to heat 1 gram of methane hydrate by 1 °C.





Solve the Problem and Document Your Solution

Na	ame:
Ot	ther Team Members:
Da	ate: Activity Title:
Le	evel of Help used to solve this problem by the team: $none$ \square Au \square Ag \square Cu \square
co str sh	ork with your team to solve the problem. Your instructor can provide three levels of help called gold, silver, and pper. Au Help presents a strategy that resembles the way experts think when they solve problems. The use of this ategy is illustrated and prompted to different degrees in Ag Help and Cu Help. As the semester progresses, you ould move through these stages of Help to grow your problem solving skills. Your instructor will tell you what you ed to do to document your solution. One method would be to provide the information requested in Au Help.
1.	Is it reasonable to find methane hydrate at a depth of 1000 m (i.e., does a stable phase of methane hydrate exist at the temperature and pressure at that depth)? Explain your answer.
2.	If we can dig the methane hydrate out from under the sediment, will it then lie on the bottom or will it float to the surface? Explain your answer.
3.	If methane hydrate floats to the surface, can we harvest it as a solid from the surface or will it decompose on the way up, releasing all the methane gas before we can capture it? Explain your answer.

hydrate? Explain your answer.

Knowledge Form: Contexts

4. At what temperature will methane hydrate decompose at 1000 m and release the methane? Explain your answer. 5. How much energy is required to raise the temperature and decompose 1 kg of methane hydrate at a depth of 1000 m? Explain your answer. 6. How many moles of methane can be obtained from 1 kg of methane hydrate? Explain your answer.

7. How many liters of methane at 1 atm pressure and 300 K can be obtained from 1 kg of methane

? Does Your Answer Make Sense?

1. Does the stability of methane hydrate under the ocean floor seem reasonable given the conditions there? Explain.

2. Do your answers indicate that it is easy or technologically challenging to mine methane hydrate under the ocean floor? Explain.

BUILDING YOUR PROBLEM-SOLVING SKILLS

You will be able to complete the *Got It!* section, which comes next, more efficiently, and you will do better on exams if you take a few minutes now to improve your problem-solving skills. Communicating the steps in your problem solution to others and thinking back on the problem that you just completed will help you to improve.

1. Share your team's problem solution with your class as called upon by the instructor.

Knowledge Form: Contexts

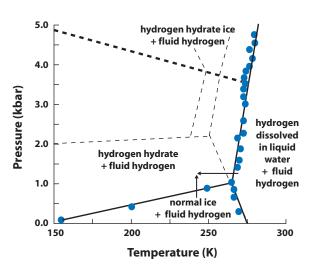
2.	Identify the most important thing you learned about problem solving today that will help you solve new problems.
3.	Consider whether you could solve this problem using a more efficient procedure so you can answer a similar exam question more quickly. If you find one, describe this more efficient procedure.
4.	Identify whether there are any issues or assumptions contained in the problem and its solution that would limit using the same procedure for other problems.
5	Identify features of this problem and its solution that could apply to other problems.



GOT IT!

- 1. If your mining company decided it would be more practical to remove the methane hydrate as a solid in a pressurized container, what pressure would need to be held by the container at 60 °F? Explain.
- 2. Hydrogen gas, H₂, would be an ideal fuel. It could be produced by decomposing water using solar energy, and the combustion product is water back again. One major barrier to the use of hydrogen in fuel cells for cars is safe storage and handling. Much research is presently going into finding materials that can trap H₂ in a solid form. One exciting prospect is the recent preparation of hydrogen hydrates (also called hydrogen clathrates) that are similar to the naturally occurring methane hydrates.

A phase diagram of a hydrogen hydrate using information from a recent research article is shown here. The article discusses the process indicated by the vertical arrow in the diagram.



- a. Describe the process indicated by the vertical arrow. In your description, identify the composition of the initial phase, the composition of the final phase, and the pressure in atmospheres and the temperature in Fahrenheit at which the phase transition occurs.
- b. If a storage system were designed to maintain the pressure indicated by the horizontal arrow, what change in temperature conditions would be necessary to release gas phase hydrogen by this system? Explain.



http://www.netl.doe.gov/scngo/NaturalGas/hydrates/about-hydrates/conditions.htm http://en.wikipedia.org/wiki/Methane clathrate

Kvenvolden, K. A. 1998. A primer on the geological occurrence of gas hydrate. In: Henriet, J-P. & Mienert, J. (Eds) Gas Hydrates: Relevance to World Margin Stability and Climate Change. Geological Society, London, Special Publications, 1379-30.

Lokshin, Konstantin A.; Zhao, Yusheng. Fast synthesis method and phase diagram of hydrogen clathrate hydrate. Applied Physics Letters (2006), 88(13).



1. Understanding the problem.

Restate the problem in your own words. Your statement should clearly identify the information that you are given and what you need to find in order to solve the problem.

It often is helpful to restate the problem by drawing a picture or diagram or by constructing a table that reduces the problem statement to a simpler representation.

- 2. Analyzing the problem.
 - (a) Identify the concepts or ideas that probably are needed to reach a solution because they connect what you know to what you need to find. Add these to your diagram or table.
 - (b) Identify the procedures and equations to use that are associated with these concepts, and add these to your diagram or table.
 - (c) Think about how you can use the concepts, procedures, and equations to link the information that you have to what you need to find.
 - (d) Consider whether any information that you need is missing and where can you find it.
 - (e) Check whether you have made or need to make assumptions.
- 3. Solving the problem. Use the information that you have produced in understanding and analyzing the problem (items 1 and 2 above) to
 - (a) Separate the problem into sub-problems if possible.
 - (b) Solve each sub-problem.
 - (c) Integrate the solutions of the sub-problems into a solution of the problem.



- 1. Is it reasonable to find methane hydrate at a depth of 1000 m (i.e., does a stable phase of methane hydrate exist at the temperature and pressure at that depth)? Explain or justify your answer based on the phase diagrams provided.
- 2. Can we just dig the methane hydrate out from under the sediment (i.e., will it then lie on the bottom or will it float to the surface)? Explain in terms of the density of the methane hydrate compared to the density of the seawater.
- 3. If methane hydrate floats to the surface, can we harvest it from the surface or will it decompose on the way up? What changes in pressure and temperature occur moving from great ocean depths to the surface?
- 4. At what temperature will methane hydrate decompose at 1000 m and release the methane? Explain how you know based on the phase diagram.
- 5. How much energy is required to heat and decompose 1 kg of methane hydrate at a depth of 1000 m? You must consider both the original temperature at this depth and the phase change.
- 6. How many moles of methane can be obtained from 1 kg of methane hydrate? The formula of methane hydrate is relevant to this problem.
- 7. How many liters of methane at 1 atm pressure and 300 K can be obtained from 1 kg of methane hydrate? Your calculation will depend on your answer to Question 6, and the assumption that methane is an ideal gas.



- 1. Is it reasonable to find methane hydrate at a depth of 1000 m (i.e., does a stable phase of methane hydrate exist at the temperature and pressure at that depth)? Explain or justify your answer based on the phase diagrams provided. Figures 3 and 4 provide the same information, except pressure rather than water depth is plotted in Figure 4. What is the direction of increasing pressure in Figures 3 and 4? Mark the direction of increasing pressure with an arrow on each of these figures. What are the regions of pressure and temperature for the four phases shown in Figure 3? Label the regions in Figure 4 using the information provided in Figure 3.
- 2. Can we just dig the methane hydrate out from under the sediment (i.e., will it then lie on the bottom or will it float to the surface)? Explain in terms of the density of the methane hydrate compared to the density of the seawater. In terms of density, what determines whether an object will float on water or sink to the bottom?
- 3. If methane hydrate floats to the surface, can we harvest it from the surface or will it decompose on the way up? What changes in pressure and temperature occur moving from great ocean depths to the surface? What must the pressures be for methane hydrate to be stable at the temperatures it would encounter at various depths?

4. At what temperature will methane hydrate decompose at the depth of 1000 m and release the methane? Explain how you know, based on the phase diagram. What is the highest temperature at which methane hydrate is stable at this depth?

Knowledge Form: Contexts

5. How much energy is required to heat and decompose 1 kg of methane hydrate at a depth of 1000 m? You must consider both the original temperature at this depth and the phase change. Heat must be added to the methane hydrate at this temperature to reach the phase boundary, which is determined by the specific heat capacity in Table 1, the mass of methane hydrate, and the temperature change, ΔT. Heat must then be added to decompose the methane hydrate, which is given by the enthalpy of decomposition in Table 1. You must determine the number of moles of methane hydrate in 1 kg.

- 6. How many moles of methane can be obtained from 1 kg of methane hydrate? The formula of methane hydrate is relevant to this problem as in Question 5.
- 7. How many liters of methane at 1 atm pressure and 300 K can be obtained from 1 kg of methane hydrate? Your calculation will rely on your result from Question 6 and the assumption that methane is an ideal gas where PV = nRT.

Activity 19

Great Ideas in the History of Psychology

Purpose

This activity will involve you in a search for information about when and why some of the great questions of psychology were first addressed scientifically or professionally. Knowing about some of the milestones in the history of psychology will help you to understand why certain questions have remained central. Recognizing that the questions addressed by psychologists have changed or evolved over time will also help you to realize that you can, and should, creatively and independently ask questions important for your own life.

Objectives

- 1. List four significant questions asked by individual psychologists from varied times in history.
- 2. Find information needed to fill in a "scavenger hunt" form (provided) for each of the four psychologists in your list.
- 3. Write at least two insights you gained from this historical information search.

Criteria

- 1. Significant psychologists are listed.
- 2. All blanks in the "Scavenger Hunt Form" are accurately filled in for each psychology.
- 3. The reflection entry includes two insights plus evidence of understanding of the historical context of each of the psychologists chosen.

Resources

- 1. handout—The Story of Psychology: Perspectives, Theories, and Disciplines
- 2. lecture notes on the history of psychology (found at the end of this activity)
- 3. Table of Contents of this text (for various topics) and the Sattler & Shabatay reader (chapters refer to topics)
- 4. Internet websites, e.g., History and Philosophy of Psychology (start with apa.org) and/or psychology articles and books (use WebCat, ProQuest, etc. or browse in the psychology book section)
- 5. Scavenger Hunt forms (see pages 87 & 88)
- 6. Answers to Critical Thinking Questions

Plan

- 1. Gather information from lecture notes, library resources, internet resources, and introduction sections of Sattler & Shabatay.
- 2. Complete the Critical Thinking Questions.
- 3. Compete the Objectives, including filling out the four scavenger hunt forms, and summarize results of work on objectives in an Activity Report Form (see pages 210 & 211).
- 4. Be prepared to give a brief summary of one of the psychologists you found for the scavenger hunt.
- 5. Complete the Journal Exercise.

Knowledge Form: Way of Being

Critical Thinking Questions

- 1. Define psychology and give a reason why it is a scientific discipline.
- 2. What are two historical influences that have caused changes in the focus of psychological scientists and/or professionals?

3. Give an example of a scientific tool that is used by psychologists. What are 2 ways that the availability of more reliable and valid measurement tools has changed the way topics are studied by psychologists?

4. What are three examples of how current media (e.g., the TV sitcom *Frasier*) and news (e.g., stories about mental health) present psychology and/or psychologists?

5. What are two topics that seem to have captured the interest of both psychologists and the public throughout the history of psychology? Why?

Journal Exercise

How do the perspectives or viewpoints of the psychologists you studied in order to complete the scavenger hunt seem to differ from yours about what the important questions are in life? As you have studied psychology in this course, how have your perspective changed about how to understand your and other's behavior?

Knowledge Form: Way of Being

Scavenger Hunt Form Great Questions in the History of Psychology

Psychologist:	Country:
DOB/DOD	Decade of Greatest Fame:
Area within Psychology:	Main work setting:
State a problem he or she addressed:	
Main research or professional method(s):	
This psychologist is well known for:	
Psychologist:	Country:
Psychologist: DOB/DOD	Country:
DOB/DOD	Decade of Greatest Fame:
DOB/DODArea within Psychology:	Decade of Greatest Fame:
DOB/DOD Area within Psychology: State a problem he or she addressed:	Decade of Greatest Fame: Main work setting:

Sample Activity 5

Knowledge Form: Way of Being

Scavenger Hunt Form Great Questions in the History of Psychology

Psychologist:	Country:
DOB/DOD	Decade of Greatest Fame:
Area within Psychology:	Main work setting:
This psychologist is well known for:	
Psychologist:	Country:
DOB/DOD	Decade of Greatest Fame:
Area within Psychology:	Main work setting:
State a problem he or she addressed:	
Main research or professional method(s):	
This psychologist is well known for:	

Knowledge Form: Way of Being

Notes on the History of Psychology

- Psychological thinking and theorizing is natural for humans; examples can be analyzed from ancient religions and philosophies. Despite many variations across time and place, all make the assumption that it is valuable to understand what it means or what it is to be human. Cave dwellers from 17,000 years ago left impressive drawings that suggest the importance of animals in their lives; these people may have been highly oriented to small communities and more to what was important outside of themselves than to introspection. Other approaches were highly introspective, such as those of some ancient monks. To contemporary people many of these early documents and drawings seem quite exotic but they are understandable because many of the assumptions about being human are still shared.
- The Greek philosophers (especially those from about 300 to 400 B.C.), e.g., Plato, demonstrated the value and power of logical reasoning. Aristotle, another famous philosopher of that time period, showed the importance of careful observations to check the validity of conclusions gained through thinking. After many centuries the scientific model of research emerged. Ideas were more systematically researched on the basis of very carefully thought out hypotheses that could be tested with real data.
- Modern psychology emerged from two important sources: philosophy and physiology. Contemporary scientific psychology still uses guidance from the first source, philosophy, about the nature of valid knowledge and other broad questions but has generally moved to very specific investigations of behavior and mental processes. Some of the earliest psychological investigations involved the second source, physiology—the study of bodily processes. In the middle of the 19th century there was a large interest in how the organs of sensation work. It quickly became apparent that perception involves more than just the operation of the eyes, the ears, etc. People vary in their judgments about colors, the intensity of a stimulus, etc. Review information in the activities on sensation and perception for more detailed information.
- In 1859 Darwin published his book on evolution. This landmark insight remains the best way to integrate all of biological and psychological knowledge. All life evolves in highly varied ways to adapt to changes in the environment. Some psychologists, e.g. William James around 1892 in the first major textbook covering all of psychology, organized their ideas and evidence around the assumption that human abilities evolved for adaptive functions—just as physical biological changes do. James called his theory "functionalism." Later John Watson (in a famous 1913 paper) proposed that psychologists should study only behavior that is directly observable. He called his theory "behaviorism." Sigmund Freud is another psychologist who was directly influenced by Darwin's theory of evolution. Freud, a physician who started in research, moved to a newly emerging field, psychiatry, partly because income was much better from treating patients than from doing research. He focused on the more negative aspects of human behavior with the assumption that individuals must somehow subjugate natural aggressive and sexual drives to the requirements of family and society.
- Each of the early psychological approaches has continued in some way into the present day. Behaviorism remained prominent, except for Gestalt theories in the 1920's and 1930's, until about 1960 when cognitive perspectives finally returned. Social learning theory is an example of how behaviorism and cognitive became integrated. Review the notes for the activity on Self-efficacy for more information. William James's theory of functionalism might be considered an earlier example of social learning theory—although the available research was much more limited and some of his assumptions about how directly evolution influences human function proved incorrect. (Behavior is heavily influenced by current environmental conditions; biological influences such as genetics

Sample Activity 5

Knowledge Form: Way of Being

are said to cause "predispositions" for some common patterns of "temperament.") Freud's approach remains influential among therapists because of its useful insights about ways that humans react with unconscious psychological defense mechanisms. Neo-Freudians tend to emphasize the development or maturing of the "ego" or self-determination aspects of personal functioning—in contrast to Freud's more deterministic assumptions that the unconscious controls the majority of behavior. One of the offshoots of Freudian theory that is expanding today was Humanistic Psychology. Carl Rogers and Abraham Maslow were two prominent humanistic researchers who proposed that humans have much more positive motives than Freud was assuming. During the past decade a new version of humanistic psychology, Positive Psychology, has emerged that uses much more scientific investigation.

- Cultural and cross-cultural psychology are very important today as "globalism" advances to decrease the significance of borders and distances between groups of people. Investigations of differences between peoples also helps to deepen the understanding of many psychological principles that can be seen to vary in more ways than original researchers may have expected. Consider the differences in use of humor across cultures—and even within subgroups in a culture group.
- Current textbooks usually list the following as important contemporary perspectives in psychology: psychodynamic (related to Freud's theory), behaviorism, humanistic, psychobiological (related to evolution and biology), social learning, and cultural.
- Remember that these "schools" of psychology exist as the best ways to understand and deal with the complexity of behavior and mental processes. Over time, as research and theory progress there will probably be more unity in the understanding of psychology. One reason it may never achieve the unity of some of the natural sciences like chemistry and physics is that it involves humans studying themselves.

Section 8

Understanding the Value of a Knowledge Table and the Classification of Learning Skills

Activity: Team Generation of a Knowledge Table and Identification of Learning Skills

Faculty Guidebook: 2.3.9 Forms of Knowledge and Knowledge Tables

Faculty Guidebook: 2.3.3 Classification of Learning Skills

Faculty Guidebook: 2.3.4 Cognitive Domain

Faculty Guidebook: 2.3.5 Social Domain

Faculty Guidebook: 2.3.6 Affective Domain

Correlation of Activity Design with Course Design

Team Generation of a Knowledge Table and Identification of Learning Skills

Learning Skills

Identifying assumptions, checking perceptions, ensuring compatibility, and envisioning

Why?

Learning is much more effective when the activity designed is aligned with the type of knowledge that is being constructed. The learning process and the level of learning are each significantly impacted by the knowledge form selected; separating learning skills from knowledge is even more important. One's individual learning process is strengthened by applying the appropriate knowledge form to the content one is attempting to learn.

Learning Objectives

- 1. Understand each of the knowledge forms.
- 2. Separate learning skills from knowledge.
- 3. Learn to appropriately classify and label the knowledge items.

Performance Criteria

- 1. Given an assortment of words demonstrate ability to differentiate learning skills from knowledge and then to classify a given knowledge item into its preferred knowledge type.
- 2. When completed, one should be able to
 - a. Distinguish learning skills from an array of disparate words.
 - b. Classify the words describing knowledge with the appropriate forms.
 - c. Provide justification for classifications.
- 3. Transform a knowledge item into a new form by re-labeling the knowledge item.
- 4. The resulting label should be
 - a. Descriptive
 - b. Aligned effectively
 - c. Effective

Resources

Glossary

The *Faculty Guidebook* modules located in this tab of your handbook are available to you for use as introductory material and resources:

2.3.9 Forms of Knowledge and Knowledge Tables

2.3.3 Classification of Learning Skills
2.3.5 Social Domain
2.3.6 Affective Domain

Plan

- 1. Take the set of words provided and classify them into 6 categories—learning skill, concept, process, tool, context, or way of being.
- 2. When in doubt develop justification for your classification of the word.
- 3. Assess your team's classification based upon the course design document.
- 4. Identify the five words that were the most challenging to classify. Why was this the case?
- 5. Select three words to be part of a class-wide discussion on what happens to the meaning of a word based upon the classification.

Critical Thinking Questions

- 1. What are the five forms of knowledge?
- 2. What are the important differences between knowledge and learning skills?
- 3. What differentiates conceptual and process knowledge?
- 4. What differentiates a tool from process knowledge?
- 5. What are the similarities and differences between "ways-of-being" and "learning skills"?

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2.3.9 Forms of Knowledge and Knowledge Tables

Duncan Quarless (Chemistry, SUNY College at Old Westbury)

The definition of knowledge from a Process Education perspective includes both breadth and depth. Breadth is indicated by five forms of knowledge: concepts, processes, tools, contexts, and taxonomy. Depth is indicated by levels of knowledge use as represented by Bloom's taxonomy. The five forms of knowledge are the components of a "knowledge table" that can be assembled around any complex knowledge focus or application. The principles for constructing such a table are presented and exemplified to show the flexibility that emerges from this systematic approach to the analysis of knowledge.

Knowledge Forms

Donald (2002) proposes that knowledge occurs in two stages: an initial declarative (information) stage and a subsequent procedural (application) stage. There is, however, a growing body of evidence that suggests that there are both declarative and procedural stages in all of the forms of knowledge that ultimately facilitate knowledge construction. Krumsieg and Baehr (2000) argue that learner growth is exhibited in a movement between forms, and that this movement creates some subjectivity (variance) in the classification of knowledge forms. Forman's (2000) discussion of knowledge-building communities provides strong insights about the social dimensions of the forms and how these social aspects impact the interpretative flexibility between the forms (see the section "Principles for Constructing a Knowledge Table" later in this module). The five basic forms of knowledge are defined and illustrated in Table 1. Also included is a sixth form, rule knowledge. Rule knowledge is perhaps the most trivial but it is included for completeness. All knowledge can be classified as being one of these forms.

Knowledge Construction and the Knowledge Table

Knowledge is dynamic and flexible if the learning process produces growth in the level of knowing (2.2.1 Bloom's Taxonomy—Expanding its Meaning). Additionally, the five forms of knowledge span the four learning skill domains: cognitive, social, affective, and psychomotor. The implication is that any knowledge table represents substantial complexity even if it is constructed for beginning learners.

Process Education uses a learner-oriented philosophy of education in which construction of knowledge requires the implementation of learning principles (2.1.1 Overview of Learning Theory) as guided by the Learning Process Methodology (2.3.8 Learning Process Methodology). Piaget and other developmental psychologists have recognized that learners must actively develop knowledge within the framework of their cognitive organizational schemes (Liben, 1983), a perspective consistent with Process Education principles. A knowledge table (sometimes referred to as a "knowledge map") is a tool that guides the process of analyzing specific cognitive schemes or frameworks within any particular area of knowledge.

Fisher, Wandersee, & Wideman (2000) illustrate why knowledge tables are an important and useful tool in a learner-centered pedagogy. They enable educators to identify aspects of knowledge that are externally valid, e.g., facts, theories, models, and also aspects that are unique because of context and way of being. Knowledge mapping produces several significant consequences that include promoting active learning, facilitating conceptual change, and interconnecting and deepening understanding. All of these are important for elevating learner knowledge (2.2.2 Elevating Knowledge from Level 1 to Level 3). Use of the LPM is facilitated or enhanced if a knowledge table is used to present the five forms of knowledge that are relevant to a particular area of knowledge being learned (Krumsieg & Baehr, 2000). Without the knowledge table, it is easy for learners to set learning objectives with only one dimension, e.g., to memorize conceptual facts for a test.

Educators need to be aware of several practical limitations in the way that knowledge tables have sometimes been constructed and applied.

- 1. If there is excessive ambiguity in the distinctions among the five forms of knowledge within a map, e.g., by overlapping concepts with processes, learning activities may also lack appropriate focus.
- 2. If the descriptions and details used to represent the five forms of knowledge within a knowledge map are disjointed, e.g., lacking in integration or parallelism, multiple problems in learning and assessing performance are likely.
- 3. If there is not enough detailing or complexity in how the forms in the map are represented, learners may not fully recognize relevant exemplars or models, and educators may find it difficult to provide clear assessments (Fisher, 2000).
- 4. If educators falsely assume a difference between knowledge maps and knowledge tables, they may create ambiguity in their understanding that impedes curriculum design. It is argued that the term "knowledge table" is more intuitively relevant for practical pedagogical concerns.

Table 1 Types of Knowledge and Examples

Knowledge Form	Definition	Examples	
Concept	an idea that connects a set of relationships; a generalized idea about something or a clas- sification label such as process methodologies	chemistry – the mole	
Process	a sequence of steps, events, or activities that results in a change or that produces some- thing over a period of time	using chemical equa- tions to interconvert and predict masses, moles and number of particles	
Tool	any device, imple- ment, instrument, or utensil that serves as a resource to accomplish a task	chemical equation	
Contexts	the whole situation, background, or conditions relevant to the process	atomic theory (laws of conservation of mass-energy, definite composition, multiple proportion, classification of matter, use of various representations, e.g., chemical formulas, structural formulas, empirical formulas, molecular formulas)	
Way of Being	the set of behaviors, actions, and language associated with a particular discipline or knowledge area; a culture	specificity in the use of language; use of representations; application of skills, e.g., visualizing, problem-solving; validating solutions	
Rule	memorized fact or set of facts that govern performance in a knowledge area; may be thought of as a convention that is required within the knowledge construction	the units that are reported as part of the solution when unspecified in the question. In chemistry, bond length would be an illustration, specified typically either in angstroms (e.g., in the U.S.) or picometers (e.g., in Europe)	
	Additional examples: driving on the left side of the street in European countries; hand signaling with European cars which have steering wheels on the right side; spelling certain words with the addition of a "u", e.g., valor – valour		

Constructing a Knowledge Table

The various knowledge forms move from the basic, declarative kinds of knowledge to procedural or application (skill) types. The methodology for facilitating the elevation of knowledge along this continuum is treated in 2.2.2 Elevating Knowledge from Level 1 to Level 3. Table 2 contains a knowledge table related to home remodeling in which the five forms of knowledge are described for each knowledge level from "Information" to "Research."

The knowledge table is best thought of as the systematic framework that interlocks the forms. In the example presented in Table 2, it should be recognized that the forms generally interconnect. What may not be as clear is the fact that a particular learner may not demonstrate full integration of these interconnections. For example, an apprentice carpenter might be able to measure and saw straight cuts under supervision but not have an adequate understanding of building plans to make his or her own determinations of how to make the cuts. The apprentice's process is at a low level of application, and the conceptual understanding is only at the information level. The plan exists and has certain features that the apprentice is aware of, but it does not yet serve as a guide for steps in the building process.

Principles for Constructing a Knowledge Table

- 1. **Planning and Preparation**—It is important that particular learning outcomes and behaviors be incorporated in the planning. What variations in levels of knowledge must be assessed? How must the assessments address variations in forms of knowledge? What are the targeted behaviors and outcomes for a good performance?
- 2. Context and Way of Being—The knowledge-building community establishes the predominant elements of the learning environment that are relevant to the "culture" of each particular discipline. It is important to be mindful of these elements as they impact the forms. For example, argumentation may be a context for dealing with a concept in one knowledge-building community, while consensus building may be a context in another learning community. Consequently, the way of being associated with knowledge building in each of these communities will likely be different as well.
- 3. **Strengthening the Existing Knowledge Base**—The process of constructing the table should activate and strengthen the learner's prior knowledge base. The learner(s) should be encouraged (motivated) to explore their existing knowledge. This is done in light of the steps that follow.

Knowledge Levels for "Remodeling"	Concepts	Processes	Tools	Contexts	Way of Being
Information	facts, definitions, number codes on materials to be used	able to identify steps in the plan			personal preferences about home features
Conceptual Understanding	model, plan, or blueprint for the house	able to analyze one's own work or builder's work based on the plan	use city permit standards to analyze the construction plan	features of the site that will require adaptations to the plan	understanding reasons for recommended adaptations
Application	match a model to the work in progress	able to follow the plan step-by-step, imitate an expert builder	use appropriate tools and measures while building	use an adapted plan to build a specific house	open to required adaptations
Working Expertise	match of model to construction codes	efficiently integrate all elements and make adaptations during construction	nents and unusual solutions to adaptations solve unexpected		collaboration with the builder to achieve maximum outcomes
Research	propose construction models for varied climates	test new procedures or products for general improvement of home construction	use testing devices related to new home building methods	develop principles for adapting construction plans to varied sites	long-term self- assessment of ability to collaborate in varied projects

- 4. Critical Thinking Questions—It is important to determine and detail the key questions related to the various knowledge forms. In the example above on home remodeling, the idea becomes somewhat different if the house is Victorian rather than ranch style. What differences in processes and tools would be required if the remodeling construction plan were to be prepared for an older house that does not meet current code requirements? Can a relatively inexperienced but well-trained carpenter handle the new requirements? How will the electrical and plumbing requirements be different? How will costs be affected? Will the design be suitable if the owner is physically disabled?
- 5. Classification Variance—It is important to recognize the flexibility and relationship between forms. In the home remodeling illustration, the Victorian style can also be classified as a context, since it also describes conditions that are relevant to the construction. Similarly, the building materials can be classified either as tools (instruments used to accomplish the construction) or context (part of the relevant conditions for the construction).
- 6. Facilitating Both Content and Process Development—It is important to emphasize both the learning process and learning outcome(s) during the construction of the table. The framing of such an exercise should involve a mindful process to perform the task. That is, both the means and the end are important. This can be done by establishing learning outcome and learning process criteria for the performance.
- 7. Guidelines for Classifying Forms of Knowledge—Table 3 provides a matrix of guidelines for deciding what form of knowledge one is working with. The classification of knowledge forms involves a series of judgments that must remain consistent with the learning purpose and outcomes. In the example of "home remodeling" (Table 2), each column represents varying levels of complexity of that form. The information in Table 3 includes criteria and standards to support assessment of classification accuracy.

Criteria for Classifying Forms of Knowledge

	Concepts	Processes	Tools	Contexts	Way of Being
Examples	ideas, definitions synthesis, model; set of relationships	sequence of activities; producing or changing something; can continue to improve quality	method; instrument; reach a level of skill usage	conditional, will change; environmental; grows with experience	set of values; culture/beliefs; growing appreciation over time
Distinctions to Make	thinking you know versus knowing you know	actual performance; not just understanding what to do	selection/use of tool; not just concept of tool or of its use	adaptation to varied conditions; not a change in basic processes	preferences, tacit assumptions; not concepts or processes
Criteria	representational; abstract	active; continuous	instrumental; increases quality	type of environment; change in conditions	clarity of interests, values, feelings, thoughts
Standards	relevant to the area of knowledge	defines actions done to reach a goal	enhances process and outcome	used as basis to redefine other forms for best fit	able to articulate how personal factors influence knowledge

8. Classification Example—Consider the electrical components of a house. The plan of the electrical grid is conceptual. An electrician must perform many processes and use many tools to carry out the plan. Knowledge forms feedback in a sense because the plan is a "tool" for the electrician as well as a conceptual representation of an electrical layout. Each type of building plan involves context variations and home owners make many decisions to fit their personal needs and preferences.

Concluding Thoughts

This module presents the theory of forms of knowledge and relates these forms to Bloom's levels of knowledge. Creation of a complete knowledge table is a powerful technique for analyzing all aspects of knowledge related to a specific learning goal and relevant performance criteria. The forms are "linked" to each other in real practice, but assessment of performance will be enhanced if a fully worked out knowledge table is developed. An extended example is worked out in Table 2 and several principles are provided that help in building such tables. Table 3 provides criteria for differentiating and accurately classifying forms with a knowledge table. Using knowledge tables will enhance the design of curriculum and improve the ability to provide effective performance assessment.

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2.3.3 Classification of Learning Skills

by Daniel K. Apple (President and Founder, Pacific Crest), Steven W. Beyerlein (Mechanical Engineering, University of Idaho), Cy Leise (Psychology & Human Services, Bellevue University), and Marie Baehr (Vice President for Academic Affairs, Coe College)

The Classification of Learning Skills for Educational Enrichment and Assessment is an organizational scheme created by a team of process educators over a ten-year period. The Classification helps educators and learners identify and understand the nature of transferable learning skills that apply to multiple disciplines. Four distinct but interconnected domains comprise this scheme: cognitive, social, affective, and psychomotor. These are further developed in their own respective modules. (Though the authors acknowledge the existence of a fifth domain, the spiritual one, they have elected not to include it in this discussion.) Language development provides a common platform for all of the domains. Assessment provides a common core for improving performance in all domains. This module describes the educational philosophy behind the Classification and the rationale used to identify learning skills within it, as well as the features of this scheme that enhance teaching/learning effectiveness.

Need for the Classification

Educators committed to applying learning theory to educational practice have long needed a shared language to use in discussing learning skill development. This is especially important among faculty engaged in general education classes, designers of active learning curricula, and members of accreditation committees striving to connect course-level learning outcomes with program-level outcomes. The Classification is introduced as a framework for advancing understanding about the nature and inter-relationships of learning skills across all academic disciplines. It integrates key findings in pedagogical research, including the following:

- Learning involves building a tapestry of conceptual, procedural, and meta-cognitive knowledge (Bransford, Brown, & Cocking, 2000).
- 2. Learning results in subject matter mastery, transferable long-term behaviors, and mature perspectives that can be both measured and elevated (Dewey, 1997).
- 3. Subject matter mastery (conceptual development in an area of knowledge, joined with fluency in applying it) can be planned, cultivated, and assessed, using modern derivatives of Bloom's taxonomy (Anderson & Krathwohl, 2001).
- 4. Focusing on a small set of life skills at one time helps learners integrate these skills in their lives and elevate their daily performance (Covey, 2004).

The developers of the Classification began by recognizing that each discipline has its own special concepts, tools, language, and performance rubrics. However, they decided not to attempt a lengthy compilation of many overlapping skills. Instead, they chose to highlight a smaller listing

of general learning skills that appear in multiple learning contexts (Krumsieg & Baehr, 2000).

The Classification has evolved into a comprehensive model of transferable procedural knowledge that can be used to address a number of educational research questions of interest to higher education. Which learning skills are most critical for a well-rounded education? How do individual learning skills relate to each other? How can they best be taught, especially in concert with the content-mastery skills essential to specific disciplines? How should these learning skills be measured and documented? How can these skills be best communicated to support transfer from one discipline to another?

Anatomy of a Learning Skill

Learning skills are discrete entities that are embedded in everyday behavior and operate in conjunction with specialized knowledge. They can be consciously improved and refined. Once they are, the rate and effectiveness of overall learning increases. They can be identified at an early stage of a learner's development. No matter what the person's age or experience, learning skills can be improved to higher levels of performance through selfreflection, self-discipline, or guidance by a mentor. This growth in learning skill development is usually triggered by a learning challenge of some kind and is facilitated by actions built on a shared language between mentor and mentee. Finally, the growth and development of a learning skill is sustained by quality assessment and feedback. These factors underlie the rubric for learning skill development presented in Table 1. Note how these change incrementally as one progresses from the rudimentary (Level 1) to the sophisticated (Level 5).

Table 1 Stages of Learning Skill Development

Level 5 Transformative Use	The skill is expanded and integrated with other skills so that it can be applied in new contexts that inspire other comparably skilled people to investigate its use for their own purposes and possible emulation.	
Level 4 Self-reflective Use	The skill can be self-improved and adapted to unfamiliar contexts with occasional advice from a mentor.	
Level 3 Consistent Performance	The skill is routinely called upon an effectively applied in multiple context by the user, who is consciously directing the effort, frequently with the help of mentor.	
Level 2 Conscious Use The skill can be used proactively be learner, but its use needs to be of stantly encouraged and supported be mentor.		
Level 1 Non-conscious Use	The skill appears on a reactive basis in response to an immediate need, but without the awareness of the learner or of those surrounding him.	

Assumptions about Learning Skills

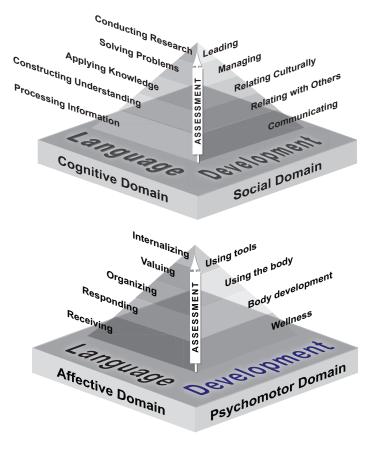
The Classification of Learning Skills is based on several assumptions. First, by focusing on a small set of transferable, mutually exclusive learning skills, educators have an opportunity to build shared language about learning performance. Admittedly, there are many more learning skills than those featured in the Classification: in addition. the labels educators use to describe these often differ from one person to the next and from one discipline to the next. So, in order to work more productively across classroom and temporal boundaries, it is helpful to have a broadly recognized system for naming these skills. Second, a rubric for learning skill development helps educators and learners to understand and assess individual skills. However, it is important to keep in mind that learning skills are developed through practice and feedback; they cannot be elevated through conceptual knowledge alone. Third, a person only recognizes the need to learn a new learning skill when he or she cannot perform a task at a certain level—in other words, when the current skill level is less than that required for the task. If the learner perceives a task to be less challenging than his or her level of competence, he or she will not seek higher-level skills to do it.

Organization of the Classification

The Classification of Learning Skills embodies a deliberately selective grouping of essential yet discrete learning skills. Each one is assigned only to the domain where it is most commonly applied; that placement is determined by a decision as to where it first becomes most critical to learning performance. While skills related to thinking processes are "housed" within the cognitive domain, those related to interpersonal processes can be found under the social domain. Similarly, skills related to attitude and emotional development are located in the affective domain, and those connected with body development and control, under the "psychomotor" domain.

The Classification of Learning Skills can be visualized using a four-sided pyramid situated on a base plate (Figure 1), with each side of the pyramid representing one of the domains. Language development lies at the base of this pyramid because this is essential for the conscious development of any learning skill in any domain. Assessment is a unifying feature that integrates learning skill improvement at all levels of learning skill use and development. Along each side, the processes associated with each domain are listed in hierarchical order. High-level learning skills associated with processes at the top of the

Figure 1 Domains and Process Areas in the Classification of Learning Skills



pyramid rely on lower-level learning skills associated with processes at the bottom of the pyramid. For example, within the cognitive domain, processing information should be addressed before tackling skills associated with the processes of constructing understanding, applying knowledge, solving problems, and conducting research.

Within each process area, learning skills are organized into clusters, as illustrated in Table 2. This example explores one of the five skill clusters that support information processing. Unlike the process areas, the skill clusters associated with a particular process area and the specific skills associated with each cluster do *not* follow a hierarchy. A listing of skill clusters and specific skills in the process areas that make up the cognitive, social, affective, and psychomotor domains are shown in companion modules.

Table 2 Example of a Skill Cluster

Domain	cognitive		
Process	processing information		
Cluster	collecting data	a (from disorganized source)	
	observing	seeing details in an object/environment	
	listening	purposeful collection of aural data	
Skills	skimming	inventorying using key prompts	
	memorizing	active mental storage of information	
	recording	transcribing key information	

The development of this Classification scheme has evolved over time, with infusions from several different traditions of scholarly research. Initial work on this system, guided by Bloom's taxonomy (Bloom, 1956/1997), focused on the cognitive domain—specifically focusing on comprehension, critical thinking, and problem solving. Later, research projects such as the SCANS Report (Secretary's Commission on Achieving Necessary Skills), focusing on communication and teamwork skills (SCANS, 1991), inspired much of the work on the social domain. Work on the affective dimension of the pyramid was shaped by current self-improvement and leadership literature that highlighted the role emotional skills play in personal and professional life (Goleman, 1997). It should also be noted that this Classification system has been debated, discussed, and developed extensively in a variety of educational institutions. By dialoguing about the design, implementation, and measurement of general education courses, educators across the nation have helped refine this approach. Even now, the Classification remains a work in progress, subject to new insights derived from classroom and clinical research.

Selection and Placement of Learning Skills

Each of the skill listings in the Classification was brainstormed, located, and validated by several cross-disciplinary teams consisting of up to a half-dozen faculty members working in Pacific Crest institutes. This typically began by writing short definitions of potential "candidate" skills that were then placed within a process area and assigned key attributes. Table 2 shows examples of the learning skills involved with the skill cluster "collecting data."

To be considered for the Classification, each learning skill was then tested against all of the following criteria:

- Improvement in this skill had to lead to enhancement of learning performance
- The skill had to be accessible and usable at all times
- Performance in this learning skill had to be unbounded, i.e., it could be "grown" to progressively higher performance levels
- The skill had to be transferable across disciplines and contexts
- The skill could apply to multiple forms of knowledge (2.3.9 Forms of Knowledge and Knowledge Tables)
- The skill had to be a holistic element which could not be subdivided, i.e., it could not be either a label for a cluster of skills or a label for a process
- The skill was not a process consisting of multiple steps

Once a skill passed all of the above tests, it was associated with a predominant domain and linked with the appropriate skill cluster. The skill cluster was then examined to ensure that it formed a compact, complete, and non-overlapping set; in other words, that nothing essential was left out or shared with another cluster. In this process, the following conditions had to be met:

- Each of the skills had to be distinct and provide unique added-value to the set
- The skills had to be worded concisely, congruently, and completely so that there could be no room for improvement in the definition
- The skills could not be critical to learning performance at the next lower process level

As candidate skills were considered for the Classification, definitions were refined so that they represented something unique and essential. This continued until all redundant learning skill components had been parsed out and nothing new remained.

Using the Classification

By incorporating the transferable learning skills found in the Classification into instructional design and delivery, process educators have found ways to make subject matter mastery more authentic (Hanson & Wolfskill, 2000). They have also developed ways to accelerate learning by using appropriate follow-on activities based on the skill levels they have identified (2.2.3 Developing Working Expertise (Level 4 Knowledge), 3.2.1 Overview of Facilitation, and 4.1.1 Overview of Assessment). Thus, optimal instruction blends discipline expertise (i.e., applied knowledge, such as solving an algebraic equation or critiquing a play) with performance in general learning skills (i.e., process knowledge, such as critical thinking, teamwork, problem solving, and language development.)

Process educators have also noted that learning skill growth in one domain can leverage growth in other domains (Krumsieg & Baehr, 2000). For instance, growth of learning skills in the affective and social domains can occur relatively quickly and can have a positive impact on skill development in the cognitive domain, where growth occurs more slowly (3.1.1 Overview of Quality Learning Environments, and 3.1.2 Introduction to Learning Communities).

Instructors who see the essential connections between skill development and subject matter mastery will find the Classification of Learning Skills to be a useful tool for course design and delivery. Yet, they are wise not to address too many of these learning skills at once. Instead, they are well advised to focus on those skills that are best matched to their students' developmental and disciplinary needs. The Classification can help determine which lower-level skills should be cultivated before addressing the more sophisticated ones. These choices are critical to effectively tailoring learning activities to different student populations; they are also key to articulating learning outcomes at different points in a program (1.5.2 Methodology for Designing a Program Assessment System).

Concluding Thoughts

The Classification of Learning Skills for Educational Enrichment and Assessment is an important tool for facilitating learners' growth and development, measuring and documenting growth, self-assessing performance, and improving instructional design for skill development. It builds upon and continues to incorporate a wide range of theories to improve lifelong learning skills to increase subject-matter mastery. Finally, the generation of this Classification has sparked interest in new kinds of questions related to the identification and understanding of learning skills. Research issues have arisen regarding

the measurement of learners' growth and development, the role of faculty in mentoring, and the importance of skill development to learning as opposed to an exclusive focus on content mastery. Faculty who use this Classification to strengthen their own skills will find they can significantly enhance their teaching, research, and service to the profession.

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2.3.4 Cognitive Domain

by Denny Davis (Bioengineering, Washington State University), Steven W. Beyerlein (Mechanical Engineering, University of Idaho), Cy Leise (Psychology & Human Services, Bellevue University), and Daniel K. Apple (President and Founder, Pacific Crest)

The cognitive domain contains learning skills predominantly related to mental (thinking) processes. Learning processes in the cognitive domain (Table 1) include a hierarchy of skills involving processing information, constructing understanding, applying knowledge, solving problems, and conducting research. These processes enable performance at five different levels of learner knowledge that parallel levels of educational objectives originally defined by Bloom and elaborated in **2.2.1 Bloom's Taxonomy—Expanding its Meaning**. However, Bloom's taxonomy focused on describing levels of attainments rather than process skills, and did not substantially address the manner in which the learner proceeds from one level to the next. The cognitive domain includes skill clusters that organize a complete, concise, and complementary listing of the learning skills most critical for each process. The cognitive domain learning skills presented here are a valuable reference for curriculum design, classroom observation, and assessment of learning outcomes.

Role of the Cognitive Domain

The cognitive domain encompasses thinking skills that are independent of context and discipline. In contrast to other domains of learning, the cognitive domain addresses development that is individual rather than interpersonal, focuses on content rather than context, and is independent of emotion. The organizational framework given in Table 1 is intended to support learner-centered knowledge acquisition as well as learner-centered growth in cognitive performance.

Cognitive skills can be evidenced at many levels of proficiency (Bransford, Brown, & Cocking, 2000). Five distinct levels that apply to all learning skills are suggested in the *Classification of Learning Skills (2.3.3)*. Cognitive skill development is best sequenced following the levels that parallel educational objectives laid out in Bloom's taxonomy because learning skills from lower-level processes are embedded in learning skills associated with higher-level processes (Bloom, 1956; Anderson & Krathwohl, 2001).

In the cognitive domain, skilled professionals typically utilize a set of specific, highly developed skills along with discipline-specific knowledge in conjunction with a broad spectrum of less-developed skills (Wenger, 1998). Methodologies provide tools for novices as well as experts to strengthen these complex performances (2.3.7 Learning Processes through the Use of Methodologies). By strengthening underlying learning skills, one can accelerate the mastery of important methodologies (2.3.8 Learning Process Methodology, 3.2.3 Facilitation Methodology, and 4.1.4 Assessment Methodology).

Cognitive Domain Processes

As illustrated in Table 1, five thinking processes comprise the cognitive domain. These processes are sequenced and identified as processing information, constructing understanding, applying knowledge, solving problems, and conducting research. Processing information includes collecting data, generating data, organizing data, retrieving data, and validating information. Constructing understanding includes analyzing, synthesizing, reasoning, and validating understanding. Applying knowledge includes performing with knowledge, modeling, being creative, and validating results. Solving problems includes identifying the problem, structuring the problem, creating solutions, and improving solutions. Conducting research includes formulating research questions, obtaining evidence, discovering, and validating scholarship.

Critical thinking is purposely not identified with a single process area in the cognitive domain. Instead, critical thinking is considered a super-process that draws from all process areas in the cognitive domain during the creation of new knowledge or the improvement of existing knowledge. This viewpoint is consistent with principles of the National Council for Excellence in Critical Thinking (Paul, 2003). Further exploration of the holistic nature of critical thought is given in 2.2.5 Overview of Critical Thinking.

Cognitive Domain Clusters

Clusters of learning skills are identified under each of the cognitive domain processes. As many as five clusters support each process area. Each skill cluster contains up to a half-dozen unique but closely related learning skills. Skill clusters are given labels that communicate their role within each process area. In Table 1, skill clusters are arranged left-to-right in a progression of increasing sophistication. There is no special significance in the order in which the learning skills appear within a cluster.

Processing Information

Collecting Data (from a disorganized source)

Observing - seeing details in an environment/object

Listening - purposeful collection of aural data

Skimming – inventorying using key prompts

Memorizing – active mental storage of information

Recording - transcribing key information

Measuring – obtaining data using a predetermined scale

Generating Data (to fill a void)

Predicting - forecasting from experience

Estimating – approximating from mathematical models

Experimenting - inferring from empirical study

Brainstorming – gathering ideas from previous experience

Organizing Data (for future use)

Filtering - selecting data based on criteria

Outlining – identifying primary and subordinate groupings

Categorizing – associating data with established groups

Systematizing – designing an organizational framework

Retrieving Data (from an organized source)

Recognizing patterns – perceiving consistent repetitive occurrences

Searching – locating information within a system

Recalling – retrieving from memory

Inventorying - retrieving from collective memory

Validating Information (for value)

Testing perceptions – verifying based on interpretations

Validating sources – verifying based on credibility

Controlling errors – verifying based on procedures

Identifying inconsistency - detecting outliers/anomalies

Ensuring sufficiency – verifying data quantity/quality to suit the context

Key for Table 1

Process

Skill Cluster

Specific skill

Constructing Understanding

Analyzing (characterizing individual parts)

Identifying similarities – recognizing common attributes of parts

Identifying differences – recognizing/distinguishing attributes of parts

Identifying assumptions – examining preconceptions/biases

Inquiring – asking key questions

Exploring context – seeing the relationship of parts to the environment

Synthesizing (creating from parts)

Joining - connecting identifiable parts

Integrating – combining parts into a new whole

Summarizing – representing the whole in a condensed statement

Contextualizing – connecting related parts to the environment

Reasoning (revealing meaning)

Interpreting – adding meaning for better understanding

Inferring – drawing conclusions from evidence and logic

Deducing – arriving at conclusions from general principles

Inducing – arriving at a general principle by observing specific instances

Abstracting – describing the essence of an idea, belief, or value

Validating Understanding (for reliability)

Ensuring compatibility – testing consistency with prior knowledge

Thinking skeptically - testing against fundamental principles/schema

Validating completeness – checking for missing aspects

Bounding – recognizing the limits of the application of knowledge

Applying Knowledge

Performing with Knowledge (in real context)

Clarifying expectations – defining proficiency level

Strategizing - planning how to use knowledge

Using prior knowledge – integrating unprompted knowledge

Transferring – using ideas in a new context

Modeling (in abstract context)

Analogizing – representing similar elements in dissimilar contexts

Exemplifying – showing by example

Simplifying – representing only primary features

Generalizing - transferring knowledge to multiple contexts

Quantifying – representing with numbers or equations

Diagramming – clarifying relationships through visual representation

Being Creative (in new contexts)

Challenging assumptions – exploring possibilities by relaxing constraints

Envisioning - imagining desired conditions

Linear thinking – generating new ideas from previous ideas

Divergent thinking - taking variety of positions to stimulate ideas

Transforming images – manipulating images to gain new insight

Lateral thinking - generating new ideas from associations

Validating Results (for appropriateness)

Complying – comparing results with accepted standards

Benchmarking – comparing with results from best practices

Validating – using alternative methods to test results

Solving Problems

Identifying the Problem (to establish focus)

Recognizing the problem – stating what is wrong or missing

Defining the problem – articulating a problem and need for solution

Identifying stakeholders – naming key players/audiences

Identifying issues – inventorying key stakeholder desires and concerns

Identifying constraints – recognizing limitations to solutions

Structuring the Problem (to direct action)

Categorizing issues – grouping by underlying principles Establishing requirements – articulating solution criteria Subdividing – separating into sub-problems Selecting tools – finding methods to facilitate solution

Creating Solutions (for quality results)

Reusing solutions – adapting existing methods/results
Implementing – executing accepted solution practices
Choosing alternatives – selecting alternatives using criteria
Harmonizing solutions – fitting components into holistic solution

Improving Solutions (for greater impact)

Generalizing solutions – modifying for broader applicability
Ensuring robustness – modifying to fit more contexts
Analyzing risks – identifying external sources/impacts of error
Ensuring value – testing against requirements and constraints

Conducting Research

Formulating Research Questions (to guide inquiry)

Locating relevant literature – searching out seminal sources Identifying missing knowledge – determining gaps in community understanding

Stating research questions – asking empirically answerable questions

Estimating research significance – forecasting the value/ impact to the community

Writing measurable outcomes – specifying deliverables from research

Obtaining Evidence (to support research)

Designing experiments – specifying observable parameters and sampling

Selecting methods – determining research procedures

Extracting results – analyzing data to produce quality characterizations

Replicating results – duplicating experiments and findings

Discovering (to expand knowledge)

Testing hypotheses – discerning significant effects

Reasoning with theory – explaining data with accepted knowledge

Constructing theory – formulating new conceptual structures
Creating tools – adapting knowledge for practitioners

Validating Scholarship (for meaningful contribution)

Defending scholarship – presenting within disciplinary performance expectations

Responding to review – improving one's scholarship based on community input

Confirming prior work – adding credibility to a body of knowledge Judging scholarship – evaluating scholarship against criteria

Cognitive Domain Skills

Learning skills are inseparable entities that can be consciously elevated and refined with proven potential to increase the rate and capacity for learning. As explained in *2.1.1 Overview of Learning Theory*, these are the mortar for building schema to which learners can connect new knowledge. Each learning skill is given a brief explanation that visualizes its use.

Two different learning skills from the cognitive domain are analyzed in Table 2: listening and identifying assumptions. These two examples illustrate how a specific skill used for basic processing of information and another skill used in constructing understanding can be demonstrated at very low levels (without conscious effort) and at very high levels (impressing and inspiring others). Monitoring learning skill proficiency along a common developmental continuum can be a tremendous motivator for learners. Similarly, recognizing which skills are underdeveloped in different learning situations can be used to plan interventions that accelerate desired cognitive development.

The cognitive domain presented in Table 1 includes over 90 transferable learning skills relevant to undergraduate education, graduate education, and professional practice. These were selected using the methods described in the *Classification of Learning Skills (2.3.3)* and worded in a manner intended to appeal to users in all academic disciplines. Enough specificity has been retained to ensure that well-defined cognitive domain learning skills can be traced to most course and program learning outcomes. Explicit attention to targeted learning skills in classroom activities, instructor interventions, and assessment sessions can increase the probability that these outcomes are achieved and that they can be transferred to other settings (2.4.5 Learning Outcomes and 4.1.9 SII Method for Assessment Reporting).

Level of Competency	Description of Individual Responses	Examples: a. Listening b. Identifying assumptions
Level 5 Transformative Use	The skill is expanded and integrated with other skills for creative, productive application in novel contexts; this inspires others to emulate use.	 a. Purposefully listens and observes nuances and contextual details that deepen the understanding of information and its application to a clearly stated need b. Clearly articulates one's own assumptions as well as those of others, enabling all to understand their impacts on interpretations and conclusions on matters involving a wide variety of disciplines and perspectives
Level 4 Self-Reflective Use	The skill is used effectively by the learner; the skill can be self-improved and adapted to unfamiliar contexts with occasional advice from a mentor.	 a. Carefully listens and reflects on success to gain maximum understanding relevant to a specific need b. Analyzes and recognizes relative impacts of assumptions made by self and others across a variety of disciplines and perspectives
Level 3 Consistent Performance	The skill is used routinely and effectively in multiple contexts through learner self-direction; not able to advance without external coaching.	 a. Carefully listens to understand key points useful for addressing a specific need b. Looks for the impacts of assumptions by self and others in discussing interpretations and conclusions within areas of specialty
Level 2 Conscious Use	The skill is used knowingly, possibly pro- actively, by the learner, but the skill needs to be constantly challenged by a mentor.	 a. Actively listens; identifies information thought to be important to a general need b. Is aware of some assumptions underlying his or her personal interpretations and conclusions, but is often unaware of assumptions made by others
Level 1 Non- Conscious Use	The use of the skill is initiated by a prompt or influence external to the learner; an unintended use of the skill.	a. Passively listens; notes only information that is highlighted by othersb. Is unaware when assumptions are made by self or others, often leading to erroneous conclusions

Concluding Thoughts

Teachers and learners need to understand the hierarchy of processes and skills within the cognitive domain so they appreciate prerequisite skills for learning as well as the way these skills need to be transformed to master more complicated elements of discipline-specific concept inventories. Development of learning skills should never be taken for granted in teaching or learning new content. Skills associated with lower-level processes should be introduced in foundation courses and elevated in intermediate-level coursework. Skills associated with higher-level processes should be thoughtfully introduced and reinforced in upper-division courses. Methodically invoking key learning skills from different process areas and clusters across the cognitive domain also provides a method for infusing richness in course activities while strengthening lifelong learning skills. Like the **Social Domain** (2.3.5), this module serves to remind us that improved cognitive domain performance is always possible, no matter what one's state of learning skill development.

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2.3.5 Social Domain

by Cy Leise (Psychology & Human Services, Bellevue University), Steven W. Beyerlein (Mechanical Engineering, University of Idaho), and Daniel K. Apple (President and Founder, Pacific Crest)

The learning processes in the social domain of learning skills (Table 1) include a hierarchy of skills related to communication, teamwork, management, and leadership. This domain is distinct from the cognitive, affective, and psychomotor domains in that all of its process areas and specific skills involve interpersonal performance in the large range of social contexts in which learning occurs. Traditionally, educators (e.g., Bloom) have subsumed the social domain mostly under the affective domain but with some crossovers to the cognitive domain (e.g., critical thinking about a communication performance). However, with the emergence of newer learning theories that take fuller account of the social and cultural contexts of learning, educators have become aware of the unique types of learning in the social domain and of interdependence among the four domains of learning for all complex performance goals. Some of the benefits of learning about social domain skills include greater awareness that communicating and teaming skills support management and leadership skills, that context greatly influences selection and uses of knowledge, and that integration of social domain processes into any learning process will enhance transfer potential.

Role of the Social Domain

Bloom (2.2.1 Bloom's Taxonomy—Expanding its Meaning) did not author a social domain of learning skills to complement his cognitive, affective, and psychomotor taxonomies. However, sociocultural and constructivist philosophies of education strongly incorporate social domain learning skills. Cobb and Yachel (1996) provide an overview of these theories.

The socio-cultural approach is associated with theorists such as the Russian psychologist Lev Vygotsky (1934/2006) and the American philosopher/educator John Dewey (2005) who assume that learning is a developmental process that starts with "external" stimulation and emerges as "internalized" abilities. In Process Education, this approach is used in the "scoping" of learning activities to assure that the learning expectations are within the present capabilities of the learners and that they are compatible with the time constraints and other available resources. It is essential to provide appropriately designed, guided experiences to encourage a learner to internalize knowledge (2.4.8 Methodology for Course Design).

The emergent/constructivist theories are often associated with Jean Piaget's (1970) developmental theory. These theories assume that the physically maturing brain and environmental stimulation contribute equally to an individual's ability to construct knowledge. These theories are similar to those of the socio-culturalists in the belief that learning is maximized if opportunities stimulate emergence of new "schemas" (knowledge patterns or units). Process Education assumes that learners not only continually construct knowledge but that the quality of that construction can be facilitated as suggested by the five levels of skill competency presented in Table 2.

Description of the Social Domain

The learning processes included in the social domain feature performances that directly focus on the development of social skills (e.g., being courteous) as well as the uses of the social skills themselves to manage situations or problems (e.g., improvising). There are general rules of thumb for identifying key distinctions among the four domains (2.3.3 Classification of Learning Skills). The cognitive domain involves reasoning-related skills that need not be connected to a concrete context, the affective domain involves valuing skills related to ways of being, the psychomotor domain involves physical skills involving tool use or movement coordination in specific contexts, and the social domain involves communication-related skills in goal-oriented contexts.

The five process areas of the social domain as defined by Pacific Crest include communicating, relating to others, relating culturally, managing, and leading. As with the other domains, the social domain processes consist of a hierarchy of complexity from the more basic or foundational (i.e., communicating) to the more complex (e.g., managing and leading).

Within each of the five social domain processes are four to six clusters of skills whose titles indicate how specific skills are related to each other. The combination of clusters for a process identifies the skill types for that process; the skills identified within a cluster have no further subdivisions because they are assumed to occur holistically in natural settings. There is no significance to the order in which the specific skills are listed under each skill cluster.

Social Domain Learning Skills

Communicating

Receiving a Message

Attending - mindful focusing by a listener

Reading body language – gathering information from nonverbal cues

Responding - giving appropriate and timely responses

Checking perceptions - feeding back implied meaning

Preparing a Message

Defining purpose – specifying outcomes for a message

Knowing the audience – predicting the background and interests of receivers

Organizing a message – sequencing elements for the best impact

Selecting word usage – using language that matches the audience's background

Formatting a message – selecting a mode or style that fits the purpose

Illustrating – enhancing a message with images, tables or drawings

Delivering a Message

Selecting a venue - deciding when and where to present a message

Generating presence - delivering a message with authority

Sharing knowledge – effectively presenting relevant facts and interpretations

Persuading - using information selectively to convince

Story telling - relating what happened

Managing transitions – using planned techniques to lead an audience

Relating Culturally

Accepting Constraints

Obeying laws – complying with rules meant for the common good Inhibiting impulses – delaying one's reaction until one is aware of the situation

Noticing social cues – recognizing situational signs that direct behavior Recognizing conventions – behaving politely within a context

Living in Society

Sharing traditions – participating in mutually meaningful rituals
Supporting institutions – upholding important organizations
Valuing communities – recognizing the worth and needs of a group
Reacting to history – responding with knowledge of past events
Being a citizen – participating in the political process

Demonstrating Cultural Competence

Clarifying stereotypes – checking assumptions about people in different cultures

Appreciating cultural differences – enjoying learning cultural knowledge Generalizing appropriately – validly acknowledging cultural differences Using culture-specific expertise – possessing detailed knowledge about a culture

Relating with Others

Inviting Interaction

Taking an interest in others – enjoying personal differences Initiating interaction – approaching and engaging others

Heating using social events to build social schoolen

Hosting – using social events to build social cohesion

Expressing positive nonverbal signals – accurately projecting feelings

Assisting others – being kind without expecting a reward

Being non-judgmental – responding with an assessment mindset

Relating for Meaning

Belonging - gaining acceptance in a group

Befriending – initiating a supportive relationship

Empathizing - taking another's emotional perspective

Collaborating - working together for mutual benefit

Parenting – guiding the social-emotional development of children

Mentoring – encouraging one's growth through an advisory relationship

Performing in a Team

Goal setting - formulating shared outcomes

Achieving consensus – agreeing on decisions based on shared values

Planning – deciding how to use resources to achieve goals

Cooperating – respecting role boundaries and responsibilities

Compromising - modifying positions to achieve common ground

Performing in an Organization

Accepting responsibility - demonstrating initiative and persistence

Being assertive – advocating strongly on the basis of reason and evidence

Making proposals - presenting plans for consideration

Documenting – creating a record of activities, work products, and processes

Influencing decisions – using assessment data to support decision paths

Key for Table 1

Process
Skill Cluster
Specific skill

Managing

Managing People

Building consensus – developing goals and plans that are well-accepted

Motivating – arranging rewards that fit individual aspirations

Modeling performance – demonstrating high quality in action

Assessing performance – providing feedback for improving performance

Evaluating performance – judging whether a performance standard has been met

Building and Maintaining Teams

Defining team roles – deciding on roles that support a goal Setting rules – defining ethical and professional expectations

Delegating authority – authorizing others to manage selected tasks

Confronting poor performance – requiring specific change

Recruiting – selecting qualified personnel for specific functions

Mediating - resolving interpersonal conflicts

Managing Communication

Connecting with stakeholders – involving key individuals at appropriate times

Networking – developing relationships with internal and external advocates

Marketing – initiating messages to persuade clients of the value of something

Sustaining change – promoting creative proposals for ongoing improvement

Managing Resources

Negotiating – making agreements with other stakeholders to advance a position

Politicking – advocating positions with external stakeholders

Securing resources – assuring appropriate funding, scheduling, and staffing

Creating productive environments – arranging for essential resources in a setting

Leading

Envisioning

Projecting the future – visualizing future status based on trends/logic

Seeing implications – describing the operational impacts of future trends

Balancing perspectives – maintaining the vision while working within constraints

Responding to change – being flexible in strategic thinking

Building a Following

Inspiring – being positive in the face of negative challenges

Sharing a vision – using empathy and imagery to help

others see a vision

Generating commitment – asking for specific signs of willingness to tackle challenges required for a vision

Maintaining integrity – responding to personal issues with clear criteria/principles

Maintaining Commitment

Meeting individual needs – responding to evidence of needs with relevant resources

Taking meaningful stands – publicly articulating principles

Thinking opportunistically – using positive strategies to predict and reduce risks

Being charismatic – displaying confidence in action

Empowering

Giving credit – publicly and equitably acknowledging performance

Encouraging ownership – engaging others in important tasks for a vision

Grooming subordinates – developing future leaders to take over key roles

Being a servant leader – placing interests of others before personal interests

Social Domain Skill Competency Levels

Table 2 presents five levels of competency that can potentially be achieved in any skill in the social domain. From the lowest to the highest, these five levels of skill use are "non-conscious use," "conscious use," "consistent performance," "self-reflective use," and "transformative use." These level descriptors provide a way to identify how much competence an individual has with any social domain skill. Brief examples are presented in Table 2 to illustrate what the varying levels of competency look like at each of the five levels in the skills of "attending" and "sharing a vision."

Level of Competency	Description of Individual Response	Examples: a. Attending b. Sharing a vision
Level 5 Transformative Use	Is highly skilled in the timely use of the skill to improve others' engagement or commitment	a. Discerning subtle changes in audiences and stakeholders b. Updating a vision to improve or "capture" the future potential of the organization
Level 4 Self-Reflective Use	Uses the skill within a planned strategy for organizational change, e.g., when running meetings	a. Noticing the effectiveness of meetings on the basis of one's own criteria for effective meetings b. Designing organizational teams to implement a vision through action projects
Level 3 Consistent Performance	Uses the skill to make a difference in real- time, e.g., cooperatively or collaboratively	a. Task-oriented listening, questioning, and paraphrasing b. Volunteering to be a member of a college committee on vision; presenting personal and peer perspectives effectively
Level 2 Conscious Use	Uses the skill passively but with an awareness of the need to grow; is limited in confidence, social smoothness, and timing	a. Actively selecting information from team comments b. Questioning a college president's vision in discussions with peers
Level 1 Non-Conscious Use	Is responsive if prompted by others; is attentive but does not consciously identify social domain processes and skills	a. Passively present; able to respond if asked a question b. Noting the main features of a new college president's vision

Concluding Thoughts

This module presents the processes, skill clusters, and skills of the social domain of learning (Table 1) and differentiates these from the processes and skills in the cognitive, affective, and psychomotor domains. A fivelevel rubric is presented in Table 2, analogous to Bloom's taxonomy for cognitive learning objectives, for assessing the level of competence with any skill in the social domain. The socio-cultural and constructivist philosophies of learning and development are briefly discussed in order to demonstrate how skills in the social domain fit into educational theory and practice. As a systematic approach to education, Process Education emphasizes the significance of social domain learning skills which in the past have often been considered peripheral to learning. By identifying the relevant skills from the social domain that are likely to make a difference in a learning context, educators will be able to integrate these skills with those from the other domains to create truly integrated learning experiences.

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2.3.6 Affective Domain

by Wendy Duncan-Hewitt (Dean of Pharmacy, St. Louis College of Pharmacy), Cy Leise (Psychology & Human Services, Bellevue University), and Ann Hall (Allied Health Technologies, Sinclair Community College)

The affective domain contains learning skills that are predominantly related to emotional (affective) processes. The learning processes in the affective domain include being open to experience, engaging in life, cultivating values, managing oneself, and developing oneself (Table 1). Within each of these general process areas are several "clusters" of specific learning skills that can be improved by means of constructive intervention and assessment. The classification of affective skills presented in this module incorporates many of the skills described in Bloom's original work. Although these earlier authors and contemporary educators generally focus more on learning objectives, cognitive learning skills, or in some contexts, psychomotor skills, the movement to learner-focused teaching/learning methods makes clear the significance of integrating learner skills across all domains. Skills in the affective domain are strongly related to student buy-in, self-management, persistence, attitudes toward assessment, and level of success. The present classification provides a valuable reference for curriculum design, facilitation, and personal growth.

The Importance of Affect in Human Behavior

Affect or emotion influences one's awareness of important sensory and situational changes, and motivates action. One example is the well-known "fight or flight" response. The importance of affect in human and animal life is clearly demonstrated in the extensive body of theory and research related to emotion and motivation. Oatley (1992), Nesse (1990), and Lewis and Haviland (2004) are examples of a wide range of approaches to affect that include neuroscience, psychoanalysis, behavioral psychology, cross-cultural psychology, and evolutionary psychology.

One indication of the increasing attention paid to affective skills is the work of Lopez and Snyder (2003), as described in their presentation of measurement options for positive psychology. Another is Goleman's (1997) popularization of the finding that "emotional intelligence" is often a better predictor of individual success than general intellectual ability as measured by most IQ tests.

Individuals who learn to recognize and engage their emotions are ready to "grow" affectively so that they can respond to challenges appropriately and explore their values. At higher levels in the affective domain classification, growth involves managing oneself, managing one's performance, and making commitments. Maslow (1970) calls this "self-actualization." Peterson and Seligman (2004) have prepared an important resource for the affective domain in their comprehensive scholarly review of what they refer to as "character strengths and virtues" in the categories of wisdom and knowledge, courage, humanity, justice, temperance, and transcendence.

The present classification emphasizes "growable" skills that tend to be a combination of emotion and motivation, sometimes referred to as "conation." What ties all of the processes, clusters, and skills together is the emphasis on affective skills that are commonly observed in learning and growth contexts.

The Role of Affect in Learning

Although many educators develop effective affect management skills in their classrooms and other learning contexts, this is often a process of trial and error. The assumption in this module is that affective skills are universally important in learning and growth and that these skills can be facilitated equally as well as those in the other domains. Table 2 provides guidance for assessing the level of competency a learner has achieved with specific affective learning skills. Learning in the cognitive, social, and psychomotor domains is often constrained if the learner is operating at a low level with key affective skills. For example, a large group of learners who do not recognize the significance of taking charge of their own learning will reduce the level of discourse in a course.

Even if a learning objective appears to be cognitive in nature, there will always be affective skills involved. For example, Halpern (1998), using a cognitive psychology perspective, emphasizes the importance of teaching transferable skills as the universal goal of effective teaching/learning. She illustrates this with a four-part critical thinking model that is empirically supported: students must be prepared for effortful cognition, there must be instruction in the skills of critical thinking, there must be training in the structure of problems and arguments, and meta-cognition is necessary for monitoring transfer of learning. The first component of her model is clearly related to the affective domain and includes aspects of a quality learning environment (3.1.3 Methodology for Creating a Quality Learning Environment) such as establishing respect, buy-in, and an assessment "mindset." The second and third components are mostly related to cognitive domain skills, but learners with more advanced social and affective skills are more likely to persist with the difficult learning involved. While the fourth component involves advanced cognitive domain learning skills, it also requires affective skills related to persistence. When learning is considered in a systems

perspective, there are many places where the level of growth in specific affective skills will make the difference between calmly persisting in a cognitive task and "bailing out" due to frustration (4.3.4 The Accelerator Model). It is essential, therefore, to incorporate techniques into facilitation plans to engage learners in ways that lead to active, self-challenging learning attitudes (3.2.5 Creating a Facilitation Plan). When learning attitudes like emotional control and objectivity are highly developed, they facilitate self-control, the deferral of gratification, stability, persistence, courage, and serenity. The affective skills are essential if one is to care enough to put in the considerable time, effort, and discomfort that it takes to improve as a learner and to grow as a person.

Description of the Affective Domain

Affective Domain Processes

As illustrated in Table 1, the affective domain is comprised of five affective processes. These processes are sequenced and identified as being open to experience (receiving), engaging in life (responding), cultivating values (valuing), managing oneself (organizing), and developing oneself (internalization). The processes, which are increasingly more complex and integrative, parallel Maslow's hierarchy of needs, Bloom's taxonomy of educational objectives in the affective domain (Krathwohl, Bloom, & Mesia, 1964). and Mayer and Salovey's (1997) conceptualization of emotional intelligence. The process framework is intended to reflect the full range of affective development because adults vary widely in this area. Individuals may need to address basic emotional issues that were put on hold earlier in life which now require growth. The higher levels of the framework reflect the affective control and performance desired by wise, mature, and integrated persons.

Affective Domain Clusters

Clusters of learning skills are identified under each of the affective domain processes. As many as four clusters support each process area and each cluster contains up to seven unique learning skills. Skill clusters are named to communicate their role within each process area. The processes and skill clusters are listed in order of increasing complexity but there is no special order to the learning skills within a cluster.

Affective Domain Skills

The affective learning skills can be consciously improved with assessment and intentional practice; moreover, growth in these skills will enhance learning in skills in the other domains and for any learning goal. Each of the skills is described briefly to enhance its meaning to the reader. The set of over 80 learning skills identified in Table 1 are transferable, i.e., they can be applied in a broad range of life situations. They were selected according to the method described in the *Classification of Learning Skills (2.3.3)*

and worded so that they would be accessible to educators and learners in all disciplines and contexts. The goal was to include enough skills to represent all major areas of affect but to limit the number to those most likely to be useful in higher education and related contexts.

Concluding Thoughts

Teachers and learners need to become familiar with the hierarchy of processes and skills within the affective domain and work to internalize how those processes and skills can be observed and assessed in real learning contexts. In traditional curricula, the skills in the affective domain are often neglected because it is assumed that students will "discover" them on their own. However, the challenges in facilitating active learning show that this is not true. Affective skills typically become an issue when instructors must build rapport and achieve buy-in. Later the level of affective challenge that learners can handle will significantly influence the quality of course outcomes. As with skills from the other domains, those from the affective domain involve performance improvement which leads to developmental growth and ultimately the empowerment to challenge oneself in all aspects of life.

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Being Open to Experience (Receiving)

Exploring Self

Observing self - noticing one's actions

Listening to self - being conscious of one's point of view

Perceiving reactions – seeing how other people respond to

Body awareness – recognizing the range of its capabilities

Identifying emotions – sensing feelings

Exploring Surroundings

Being curious - wanting to find out more

Being open- welcoming, and expecting to find novelty

Being positive - having an optimistic state of mind

Being playful - seeking fun in experiences

Being active - seeking activity

Experiencing Emotions

Feeling loved - being truly valued

Grieving – accepting loss

Feeling joyful - feeling connected with existence

Laughing - finding humor in experience

Responding to aesthetics – being moved by forms of beauty

Feeling secure – establishing a sense of security

Engaging in Life (Responding)

Emoting

Loving - giving of oneself

Caring - responding to others' needs

Respecting – demonstrating an appreciation of others

Giving - relinquishing possessions to others

Comforting - providing physical and verbal support

Addressing Life's Challenges

Coping - managing stressors

Persisting - continuing despite difficulties

Accepting help – surmounting one's personal limitations with help from others

Believing in oneself – developing and maintaining self-esteem

Responding to failure – growing in response to barriers and negative results

Appreciating evaluation – recognizing value in realistic feedback

Leveraging Life's Successes

Responding to success - investing for the future

Being humble - allowing accomplishments to speak for themselves

Seeking assessment – analyzing past performance to improve future performance

Celebrating – acknowledging the meaning of accomplishments

Acknowledging others - recognizing contributions

Table 2

Affective Domain Competency Levels

Level of Competency	Description of Individual Response	Examples: a. Persisting b. Seeking mentoring		
Level 5 Transformative Use	Is highly skilled in the timely use of the skill to improve others engagement or commitment	a. Serving as a coach for others who have habits of procrastination b. Serving as a mentor for others		
Level 4 Self-Reflective Use	Uses the skill within planned strategies for improvement of control, e.g., reacting in a chosen, but genuine manner.	a. Being aware of the role of emotions in one's personal level of motivation for challengesb. Taking on new challenges beyond those required for immediate needs		
Level 3 Consistent Performance	Recognizes affective states quickly and employs learned methods of self-management that fit the situation	a. Managing emotions such as frustration to assure completion of		
Level 2 Conscious Use	Uses the skill passively but with an awareness of the need to grow; is limited in confidence, smoothness, and timing	a. Using a planner to increase persistence in finishing tasks b. Becoming open to the need to understand personal emotional reactions in some areas such as building relationships		
Level 1 Non-Con- scious Use	Is responsive if prompted by others; is attentive but does not consciously identify affective domain processes and skills	a. Avoiding all but obviously easy learning tasks; procrastinating b. Avoiding analysis of personal reactions to important performances		

Managing Oneself (Organizing)

Regulating Self

Responding to requests– setting boundaries to maintain personal integrity

Recognizing dissonance – noticing inconsistencies in situations

Managing dissonance – achieving congruence in the face
of life's inconsistencies

Managing resources – applying assets and means to important goals

Prioritizing – addressing what is most important
Being self-disciplined – persisting regardless of emotions

Managing Performance

Being decisive - choosing with confidence

Committing to the future- engaging life goals

Preparing – realistically envisioning the performance

Rehearsing – improving one's probability of success through practice

Challenging standards – raising the expectations for one's quality

Being self-efficacious – synchronizing one's abilities with one's beliefs

Orchestrating emotions – using feelings to aid in problem solving, judgment, and learning

Managing Emotions

Modulating emotions – returning to one's balance point

Recognizing emotional contexts – tracking affect shifts in emotionally arousing situations

Preparing for future emotions – predicting expected feelings
Modeling emotions – demonstrating emotional competence
in various situations

Cultivating Values (Valuing)

Valuing Self

Building identity- aligning actions and values

Evolving a personal philosophy- bringing meaning to life

Trusting self – having an accurate sense of self-efficacy

Caring for self – attending to one's personal emotional, physical, and spiritual needs

Reflecting – increasing one's self-awareness

Valuing Natural Laws

Appreciating diversity – valuing differences as a measure of a healthy ecosystem and social system

Valuing nature – seeking to understand and harmonize one's actions with natural laws

Valuing family/significant others – enjoying closeness in a central social group

Being spiritual - experiencing awe

Cultivating Values (continued)

Refining Personal Values

Identifying values – labeling main beliefs

Exploring beliefs – questioning, researching the basis of one's values

Clarifying one's value system – achieving consistency

Validating values – taking personal ownership from experiential "tests"

Aligning with social values – acting according to mutually empowering ethics

Accepting ownership – assuming responsibility for one's behavior

Developing Oneself (Internalization)

Synergizing Feelings

Associating feelings – connecting emotions such as love and fear Interpreting feelings – understanding the social and historical meaning of emotions

Analyzing feelings – understanding causes of complex emotions

Predicting feelings - anticipating future emotions

Objectifying emotions - temporarily suspending feelings

Exploring emotions – learning and growing from both pleasant and unpleasant emotions

Facilitating Personal Development

Recognizing personal potential – identifying strengths and areas of improvement

Seeking assessment – focusing on obtaining realistic growthenhancing feedback

Seeking mentoring – seeking relationships that will challenge one's growth

Being patient – being able to "stay the course"

Challenging Self

Exploring potential – developing a life vision

Expanding identity - engaging life in new ways

Being courageous - taking risks to embrace the unknown

Being proactive – planning ahead to create new opportunities

Growing culturally – applying insights from human differences

Being empathic – responding affirmatively to complex differences in others' world views

Committing Beyond Self

Committing to caring - taking long-term responsibility

Accepting outcomes – adjusting to reality

Acting on beliefs - being ethically consistent

Enhancing self-esteem – activating one's potential

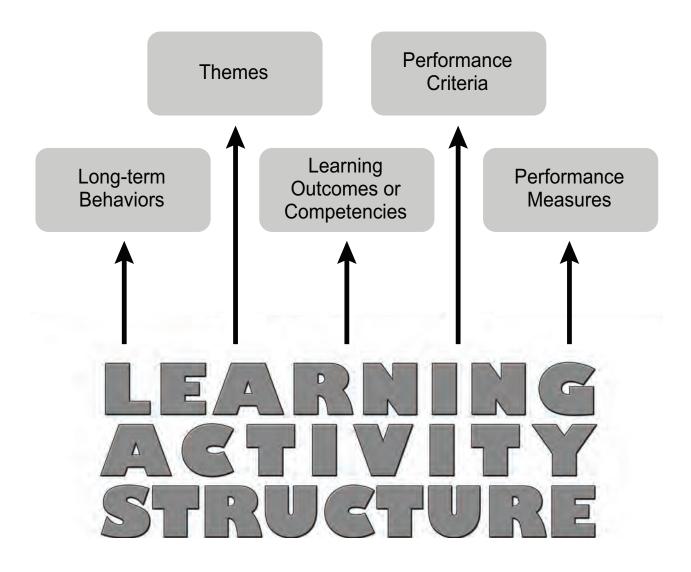
Maturing - increasing one's integration and complexity

Self-actualizing - taking responsibility for the future

Activity Design and Critical Areas of Course Design

The diagram below illustrates that an activity should align itself with five critical areas of the course design.

- An activity's performance criteria should support the **performance criteria** of the course.
- An activity should be designed so that the learner increases his or her performance in specific **measures** in the course.
- An activity should be designed to support changing the **long-term behaviors** of learners.
- An activity should be connected to at least one **learning outcome**.
- An activity should support the development of **course themes**.



Section 9

Forms of Knowledge and Activity Types

Common Activity Types
Matching Activity Types with Knowledge Forms

Common Activity Types

Excerpt from the Faculty Guidebook, 2.4.13: Overview of Learning Activities

1. Guided-Discovery Learning

This type of activity requires students to construct knowledge in one of five forms: conceptual, process, tool, context, or way of being. Typically, the level of knowledge attainment for students is at the working-knowledge or problem-solving level. In guided-discovery activities the instructor identifies key resources, models, and background information, and provides a set of critical-thinking questions that guide students' thought processes in constructing knowledge at the desired level.

2. Interactive Lecture

This is an alternative to an uninterrupted lecture that lasts for an extended period of time. The goal is to build in checkpoints during the lecture during which students test their understanding of what has been presented. Techniques for generating interactivity include giving a short quiz at the end of class; providing a set of critical-thinking questions that are intended to be processed during the lecture; taking breaks during which teams of two or three students think, pair, and share responses to interesting questions; assigning homework problems; and asking students to write one-minute papers in which they identify main points or muddiest points in what has been presented (Angelo & Cross, 1993).

3. Student Teaching

Educators know that those who teach learn the most, and that the true test of understanding comes when a person is put in a position of teaching others. The more often students are put in the role of teacher, the more responsibility they will feel for the important learning outcomes in the course. The measure for assessing the performance of student teaching should be based on the ability of learners to perform using the knowledge associated with the activity, not on whether the faculty member likes the quality of the presentation or the level of understanding demonstrated by the student

teacher.

4. Problem Solving

These activities require students to apply knowledge to new contexts, integrating complex relationships with prior knowledge. Problems should be relevant, challenging, and motivating; they should integrate knowledge gained in the class, and should require the use of a problem-solving methodology. This type of activity also lends itself well to team competition and games.

5. Projects

Compared to problem solving, projects involve even greater amounts of problem identification and definition, they occur over longer periods of time, and they place more emphasis on communicating the results in a formal manner. Projects that involve team formation and development can promote the development of learning skills in the social and affective domains. An excellent way to celebrate project success is to create a poster session that is open to faculty and students outside of class.

6. Self Assessment and Peer Assessment

If student learning is the goal of an activity, then assessment of student learning should be integrated in some form into almost every learning activity (Wiggins et al. 2005). A variety of assessment tools and methods are found throughout the *Faculty Guidebook* that can be incorporated in free-standing activities or supporting components of other activities.

7. Student Presentations

This can be a less formal variant on student teaching. Students display some aspect of part of a performance in the class, such as homework solutions, answers to quizzes, findings from reading assignments, peer assessments, and team assessments. A higher-stakes variation of the

student presentation is a *fishbowl* situation in which a team of students works through a problem while the rest of the class watches and assesses what they see. An important part of any public performance by students is a class-wide discussion that acknowledges strengths, constructively suggests improvements, and generalizes lessons learned.

8. Self-Study

The nature of this activity is to allow the student to self-facilitate his or her own learning to meet the performance criteria. The facilitator's role is to provide the learner with a complete set of resources, performance criteria, and assessment tools. When using the self-study technique it is important to make sure that the scope of the activity is within the boundaries of the learner's performance capabilities, that the activity is self-contained, that there are measures for assessing performance, and that the learner has an opportunity to apply the knowledge in a relevant context

9. Reading

In this type of activity students are responsible for comprehending written material, but typically they do not understand what they are supposed have learned or what they should be able to do as a result of reading the material. Quizzes and short essay questions can be used to motivate students to come to class better prepared when a reading has been assigned.

10. Technology

Computer-based and internet learning systems, called *interactive learning systems*, offer an asynchronous environment in which students interact with the computer and with classmates as they think through, practice, and synthesize new knowledge. This taps into an emerging part of youth culture that may engage students whose learning styles lead them to be less vocal in the classroom.

11. Role Playing

Students are encouraged to consider new perspectives and issues associated with a situation when

they engage in role playing. The instructor creates a scenario, assigns appropriate roles, provides information, and asks the groups to enact that scenario being faithful to their roles and using their knowledge of the subject. The module on has more information about using formal roles in learning activities as well as case studies and jigsaw sessions.

12. Consulting

This is a popular alternative to lecture where faculty members lend their expertise to questions and problems posed by students. While this can be a very effective starting point for a just-in-time lecture, faculty are advised to limit the time they spend consulting and redirect this effort to assessing learning. The quality of student thinking can be improved if students are challenged to process information prior to consultation and are limited in the number of questions they can ask.

Matching Activity Types with Knowledge Forms

The table below matches some of the various activity types with the forms of knowledge (from a knowledge table) and indicates the appropriateness and effectiveness of the activity type; where 6 is very appropriate and 0 is not appropriate.

Activity Type	Concept	Process	Tool	Context	Way of Being
Guided Discovery	4	4	4		2
Lecture	2	1	1		1
Interactive Lecture	4	1	2		2
Problem Solving	1	5	3	4	1
Student Teaching	3	1	1	1	1
Laboratories		4	6	3	1
Research	3	3	2	3	2
Projects		2	3	4	1
Group Discussion	4	1		2	2
Student Presentation		1		1	
Assessment		3	1		2
Self-Study	1		2		1
Collaborative Learning	2	3	2	2	1
Using Technology		2	3		
Problem-Based Learning	1	3	2	4	2
Self-Assessment	1	1	2	1	3
Journal Writing	2	2	1		4
Reading	6	1	1	1	2
Team Building					1
Consulting Session	1	1	1	2	1
Planning		1	2	1	
Writing	2	2		2	
Portfolio		2		1	2
Storytelling		1	1	4	1
Demonstration	1	5	4		1
Role Playing		1		3	4
Service Learning	2	4	2	6	5
Poster Sessions	6	3	2	3	4
Student Consulting	6	4	3	2	2

Section 10

Introduction to the Methodology for Activity Design

Faculty Guidebook: 2.4.14 Designing Process-Oriented Guided-Inquiry Activities

Criteria for Activity Design

Activity Design Template

Activity: Conceptualizing Activity Design and Implementation

Within this section you will find a set of materials to assist you as you begin to design an activity. The Activity Design Template is a tool that provides the elements of the design process that are sequentially ordered. The Criteria for Activity Design is likewise ordered to align with the template, and it states standards for the respective steps in the design. These standards should assist you in assessing the quality of the designing as you complete each step, as well as for assessing the end product for improvement. The reading materials, "2.4.14 Designing Process-Oriented Guided Inquiry Activities" provides the rationale and a methodology for activity design when the form of knowledge being addressed is conceptual. Much of this institute is designed to build conceptual knowledge, so this is a methodology that will be reinforced repeatedly throughout the institute.



2.4.14 Designing Process-Oriented Guided-Inquiry Activities

by David Hanson (Chemistry, Stony Brook University)

Research in the cognitive sciences, contemporary learning theory, and classroom research contribute to a design for classroom activities or lessons that is based on how people learn. This design recognizes that people learn by constructing their own understanding in a process that involves accessing prior knowledge and experiences; following a learning cycle that consists of exploration, concept formation, and application; discussing and interacting with others; reflecting on progress in learning; and assessing performance (Bransford, Brown, & Cocking, 2000). In this design, each activity consists of five stages: *orientation, exploration, concept formation, application*, and *closure*. These activities are most effective when teams of students work on them together with much discussion both within and between teams. The sequence of exploration, concept formation, and application lies at the heart of this design. This sequence, called the "Learning Cycle," was originally proposed by Karplus as part of SCIS, the Science Curriculum Improvement Study (Atkin & Karplus, 1962; Karplus & Thier, 1967). A discussion of the Learning Cycle is provided by Lawson (1995), and studies have documented that most students learn best when this sequence is followed. Specifically, students exhibit improved attitudes, higher achievement, better understanding and retention of concepts, and the development of learning process skills (Raghubir, 1979; Lott, 1983; Abraham & Renner, 1986; Abraham, 1988; Lawson, Abraham, & Renner, 1989).

Orientation

The orientation stage prepares students for learning. It provides motivation for the activity and creates interest, generates curiosity, and makes connections to prior knowledge. Learning objectives and criteria for success are identified. As a result, learning is enhanced because the learner feels that the topic is important and worthwhile, the learner has some understanding of what is being learned, and the learner can build understanding from explicit prior knowledge. The identification of learning objectives and success criteria focuses the learner's efforts on essential issues and sets the expected level of mastery. Background, vocabulary terms, prerequisites, and references to resources provide the learner with the necessary information to begin learning something new.

Exploration

Each activity gives students a plan or a set of tasks to follow that embody what is to be learned and that leads to meeting the learning objectives. In the exploration stage, students have the opportunity to make observations; design experiments; collect, examine, and analyze data or information; investigate relationships; and propose, question, and test hypotheses.

Conceptual Formation

As a result of the exploration, concepts are invented, introduced, or formed. Rather than presenting information in texts or lectures, educators engage students in guided inquiry or discovery to develop their conceptual understanding. This process is structured by supplying questions that compel students to think critically and analytically as they engage in the exploration. These questions, which are called guided-inquiry, critical-

thinking, or key questions, guide the learner in the exploration. They can help define the task, direct the learner to information, lead the learner to appropriate connections and conclusions, and help the learner construct understanding of the concept being learned.

Application

Once the concept is identified, it is reinforced and extended. Application involves using the new knowledge in exercises, problems, and even research situations. *Exercises* give the learner the opportunity to build confidence in simple situations and familiar contexts. *Problems* require the learner to transfer the new knowledge to unfamiliar contexts, synthesize it with other knowledge, and use it in new and different ways to solve real-world problems. *Research questions* identify opportunities for the learner to extend learning by raising new issues, questions, or hypotheses.

Closure

Each activity ends with the students validating their results, reflecting on what they have learned, and assessing their performance. Validation can be obtained by reporting results to peers and to the instructor to get feedback regarding the content and the quality. When students are asked to reflect on what they have learned, their knowledge is consolidated, and they see that they have been rewarded for their hard work. Self-assessment is the key to improving performance. When students recognize what they have done well, what they need to improve, and what strategies they need to develop in order to achieve these improvements, they are both encouraged and motivated to work toward their goal. Self-assessment is the key to success in courses, college, and careers because it produces continual improvement.

An Activity Design Methodology

- 1. **Identify the focus of the activity**—An activity will usually involve one of the following: learning a concept, developing proficiency with a process or use of a tool, or increasing understanding within a context of a discipline. The focus should be sufficiently sharp so that each activity can be completed in 20 to 40 minutes.
- 2. Select and develop the principal activity type— Since students have a variety of preferred learning styles and since learning takes place in many different forms and disciplines, it is useful to have many tools, techniques, and processes to support learning. A productive learning environment will incorporate a diversity of activity types. A list of possibilities is provided in 2.4.13 Overview of Learning Activities. Also, any single activity can be composed of a combination of activity types. The activity should be at the appropriate level for the students and should support the learning objectives and success criteria.
- Choose an appropriate title—Use a short sentence or phrase rather than a word or two. The title should be clear and inspiring, and should convey a sense of the content.
- 4. Create the "Why" for the activity—Begin each activity with a section titled "Why." This section should put the activity in context for the learner by addressing three questions: What will the student learn? Why is it relevant to the subject? Why is it relevant to the learner? The first sentence clarifies the title and further defines the content of the activity. The second sentence defines the general importance of the activity and describes how it fits into the course. The third sentence provides justification for the activity from the perspective of the individual learner.
- 5. Identify the learning objectives—A learning objective identifies what is to be learned or understood as a result of completing the activity. An activity should have two or three objectives: activities with only a single objective may not be very interesting to the learner while those with many objectives may be too formidable. Objectives should be orthogonal, i.e., not overlapping, and should relate to the "Why" statement. Compound objectives need to be separated. The objectives should be written in a clear, concise style that is easy for students to understand, so both students and faculty know when they are achieved. The most important objectives should be listed first and the least important last. Finally, objectives should include learning process skills, not just mastery of content.

- 6. **Define the success or performance criteria**—Success criteria are the measurable outcomes of the activity; they describe what the learner should be able to do after completing the activity. Good success criteria are understandable, measurable, realistic, and relevant to the learning objectives. Generally, an activity should have one or two success criteria. Without any criteria, students can easily lose accountability for their outcomes and the tendency is to coast through the activity with minimal effort. More than two criteria can confound students and cause them to lose their focus. If students know what is expected and how they will be assessed, their accountability and performance level increase dramatically.
- 7. **Identify prerequisites**—Students and others who may use your activity need to know what prior knowledge and skills are needed to complete the activity and whether any reading assignments need to be completed in advance.
- 8. **Identify necessary information and resources**The information and resources should help students answer the key questions and complete the activity. Information can be provided within the activity itself, by outside resources that are referenced for students, or by sources that they need to find or research for themselves.
- 9. Create a glossary of relevant terms—List the new important terms and vocabulary required to complete the activity. Definitions may accompany the terms, or you may require students to find and write definitions in the glossary in their own words.
- 10. Write a plan for the activity—The plan is a numbered list of tasks or steps that detail what is to be done in the activity. A process-oriented course is likely to be a new experience for the students, so at the beginning of the course, the plan should be explicit, thorough, and complete. As the course progresses, it should become less structured, providing broad guidance and challenging the students to devise the specifics. After the students have gained experience, the plan may be implicit, or the students can be asked explicitly to develop their own plan in order to achieve the stated objectives and meet the success criteria.
- 11. **Create key questions**—Critical-thinking questions are the heart of a guided-inquiry learning environment in which students are actively working to learn new content and develop process skills. This form of learning is most effective when it involves the use of three types of questions: *directed*, *convergent*, and *divergent*. Each activity should require students to

answer five to ten key questions: two or three directed questions, two to six convergent questions, and one divergent question.

Directed questions require that students process and recall information. The answer can be found by examining the model, information, resources, or by drawing on personal experience and prior knowledge. Such questions have a definite answer and build the foundation for more challenging questions.

Convergent questions require that students make connections and reach conclusions that are not obvious upon first examination. Convergent questions have answers that are not directly available in the model, information, or resources; they require students to analyze and synthesize; and they may have more than one correct answer. The level of difficulty should progress with the questions, and the questions should drive students to develop and understand the concepts presented in the activity.

Divergent questions send students in different directions. This type of question may have no right or wrong answer, but it requires students to ponder, explore, generalize, and expand upon their current knowledge. Divergent questions require the highest level of thinking and produce outcomes and conclusions that vary among teams and individuals. Divergent questions have no readily available solution, are open-ended, provide significant challenges, do not need to relate directly to the learning objectives, and are beyond the stated success criteria for the activity. They may even launch research ideas.

- 12. **Develop skill exercises**—Students apply their new knowledge in simple situations and familiar contexts to build confidence and to strengthen understanding. Typically an activity should have two to five exercises. They often repeat the key questions in an identical or similar context as that presented by the model.
- 13. **Design problems**—These problems present new situations that require students to transfer, synthesize, and integrate what they have learned. The purpose is to move them to the problem-solving level of knowledge. The problems often have a real-world context, contain superfluous or missing information, have multiple parts, do not contain overt clues about the concepts needed to arrive at a solution, and may not have a right answer.

In a process-oriented classroom, student teams will work at different rates and will not complete sections of the activity at the same time. The differences are made easier for faculty to manage by using different levels of key questions and problems. An open-ended or divergent key question at the end serves as an equalizer for faster teams who reach this question ahead of others. Such questions can take up considerable time, especially with added facilitation and intervention by the instructor, allowing other teams to catch up. Not all teams will get as far on such questions, and it is important to reward or acknowledge the efforts of the faster teams for their additional work, especially if it is of high quality. Problems of varying difficulty also serve the purpose of pacing the class. The most difficult problems should be at the end. Also, note that the amount of blank space left between questions, exercises, or problems on a work sheet sends a message to the students about your expectations for their response. There should not be equal amounts of space between every question.

14. **Determine how closure will be accomplished**Students must have some means for validating their results, and they need to be encouraged to self-assess their performance and identify ways they can improve. Their learning will also improve if they are given the opportunity to reflect on what they have learned. Self-assessment and reflection should be done in a meaningful and interesting way, consistent with the learning objectives and success criteria.

Activity Template

The components in the Activity Design Template in Table 1 (on the following page) contribute to high-quality, processoriented, guided-inquiry activities. While all enhance learning, not every one is needed in each activity. For example, while learning objectives and success criteria definitely should be part of the instructor's planning, it may be desirable for students to work on the exploration and concept formation without this information.

Concluding Thoughts

While the focus of this module has been the design of *guided-discovery* learning activities, the same principles and methodology also apply to the design of other types of learning activities. The learning objectives of an activity should either contribute to or match the learning outcomes of the course. Activities are where student learning occurs in support of the learning outcomes for a course. It is important to use several different activity types during a course both for variety's sake and to support the varying learning styles of students. A learning activity should always be assessed by students to identify opportunities for refinement and improvement.

Activity Design Template

Title	Label the activity			
Why	Explain and identify the reasons for learning			
Learning Objectives	List what is to be learned			
Success Criteria	Determine the desired outcomes and abilities that will be used to measure performance and achievement			
Prerequisites	Identify the prior skills and knowledge that are needed			
Resources and Information	Provide information needed for the activity. Additional information can be provided to help students consolidate their learning after they have completed the "key questions." List essential references related to the activity.			
Glossary	Provide key terminology			
Plan and/or Tasks	an and/or Tasks List the plan and/or tasks for meeting the learning objectives			
Key Questions	Pose questions that guide the execution of the plan and/or tasks, the exploration of the model, and processing of the information and resources in order to stimulate thought, introduce or form concepts, and construct understanding			
Skill Exercises	Apply the new knowledge in simple situations and familiar contexts			
Problems	Use the knowledge in new or real-world contexts requiring transference, synthesis, and integration of concepts			
Validation	Share results with peers and assess			
Reflection on Learning	Have students think about what has been learned and assess how well the material has been mastered			
Self Assessment	Have students identify what has been done well and develop strategies for improvement			

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Activity Design Criteria

Pur	pose				
	Supports performance criteria of course				
	Facilitates learner performance on specific course performance measures				
	Designed to support changing long term behaviors				
	Connected to one of course's learn	ing o	utcomes		
	Supports development of course themes				
Title	•				
	Concise		Motivating and inspirational		
	Descriptive		Honest		
	Accurate		Does not use same word to define a word		
Туре	e of knowledge item				
	Concept				
	Process				
	Tool				
	Context				
	Way of being				
Prod	duce learning model that is to be o	devel	oped to correspond with activity type		
	Concept = concept model				
	Process = methodology				
	Tool = template or software applica	tion			
	Context = case study/story				
	Way of being = profile				
Why	Statement				
	Short, to the point		Three to four sentences in length		
	Understandable		1st sentence describes "what"		
	Does not overstate		2 nd sentence describes relevance to big picture		
	Personally relevant		3rd sentence describes relevance to student		
	Relevant to course				
Lea	rning Objectives				
	Appropriate kind (competency, mov performance)	/eme	nt, accomplishment, experience, integrated		
	Obtainable		Student-oriented		
	Specific, clear		Road map for what's ahead		
	2-3 in number		Realistic within constraints and resources		

Perf	formance Criteria		
	Emphasizes quality		Measurable
	1-2 in number		Realistic and obtainable
	Clear, understandable		Relevant to learning outcomes
	Includes attributes		Prioritized
	Describes desired behavior and th	ought	process
Lea	rning Skills		
	Aligned to course		Focused number
	Relevant to activity		Integrated
	Opportunity to improve		
Crit	ical Thinking Questions – Directe	d	
	2-3 in number		Builds the foundation
	Motivational		Requires information, processing
	Simple and basic		Steers learner to variety of resources
	Relevant to learning outcomes		
Crit	ical Thinking Questions – Conver	gent	
	2-3 in number		Requires student to analyze & synthesize
	Includes assessment		Allows for more than one correct answer
	Contextual in nature		Requires making linkages to knowledge
	Relevant to learning outcomes		Answer is not directly available in reading, lectures, etc.
Crit	ical Thinking Questions – Diverge	ent	
	Open ended		Involves the research process
	Provides challenges		Adds robustness and excitement
	Can be used as a "bonus"		No solution readily available
	No expectation for evaluation		Is beyond the performance criteria
	Does not need to directly relate to	learni	ng objectives
Plar	n for Execution		
	Inclusive		Provides necessary base of information
	Comprehensive		Available to all
	Specific		Identifies required homework
Pre-	activity		
	Language identified		Resources reviewed
	Readings completed		Readiness assessed
	Inquiry questions developed		

Information and Resources				
	Relevant		Graphics	
	Well-written		Comprehensive	
	Organized			
Prio	r Knowledge			
	Comprehensive		Relevant	
	Links provided		Mastery Level	
	Language Noted			
Glos	ssary			
	New		Relevant	
	Important			
Skill	l exercises			
	Sufficient		Contextually relevant	
	Levels of complexity		Works toward generalization	
	Evidence of progression			
Prol	olem Solving			
	Uses level 3 knowledge		Relevant context	
	Appropriately scoped		Designed for teams	
	Focuses on problem solving			
Use	of Technology			
	Adds creativity		Playful	
	Increases learning		Engaging	
	Interactive			
	Validation			
	Self Assessment			
	Timely		Improves performance	
	Properly scoped		Aligned with performance criteria	
	Sequenced for development			
Clos	sure			
	Learning is measured		Key issues addressed	
	Questions are inventoried		Foundation laid for future	
	Follow up action determined			

Activity Design Template for Faculty

Design	Team Members:
1. Ident	tify purpose
2. Title	
Z. Title	
3. Type	e of Knowledge Item
Cor	ncepts (IA)
Pro	ocesses (M)
Too	ols (T)
Cor	ntexts (CS)
Wa	ys of Being (P)
4. Crea	te the Learning Model / Instrument for the Knowledge Item
	ology (<i>Process</i>), Profile (<i>Way of Being</i>), Story/Case Study (<i>Context</i>), Template (<i>Tool</i>), Interactive Concept – delay till step 10)
5. Why	?
Wh	nat?
Big	Picture
Rel	levance
6. Lear	ning Objectives
7. Perfo	ormance Criteria with attributes
8. Lear	ning Skills
Co	gnitive
Soc	cial
Affe	ective
Psy	ychomotor

9. Key Critical Thinking Questions	
Directed	
Convergent	
Divergent	
10. Plan/Tasks for Execution of Activity	
11. Pre Activity	
12. Sequencing Critical Thinking Questions	
13. Information and Resources Needed	
14. Prior Knowledge Required	
15. Glossary	
Previous Terms	New Terms
	New Terms
Previous Terms	New Terms
Previous Terms 14. Skill Exercises	New Terms
14. Skill Exercises 15. Problems to Be Addressed	New Terms
14. Skill Exercises 15. Problems to Be Addressed 16. Technology to Be Used	New Terms



Conceptualizing Activity Design & Implementation

Learning Skills

ensuring compatibility, identifying assumptions, strategizing, subdividing

Why?

If faculty are to expect higher learning outcomes from guided inquiry activities compared to those achieved in the traditional classroom, activities need to be well designed with intentional learning outcomes and processes for student success. Developing an understanding of both activity design and facilitation lays the foundation for a high-quality classroom experience.

Learning Objectives

- 1. To develop an understanding of the elements (steps) for comprehensive activity design.
- 2. Build an appreciation for the value of the effectiveness of the design process.
- 3. Correlate the activity design process to the phases of classroom facilitation.
- 4. Recognize the importance of the design criteria for quality control of the completed activity.

Performance Criteria

- 1. Clear statements of understanding reflected in the answers to the critical thinking questions
- 2. Evidence of learner anticipating pitfalls due to poor planning/implementation

Resources

Designing Process-Oriented Guided-Inquiry Activities (*Faculty Guidebook* 2.4.14), Activity Design Criteria, Activity Design Template

Designing Process-Oriented Guided-Inquiry Activities (*Faculty Guidebook* 2.4.14) begins with a description of five phases for facilitating an activity then offers a methodology with 15 elements for faculty to use when designing an activity. The Activity Design Criteria offers 22 activity design elements with supporting criteria for measuring the effectiveness of each element.

Plan

Read through the resources, discuss with your team, and then together answer the Critical Thinking Questions.

Critical Thinking Questions

1. Which of the steps in the methodology support each of the respective phases of implement

2. What are outcomes should you expect if a **Why** statement is oblique, unclear, overstated, or irrelevant to students?

3. How do the 15 elements in the design process correlate with the 22 design elements (with criteria)?

4. What value, if any, do you believe is gained by including the 7 additional elements in the design criteria?

Validation: Reflection on Learning

- 1. Identify three team insights about the importance of quality activity design.
- 2. Clarify the relationship between learner ownership of learning and high-quality activity design.

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Section 11

Phase 1: Preplanning

Phase 1: Preplanning (overview)

Activity: Preplanning of an Activity

Worksheet: Purpose

Worksheet: Title

Worksheet: Type

Worksheet: Learning Model/Instrument

Faculty Guidebook: 2.4.16 Methodology for Creating Methodologies

Faculty Guidebook: 2.4.3 Development and Use of an Expert Profile

In Process Education™ classrooms the quality and execution of activities are central to the effectiveness of the learning that occurs. The process of designing activities to assure that the desired learning is realized is both significant and complex work. The activity design process has been structured to minimize its' complexity. Each of the nineteen interactive steps occurs in a manner that is coherent and doable by the faculty member. In order to achieve that end, we have divided the process into three phases.

Phase one is the pre-planning phase:

- It is in this phase that the designer determines the focus or purpose of the activity as it relates to which of the learning outcomes of the course are to be achieved.
- The designer identifies a meaningful title to assist the learner in understanding the subject matter to be addressed.
- The designer then determines which of the five forms of knowledge is to be achieved. Is it conceptual knowledge? Is it knowledge that requires understanding a process? Is it knowledge that requires learning to use a tool? Is the knowledge unique to a specific context or multiple contexts? Or, is it knowledge that relates to an individual's way of being?
- There are learning models or instruments that are appropriate for each of the respective forms of knowledge.

Conceptual knowledge is achieved through integrated activities often referred to as process-oriented guided-inquiry learning, POGIL.

Process knowledge is acquired through use of a methodology.

Knowledge in the form of tools comes in multiple forms, but a template is one of the more common forms for facilitating this knowledge growth.

Contextual knowledge is situational and is best learned through use of case studies or stories.

Way of being knowledge is articulated through the development of a profile describing how the individual possessing a given way of being behaves, what the individual believes, and how others perceive the individual.

This reflective phase is essential for the next phase to successfully occur. However, it is a phase that often seems so automatic that it may not get the attention needed. It is important to assure that this stage is carefully completed as it directly affects the quality of the completed activity.



Preplanning of an Activity

Learning Skills

strategizing, validating completeness

Why?

Prior to designing an activity as part of a lesson plan, it is helpful to have a template for the process of such a design. Activity design begins with the following processes: identification of focus (purpose), giving a title, determining the direction in which headed (knowledge form), and production of the appropriate learning model. The cornerstone of every activity is the learning model used, i.e., *concept = concept model*; *process = methodology*; *tool = template*; *context = story/case study*; and *way of being = profile*. As an educator, you will be able to better connect with the learner when providing the appropriate learning model associated for learning a specific type of knowledge.

Learning Objectives

- 1. Determine what knowledge form to use for the intended activity.
- 2. Identify a title consistent with the form of knowledge.
- 3. Develop the fundamental knowledge and skills to determine the appropriate model type to match the knowledge form.
 - a. Concept Model
 - b. Methodology
 - c. Template
 - d. Case study/story
 - e. Profile

Performance Criteria

- 1. Ability to construct the appropriate learning model for the decided upon knowledge form.
 - a. Effective
 - b. Engaging
 - c. Minimal complexity
- 2. Demonstrate ability to select the focus of the activity and title that clearly reflect the learning desired.
 - a. Matches the progression of level of learning desired.
 - b. Title is appropriate for knowledge form.

Part 1: Building a Concept Model

Critical Thinking Questions

- 1. What are the important components of the concept?
- 2. What needs to be visualized?
- 3. What is the prerequisite knowledge upon which this concept is built?
- 4. What knowledge item is similar or related to the concept being modeled?
- 5. What are the boundary issues related to the concept?
- 6. What context is useful for placement of this concept?

Part 2: Constructing a Methodology for Process Knowledge Form

Utilize the information in the reading **2.4.3 Methodology for Creating Methodologies** (located at the end of the current tab of your handbook).

Critical Thinking Questions

- 1. Why are the starting and ending points significant?
- 2. Why is step 3—seeing the bigger picture—important?
- 3. When modeling the process how do you use Step 2, issues in defining key steps?
- 4. Why is it important to do step 7 correctly after you draft the first pass of the methodology?
- 5. How do you use step 4 to improve the design process?

For the following three learning model types there are currently no methodologies presented for developing these learning models. However, the following are guiding questions to assist, if you choose one of these types to design.

Part 3: Designing a Template for a Tool Form of Knowledge Critical Thinking Questions

Cr	itical Thinking Questions
1.	What are the tool's most important features?
2.	What are the tool's most important functions?
3.	What is the best simplification for presentation of the tool to highlight the key functions and features?
4.	What should be captured in the demonstration illustrating the tool usage?
art	4: Crafting a Case Study/Story for a Context Form of Knowledge
	4: Crafting a Case Study/Story for a Context Form of Knowledge itical Thinking Questions
Cr	
Cr 1.	itical Thinking Questions
1. 2.	itical Thinking Questions What characteristics make this context unique?
1. 2.	itical Thinking Questions What characteristics make this context unique? Where is the true meaning in the story?

Part 5: Designing a Profile for a Way of Being Form of Knowledge Critical Thinking Questions

1.	What qualities are associated with that way of being in a professional in a given discipline?
2.	Should there be any overlap in the behaviors?
3.	How many behaviors do you put into a profile?
4.	How do you analyze a quality?
5.	What are the important criteria for a professional behavior?

PURPOSE

Identify the Purpose of the activity:

Crite	eria
	Supports performance criteria of course
	Facilitates learner performance on specific course performance measures
	Designed to support changing long term behaviors
	Connected to one of course's learning outcomes
	Supports development of course themes

		_	

Determine a title:

Title		
	Concise	Motivating and inspirational
	Descriptive	Honest
	Accurate	Does not use same word to define a word

TYPE

Determine the type focused upon concept, process, tool, context, or way of being:

Type of knowledge item			
	Concept		
	Process		
	Tool		
	Context		
	Way of being		

LEARNING MODEL / INSTRUMENT

Create the Learning	Model / Instrument	for the Knowledge Item
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Methodology (Process), Profile (Way of Being), Story/Case Study (Context), Template (Tool), Concept Model (Concept)

Produce learning model/instrument that is to be developed to correspond with activity type			
	Concept = concept model		
	Process = methodology		
	Tool = template or software application		
	Context = case study/story		
	Way of being = profile		



2.4.16 Methodology for Creating Methodologies

Peter Smith (Mathematics & Computer Science, St. Mary's College, Emeritus) and Daniel K. Apple (President and Founder, Pacific Crest)

Curriculum designers frequently must construct methodologies that facilitate the learning of processes. This module, a companion to **2.3.7** *Learning Processes through the Use of Methodologies*, provides a step-by-step procedure for constructing methodologies. It explains in detail the importance of each step, it offers a detailed example of a methodology, and identifies obstacles to the successful application of the procedure. This module pays careful attention to the underlying theory and benefits of using such a methodology to convince skeptics who question the need for a methodology to create methodologies.

Introduction

A methodology, or multi-step model for performing a complex process, can be a powerful teaching and learning tool (Cleary & Duncan, 1997). Proven methodologies for common classroom processes can be found in widely-used educational references (Dick, Carey, & Carey. 2004; McKeachie & Svinicki, 2006) and in other modules in this book (2.3.8 Learning Process Methodology, 3.2.3 Facilitation Methodology, 4.1.4 Assessment Methodology, 1.4.7 Evaluation Methodology, 2.4.6 Methodology for Program Design, and 2.4.8 Methodology for Course Design). However, faculty members often need to construct course-specific methodologies that are unique to their discipline.

Need for this Methodology

It is a complex process to create a methodology, but the process can be made easier by formalizing its steps. The methodology for creating methodologies is intended to help curriculum designers create more effective tools for learning (Wiggins & McTighe, 2005) and to strengthen institutional memory (Senge, Cambron-McCabe, Lucas, Smith, Dutton, & Kleiner, 2000). Any methodology should be comprehensive enough to cover the full range of performances for a process, and should stimulate reflective thought about the performance (Schön, 1990). Table 1 gives a general-purpose methodology to help educators create new methodologies for their courses. Users will benefit from following it closely in the beginning and then internalizing some of the steps with repeated use.

Table 1 Methodology for Creating Methodologies

Step	Description		
1. Define the direction.	Specify objectives for the process and identify who benefits from it		
2. Identify key issues.	Identify key performance factors that affect the quality of the process		
3. Put the process into context.	Obtain a systematic overview to determine the scope, focus, and use of the process		
4. Set criteria.	Set criteria and determine outcomes that will be used to assess the quality of the process and its results		
5. Inventory information & resources.	Collect expertise in the use of the target process, including quality, quantity, timeliness, and the cost of relevant information		
6. Logically order process.	Organize the process into steps; include implicit feedback loops		
7. Execute the methodology.	Test the methodology, using it as a guide, not as a rule book		
8. Assess each step.	Collect data and measure performance in "real time" to improve future performance		
9. Facilitate the process.	Use facilitation, assessment, and management skills to help participants learn the process		
10. Assess performance.	Determine necessary changes in the methodology by analyzing the differences between the desired and actual outcomes		

Discussion of the Methodology

Step 1—Define the direction.

Before you begin to construct a methodology, set the scope of the process by establishing its starting and ending points. Identify the purpose and objectives of the process as well as who benefits from it. As you construct the methodology, keep in mind the audience and objectives so that the completed methodology remains true to the context in which the process is practiced and experienced.

Step 2—Identify key issues.

This is one of the most important steps in the methodology and the one most often overlooked. Take time to identify 7-10 key issues or performance factors that affect the quality of the process. As you contrast expert performers with novices, what major differences do you see? Ask yourself what is difficult in the process. What does a quality performance entail? What factors hinder the quality of a performance? Be sure to focus on affective as well as cognitive and social issues. Take on the perspectives of different stakeholders in the process.

Step 3—Put the process into context.

Next identify a larger system in which the process is a component. The context is critical because the use of the process is greatly impacted by the culture, values, and systems in which the process will be performed. As you create the methodology, you may need to expand or contract the context, but it is important at this point to determine the scope, limits, and focus of the process. Often a review of key issues and process objectives will help identify an appropriate context.

Step 4—Set criteria.

In order to assess the quality of a performance achieved by following the methodology, you will need to set criteria for the process and for its results. Criteria serve as a guiding force as well as a means of focus; they help ensure that the desired outcomes have been met. Identifying five criteria for both process and product will enhance the design of the constructed methodology.

Step 5—Inventory information and resources.

Before continuing, it is important to review the quality, quantity, timeliness, and cost of relevant information. If essential information needed to address the key process issues is missing or is of poor quality, take time to correct this problem now. An expert in the use of the process is a great resource. If the person who is creating the methodology is not an expert, it is especially important to consult someone who is.

Step 6—Logically order the process.

Now organize the process into a methodology by logically ordering the steps, adding feedback loops if necessary. First, break the process down into stages. Within each stage, determine the key things that must be done and how they can be sequenced most effectively. At each step, ask whether there are gaps in the methodology. Is every step valuable to the whole and thus worth highlighting? The goal is to have the minimum number of steps while at the same time keeping each step manageable. It can be very helpful at this point to observe an expert performing the process.

A key thing to remember in the event of a feedback loop is not to repeat steps: simply note that an earlier step might need to be repeated. If more than a dozen steps seem necessary, try to reduce the number. Ask an expert whether some may be omitted or combined without disrupting the flow. If the process is too complex for a single methodology, it may need to be broken down into component processes. For examples of stages in a process, see 2.3.8 Learning Process Methodology or look at the example of a process for critiquing student papers which immediately follows this discussion.

Step 7—Execute the methodology.

As you create a methodology, it is important to assume the mindset of a person performing the methodology for the first time. Execute the process using the methodology as a guide. Pay attention to any confusion that a first-time user may experience in performing each step and ask how the step might be rewritten to make it clearer. Be especially alert for missing or extraneous steps. Once you are satisfied, ask both an expert and a novice to test the methodology. Carefully document their performance at each step.

Step 8—Assess each step.

Once the methodology is deemed sound and it achieves the objectives identified in Step 1, it is time to collect the data observed in Step 7, and use the criteria from Step 4 to measure performance in "real time." The goal here is to improve the quality of the methodology as seen both in the effectiveness of following the methodology and in the product that results. Repeat Steps 7 and 8 until you are satisfied that the methodology meets expectations.

Step 9—Facilitate the process.

Test the effectiveness of the methodology by choosing a context in which to facilitate it (i.e., a class of students, a group of colleagues, a workplace setting, etc.). Use facilitation, assessment, and management skills to help

participants use the methodology to learn the process (2.3.7 Learning Processes through the Use of Methodologies). Collect data from this experience. Be sure to ask the participants to assess every step while the activity is being facilitated.

Step 10—Assess performance.

Use the performances and assessment data collected in Step 9 to determine what improvements should be made to the methodology; analyze the differences between desired and actual outcomes. Every time a change is made, repeat Steps 7-9. When participants use a methodology in a real-life context, they often have trouble understanding steps that seem clear to experts. Pay careful attention to any rewording suggested by participants.

Example of the Methodology

The context for this example is a classroom activity in which students learn how to critique a paper. This example was constructed from insights given by Bean (1996) as well as from input from writing instructors at a Pacific Crest workshop.

Step 1 Define the direction.

Starting with a given paper, produce a high-quality constructive assessment of the paper; include the feedback stage to improve current and future papers.

Step 2 Identify key issues.

The following issues are key in producing a high-quality constructive assessment of a paper:

Affective issues	Cognitive issues	Social issues
honesty	quality of reading	clear articulation of ideas
confidence in	quality of thinking	
expressing ideas	understanding	willingness to help others
focus	criteria	
	use of criteria	

Step 3 Put into context.

The context for the process (critiquing a paper) is a college writing classroom.

Step 4 Set criteria for the process and for the product.

Process	Product
is quick (less than 30 min.)	is comprehensive
produces high-quality feedback	written comments are specific
uses the established criteria	written comments are pertinent to key issues
is assessee-oriented	it offers interactive feedback
motivates the assessor	valuable feedback that motivates the assessee

Step 5 Inventory information and resources.

Seek the advice and help of writing experts. Locate resources related to writing papers.

Step 6 Logically order process.

The following steps were developed based on the work done in the previous steps of the methodology. They fall into three stages: preparation (1-4), assessment (5-9), and reporting (10-11).

Methodology for Critiquing a Paper

- Inventory the criteria and feedback mechanism to be used.
- 2. Decide whether it is to be a collaborative or individual assignment.
- 3. Allocate the amount of time for the assessment.
- 4. Read the paper and record observations.
- 5. List several observable strengths in the paper based upon the criteria.
- 6. List several observable areas for improvement in the paper based on the criteria.
- 7. Select the top four strengths and explain why they are strengths.
- 8. Select the top four areas of improvement and explain how to make these improvements.
- 9. Determine the three most meaningful insights gained and answer the question "So what?"
- 10. Articulate your assessment clearly and interactively to allow the writer to ask questions.
- 11. Ask the writer to assess the critique, or ask an expert or others who will critique it.

Step 7 Execute the methodology.

Work through the methodology with a few student volunteers using a representative sample of student papers.

Step 8 Assess each step.

Make sure each step of the process is placed in its proper sequence and is designed to handle anticipated complexities. Be alert for missing or superfluous steps. Adjust the methodology accordingly. Check that both the process of critiquing a paper and the critique itself meet the criteria listed in Step 4.

Step 9 Facilitate the process.

Design an activity to help students learn how to use the methodology for critiquing a paper and facilitate this activity with a class of students. After they use the methodology have them assess it.

Step 10 Assess performance.

Have the students assess their performance when they follow the methodology; also assess it yourself. Analyze the differences between the desired and actual outcomes. If necessary, adjust the methodology to improve performance.

Obstacles to Successfully Creating a Methodology

Although the methodology for creating methodologies given here has proved successful for creating methodologies, it is not unusual for one or more of the following obstacles to arise.

- 1. A Lack of belief in the utility of a methodology. This common obstacle can be countered by reminding the skeptic that a methodology accomplishes four objectives: it forces the creator to analyze the process; it provides a clear procedure for assessing the process; it allows an expert who models the process to be better understood; and finally it provides a basis for shared understanding of the purpose, scope, results, and quality of the process.
- 2. Lack of patience with setting up the process. People always want to skip the planning stage and start doing. In the case of this methodology to create methodologies, people tend to want to jump to Step 6 immediately. The quality of a methodology so created, however, will suffer. A methodology will only be as good as the quality of the setup steps allows. Without objectives, key issues, context, and criteria, it is impossible to assess the quality of a methodology. On the other hand, remember that a methodology should be viewed as a guide, not a rule book. Experts do not

- need methodologies to perform familiar processes until they must help someone else gain similar expertise.
- 3. Losing the knowledge and documentation of the underlying rationale for the methodology. Even when people carefully follow the methodology for creating methodologies, they rarely save the setup process in institutional memory by documenting it. Without this documentation, it becomes more difficult to improve methodologies when their underlying processes change, or to teach the process of creating methodologies to new curriculum designers.

Concluding Thoughts

This module introduces a methodology for creating methodologies, a tool that could be called the "mother of all methodologies." Though it is challenging to use this methodology, it is absolutely essential to do if one wants to support the effective and efficient acquisition of procedural knowledge within a learning community. The first time one creates a methodology, it is helpful to work through the steps described here with an experienced mentor. After new methodologies are created, it is helpful to keep documentation on each of the ten steps. Analyzing the documentation produced in each step can be a rich source of discussion among faculty and students who use the methodology.

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2.4.3 Development and Use of an Expert Profile

by Denny Davis (Bioengineering, Washington State University) and Steven W. Beyerlein (Mechanical Engineering, University of Idaho)

An expert profile gives a concise, vivid synthesis of behaviors demonstrated by experts in a particular field. Expert profiles should be meaningful to a general audience as well as to professional practitioners, providing a basis for understanding the special characteristics exemplified by experts in the field. Expert profiles can serve as guides for career planning, professional development, and program design. This module summarizes the features of an expert profile, it outlines a process for creating an expert profile, and it explains how profiles can be used to advantage by various stakeholders.

Need for Expert Profiles

Performance expectations within the professions (i.e., medicine, law, engineering, and education) often take the form of job announcements, codes of ethics, lists of desired attributes, and performance evaluations. Students seek information to help them match their skills and interests with the realities and opportunities of professional practice. Employers publish minimum requirements for new hires and performance rubrics for employees. Educators use syllabi to summarize important knowledge and skills developed in their courses and to align these with aspects of professional practice. Professional societies define standards and guidelines for accrediting programs and licensing members. Each of these descriptions tends to be customized to specific contexts and usually does not extend to the highest possible level of professional performance.

Multiple stakeholders can benefit from expert profiles that communicate the blend of explicit and tacit knowledge, intelligence, creativity, and wisdom that defines expert performance in a particular profession (Sternberg, 2003). As such, an expert profile paints a picture not only of the content and tools of the profession, but also the "artistry" of the profession: in problem framing, in implementation, and in improvisation (Schön, 1990). Students can use these profiles to form accurate perceptions, dispel misconceptions, and generate motivation to pursue a field of study (Rosser, 2000). Departmental faculty can use these profiles to clarify critical practices within their discipline and to articulate linkages to other disciplines (Wiggins & McTighe, 2005). Employers can refer to profiles to communicate workplace expectations for graduates as well as areas for ongoing professional development (SCANS, 1991). Program evaluators can reference these profiles when they establish outcomes-centered evaluation criteria intended to perpetuate professional practice (Sanders, 1994). The specifications and methodology for profile development given in this module are intended to produce a product that meets the needs of all these stakeholders.

Method for Development

The steps shown in Table 1 provide a road map for creating an expert profile. To capture the diversity and richness of the entire profession, it is important to involve participants with different training, experiences, and perspectives. Steps 1-5 describe preparations for a productive focus group session. Steps 6-8 refer to focus group activity appropriate for a lively two to four-hour session with faculty, practitioners, and/or advisory board members.

Table 1 **Method for Developing an Expert Profile**

- Inventory codes of conduct, employee/member profiles, and competency targets used by companies and professional organizations.
- 2. Isolate those qualities associated with the profession/ discipline of interest.
- 3. Identify major performance areas for grouping behaviors/ characteristics.
- 4. Write a holistic description for each performance area in the form of a role.
- 5. Craft, sort, combine, and refine statements about behaviors/characteristics under each role.
- 6. Remedy obvious gaps with new statements.
- 7. Assemble a diverse focus group intimate with the profession/discipline.
- 8. Rank statements based on importance, suggesting reorganization and additions, and elevating statements to reflect expert activity.
- 9. Assess the profile with respect to the following criteria.
 - **Comprehensive** statements address all key areas important to the profession or discipline.
 - **Concise** statements provide a snapshot of key behaviors/characteristics.
 - **Distinct** statements do not overlap.
 - **Organized** statements are ordered or grouped for deeper meaning.
 - **Action-Oriented** statements identify observable actions.
 - **Compelling** statements inspire development and respect.
- 10. Iterate between Step 6 and Step 8 with different forums that represent the breadth of a profession/discipline until the profile is stable.

Table 2

Roles and Holistic Behaviors of an Engineer

Technical Roles	Holistic Technical Behaviors		
Analyst	When conducting engineering analysis, the engineer adeptly applies principles and tools of mathematics and science to develop understanding, explore possibilities, and produce credible conclusions.		
Problem Solver	When facing an engineering problem, the engineer produces solutions that properly address critical issues and assumptions that are conceptually and contextually valid.		
Designer	When facing an engineering design challenge, the engineer develops designs that satisfy stakeholder needs while complying with important implementation, societal, and other constraints.		
Researcher	When conducting applied research, the engineer designs and conducts studies that yield defensible results and answer important applicable research questions.		
Interpersonal Roles	Holistic Interpersonal Behaviors		
Communicator	When exchanging information with others, the engineer prepares, delivers, and receives messages that achieve desired outcomes.		
Collaborator	When working with others in joint efforts, the engineer supports a diverse, capable team and contributes toward the achievement of its collective and individual goals.		
Leader	When providing needed leadership, the engineer promotes a shared vision to individuals, teams, and organizations and empowers them to achieve their individual and collective goals.		
Professional Roles	Holistic Professional Behaviors		
Self-Grower	Motivated for lifelong success, the engineer plans, self-assesses, and achieves necessary personal growth in knowledge, skills, and attitudes.		
Achiever	When given an assignment, the engineer demonstrates initiative, focus, and flexibility to deliver quality results in a timely manner.		
Practitioner	Driven by personal and professional values, the engineer demonstrates integrity and responsibility in engineering practice and contributes engineering perspectives in addressing societal issues.		

Table 3

Behavior-Based Profile of an Engineer

Role	Behaviors or Observable Actions			
Analyst	 a. Searches strategically to identify all conditions, phenomena, and assumptions influencing the situation b. Identifies applicable governing principles of mathematics, natural sciences, and engineering sciences c. Selects analysis tools consistent with governing principles, desired results, assumptions, and efficiency d. Produces and validates results through skillful use of contemporary engineering tools and models e. Extracts desired understanding and conclusions consistent with objectives and limitations of the analysis 			
Problem Solver	 a. Examines the problem setting to understand critical issues, assumptions, limitations, and solution requirements b. Considers all relevant perspectives, solution models, and alternative solution paths c. Selects models for obtaining solutions consistent with problem type, assumptions, and solution quality d. Uses selected models, methods, and data to produce a desired solution e. Validates results, interprets and extends the solution for wider application 			

Role	Behaviors or Observable Actions					
Designer	 a. Searches widely to determine stakeholder needs, existing solutions, and constraints on solutions b. Formulates clear design goals, solution specifications (including cost, performance, manufacturability, sustainability, social impact), and constraints that must be satisfied to yield a valuable design solution c. Thinks independently, cooperatively, and creatively to identify relevant existing ideas and to generate original solution ideas d. Synthesizes, evaluates, and defends alternatives that efficiently result in products (components, systems, processes, or plans) that satisfy established design criteria and constraints to meet stakeholder needs e. Reviews and refines design processes for improved efficiency and product (solution) quality 					
Researcher	a. Formulates research questions that identify relevant hypotheses or other new knowledge sought b. Plans experiments or other data-gathering strategies to address questions posed and to control error c. Conducts experiments or other procedures carefully to obtain reliable data for answering questions d. Uses accepted data analysis procedures to infer trends, parameters, and data errors e. Interprets and validates results to offer answers to posed questions and to make useful applications					
a. Listens, observes, and questions to assess the audience background and information needs b. Documents and mines available information and differing perspectives for understanding and applica c. Prepares a message with the content, organization, format, and quality fitting the audience and purpor d. Delivers a message that achieves desired outcomes efficiently in a timely, credible, and engaging was e. Assesses the communication process and responds in real time to improve its effectiveness						
Collaborator	 a. Respects individuals with diverse backgrounds, perspectives, and skills important to the effort b. Values roles, accepts role assignments, and supports others in their roles c. Contributes to the development of consensus goals and procedures for effective cooperation d. Resolves conflicts to promote enhanced buy-in, creativity, trust, and enjoyment by all e. Contributes to and accepts feedback and change that supports continuous improvement 					
Leader	 a. Facilitates and articulates a shared vision valued by targeted individuals, groups, or organizations b. Motivates others to action by crafting a compelling yet credible case for achieving individual and organizational goals c. Provides authority and resources and removes barriers to others' success d. Supports risk-taking and growth by creating trust, providing counsel, and by modeling desired attributes e. Encourages achievement by recognizing and rewarding individual and group successes 					
Self-Grower	a. Takes ownership for one's own personal and professional status and growth b. Defines personal and professional goals that support lifelong productivity and satisfaction c. Regularly self-assesses personal growth and challenges to achieving personal goals d. Undergoes the personal development necessary to reach personal goals e. Seeks out mentors to support and challenge future growth and development					
Achiever	a. Accepts responsibility and takes ownership in assignments b. Maintains focus to complete tasks on time amidst multiple demands c. Takes appropriate actions and risks to overcome obstacles and achieve objectives d. Monitors and adapts to changing conditions to ensure success e. Seeks help when the challenge exceeds one's current capability given the time constraints					
Practitioner	 a. Displays integrity, consistency, and an ethical and professional demeanor in engineering practice and relationships b. Embraces and employs appropriate professional codes, standards, and regulations c. Engages with engineering professionals and organizations to support excellence in engineering practice d. Demonstrates citizenship through service to society on local, national and/or global scales e. Brings responsible engineering perspectives to global and societal issues 					

Engineering Example

The Transferable Integrated Design Engineering Education (TIDEE) consortium has produced several iterations of expert profiles for engineering (Davis, Beyerlein, & Davis, 2005). The latest TIDEE profile is built around a collection of technical, interpersonal, and personal behaviors defined in Table 2. Each behavior is introduced in terms of a role that supports the field. Common performances within each role are cited in the expert profile shown in Table 3. Each performance begins with an action verb and gives evidence of underlying knowledge, skills, and attitudes.

Ideas for Implementation

Expert profiles can be used to prompt discussion and analysis of a profession/discipline in a variety of settings. They can be used to introduce the profession/discipline in a freshman seminar. Inquiry questions for this audience include:

What elements of this profession/discipline do you find most attractive? Why?

What elements of this profession/discipline do you find most surprising? Why?

What are the top three questions you would like to ask professionals in this area about their choice of career? What would you hope to learn through each question?

Expert profiles can be used to obtain mindshare between faculty and industry representatives on key knowledge, skills, and attitudes that are developed within a program. Inquiry questions for this audience include:

How well does this profile represent the highest level of professional performance in your organization?

In what areas of the expert profile are graduates from this program best prepared? Why is this valuable and how does this occur?

In what areas of the expert profile are graduates from this program least prepared? What, if anything, should be done about this?

Expert profiles can complement course syllabi and can help learners process learning outcomes for a course. Inquiry questions for this audience include:

What aspects of the expert profile relate most closely to this course? Why are these emphasized and what might be the long-term implications for your career?

What is your background in each of the emphasized skill areas? What actions should you need to take to be better prepared for this course?

What types of evidence will be produced in this course so that your professional knowledge, skills, and attitudes will be further developed? What challenges might you experience in achieving this growth? Expert profiles can be used to reflect on personal/professional growth that has occurred over a semester. Inquiry questions for this audience include:

In what aspects of the expert profile did you experience the greatest change? What evidence can you provide for the reasons that underlie these changes?

In what aspects of the expert profile do you have the greatest opportunity to grow? Why would this be valuable? What conditions need to exist for this growth to occur?

What new insights about the profession/discipline have you developed? What implications do these have for your future career path?

Concluding Thoughts

No matter what stage of development an individual is in, expert profiles raise the bar on one's performance. They inspire novices to accept the challenge of purposefully elevating personal skills. They help teachers prioritize, communicate, and facilitate learning outcomes that are aligned with long-term behaviors within the profession/ discipline. They remind even the most talented professionals that there are multiple dimensions of professional practice and that ongoing personal development in all dimensions is needed to stay abreast of new knowledge. technology, and ever increasing societal challenges. Expert profiles, therefore, can be a unifying force in a community of practice, encouraging all members (learners, teachers, and practitioners) to engage in dialogue about their profession/discipline and to walk the talk of continuous self-improvement toward a common ideal.

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Section 12

Phase 2: Designing the Core Activity Elements

Phase 2: Design Core Elements (overview)

Worksheet: Why?

Worksheet: Learning Objectives

Definition and Information: Performance Criteria

Worksheet: Performance Criteria

Worksheet: Learning Skills

Worksheets: Critical Thinking Questions

Faculty Guidebook: 2.4.15 Writing Critical Thinking Questions

Phase 2: Design Core Elements

This is the critical phase for consideration of those elements that are basic to any activity.

- It begins with the "why" statement intended to assist the learner in understanding the reasons that this activity is important in relationship to the rest of their learning in a course.
- This is followed by the learning objectives so that learners understand the "what" of their learning. Learning objectives are much easier to write if the learning outcomes for the course have been well established within the course design. Multiple activities with their specific learning objectives are generally needed in order to achieve a single learning outcome for a course.
- Performance criteria follow and tell the learner what will be measured as they proceed through the activity as evidence of success in accomplishing the learning objectives. The performance criteria identified for the course serve as a primary source in writing those stated for the activity. Like learning objectives, this element is a subset of that found at the course level.
- Learning skills are the next to be stated, are drawn from the list of skills that appear within the classification of learning skills for the course, and serve to make explicit to the learner the skills that are being developed.
- Critical thinking questions make up the final core element and are essential for guiding the learner's thinking. They progress through three types.
 - o Directed questions have specific answers and build a foundation for more complex questions.
 - o Convergent questions require learners to make connections and develop an understanding of concepts inherent within the activity.
 - o Divergent questions lack a single correct answer and instead serve to guide the learner to think beyond the existing activity to new applications and possibilities. These questions help them to expand their current knowledge level.

Phase 2: Design Core Elements

WHY?

Develop a "Why?" statement.

This section should put the activity in context for the learner by addressing three questions: What will the student learn? Why is it relevant to the subject? Why is it relevant to the learner? The first sentence clarifies the title and further defines the content of the activity. The second sentence defines the general importance of the activity and describes how it fits into the course. The third sentence provides justification for the activity from the perspective of the individual learner.

Why	Statement	
	Short, to the point	Three to four sentences in length
	Understandable	1st sentence describes "what"
	Does not overstate	2 nd sentence describes relevance to big picture
	Personally relevant	3 rd sentence describes relevance to student
	Relevant to course	

Phase 2: Design Core Elements

Learning Objectives

Establish learning objectives for the activity which are matched to learning outcomes for the course

A learning objective identifies what is to be learned or understood as a result of completing the activity. An activity should have two or three objectives: activities with only a single objective may not be very interesting to the learner while those with many objectives may be too formidable. Objectives should be orthogonal, i.e., not overlapping, and should relate to the "Why" statement. Compound objectives need to be separated. The objectives should be written in a clear, concise style that is easy for students to understand, so both students and faculty know when they are achieved. The most important objectives should be listed first and the least important last. Finally, objectives should include learning process skills, not just mastery of content.

Learning Objectives			
	Appropriate kind (competency, move mance)	ement	, accomplishment, experience, integrated perfor-
	Obtainable		Student-oriented
	Specific, clear		Road map for what's ahead
	2-3 in number		Realistic within constraints and resources
	Relevant to course		

Performance Criteria

Areas of performance, clearly and explicitly defined, which allow all involved (performer, assessor, evaluator, etc.) to have a mutually understood set of expectations by which performance may be measured, assessed, and/or evaluated. Performance criteria provide simple-to-understand, realistic, and measurable values of excellence.

For both faculty and students, performance criteria serve as a contract, translating implicit expectations into explicit statements about what levels of effort and achievement are expected and what types of performance will be valued and recognized.

It is important to recognize that performance criteria are applicable for all developmental roles, from program-level (Institutional Development) to course-level (Professional Development) to activity-level (Learner and Intellectual Development). It is critical, therefore, that the performance criteria for an activity support the broader course-level performance criteria.

Some important characteristics:

- Performance criteria are meant to provide a mental image of what best practices look like in a specific role or group charter.
- Not all performance criteria are applicable to every situation, individual performer, or group of performers, and should be modified to be applicable to individual performances. Performance criteria are works-in-progress and should be recognized as such. Although sufficient time should be allocated to creating the criteria, it is reasonable to expect these criteria to evolve through regular use.
- Performance criteria support an assessment philosophy.

Methodology for Developing Performance Criteria for Individuals and Groups

- 1. Brainstorm to get a list of areas of quality that can be observed within the expected performance.
- 2. Minimize redundancy and overlap among the areas of quality.
- 3. Select and describe critical attributes of quality that most contribute to the desired performance.
- 4. Articulate connections among attributes within each area of quality in terms of how they work together to produce the desired outcomes.
- 5. Develop clear statements of performance by synthesizing the relationships among attributes within each area of quality.
- 6. Sequence the statements to form a logical set.
- 7. For each performance criteria, select up to 3 measurable attributes of the performance criteria.

Performance Criteria

Determine the performance criteria

Good success criteria are understandable, measurable, realistic, and relevant to the learning objectives. Generally, an activity should have one or two success criteria. Without any criteria, students can easily lose accountability for their outcomes and the tendency is to coast through the activity with minimal effort. More than two criteria can confound students and cause them to lose their focus. If students know what is expected and how they will be assessed, their accountability and performance level increase dramatically.

Perf	Performance Criteria					
	Emphasizes quality		Measurable			
	1-2 in number		Realistic and obtainable			
	Clear, understandable		Relevant to learning outcomes			
	Includes attributes		Prioritized			
	Describes desired behavior and thought process					

Learning Skills Identify the learning skills needed and enhanced by the activity Cognitive Social Affective Psychomotor

l oar	ning Skills		
Leai	-		
	Aligned to course		Focused number
	Relevant to activity		Integrated
	Opportunity to improve		
		1	77

Critical Thinking Questions: Directed

Write the directed critical thinking questions

Directed questions require that students process and recall information. The answer can be found by examining the model, information, resources, or by drawing on personal experience and prior knowledge. Such questions have a definite answer and build the foundation for more challenging questions. (See 2.4.15 Writing Critical Thinking Questions at the end of this section of your handbook.)

Criti	Critical Thinking Questions – Directed				
	2-3 in number		Builds the foundation		
	Motivational		Requires information, processing		
	Simple and basic		Steers learner to variety of resources		
	Relevant to learning outcomes				

Critical Thinking Questions: Convergent

Write the convergent critical thinking questions

Convergent questions require that students make connections and reach conclusions that are not obvious upon first examination. Convergent questions have answers that are not directly available in the model, information, or resources; they require students to analyze and synthesize; and they may have more than one correct answer. The level of difficulty should progress with the questions, and the questions should drive students to develop and understand the concepts presented in the activity. (See 2.4.15 Writing Critical Thinking Questions at the end of this section of your handbook.)

Critical Thinking Questions – Convergent					
	2-3 in number		Requires student to analyze & synthesize		
	Includes assessment		Allows for more than one correct answer		
	Contextual in nature		Requires making linkages to knowledge		
	Relevant to learning outcomes		Answer is not directly available in reading, lectures, etc.		

Critical Thinking Questions: Divergent

Write the divergent critical thinking questions

Divergent questions send students in different directions. This type of question may have no right or wrong answer, but it requires students to ponder, explore, generalize, and expand upon their current knowledge. Divergent questions require the highest level of thinking and produce outcomes and conclusions that vary among teams and individuals. Divergent questions have no readily available solution, are open-ended, provide significant challenges, do not need to relate directly to the learning objectives, and are beyond the stated success criteria for the activity. They may even launch research ideas. (See 2.4.15 Writing Critical Thinking Questions at the end of this section of your handbook.)

Criti	Critical Thinking Questions – Divergent					
	Open ended		Involves the research process			
	Provides challenges		Adds robustness and excitement			
	Can be used as a "bonus"		No solution readily available			
	No expectation for evaluation		Is beyond the performance criteria			
	Does not need to directly relate to learning objectives					



2.4.15 Writing Critical Thinking Questions

y David Hanson (Chemistry, Stony Brook University)

Much educational research documents that, in order to achieve real understanding and knowledge that persists over time, learners must actively restructure the information they absorb. In this restructuring, the new knowledge must be integrated with prior knowledge, experiences, and beliefs; contradictions must be identified and resolved; and generalizations and implications must be articulated and applied in solving problems. Guided-inquiry activities help students with this restructuring by employing a learning cycle consisting of exploration, concept formation, and application. Critical thinking questions are at the heart of these activities and serve to guide students in the exploration that leads them to inventing or developing an understanding of the relevant concepts (3.3.3 Process-Oriented Guided-Inquiry Learning).

Role of Critical Thinking

Critical thinking has been defined in several ways (2.2.5 Overview of Critical Thinking). Some definitions are synonymous with thinking critically, while others appear to be synonymous with thinking analytically.

In 1962, Robert Ennis defined 12 aspects of critical thinking in terms of assessing statements. In this context, critical thinking involves being challenging and skeptical, i.e. thinking critically: for example, by identifying ambiguities and assumptions, finding contradictions, examining the logic leading to a conclusion, judging whether a statement is overly general, critiquing the application of principles and concepts, deciding whether a definition is adequate, and determining whether a statement made by an alleged authority is relevant or believable (Hoaglund, 1995).

Critical thinking also can be thought of as a process for actively exploring situations by asking relevant questions in order to decide what to believe or what to do. In this context, critical thinking means thinking analytically. "In fact, the ability to ask appropriate and penetrating questions is one of the most powerful thinking tools you possess, although many people do not make full use of it. Active learners explore the learning situations they are involved in with questions that enable them to understand the material or task at hand, and then integrate this new understanding into their knowledge framework. In contrast, passive learners rarely ask questions. Instead, they try to absorb information like sponges, memorizing what is expected and then regurgitating what they memorized on tests and quizzes." (Chaffee, 2004)

Sequencing of Questions

Critical thinking questions are used to explore models in learning activities guide inquiry through multiple levels in Bloom's taxonomy, and help students recognize how such questions aid learning (2.4.14 Designing Process-Oriented Guided-Inquiry Activities). Guided-inquiry activities typically require students to answer 6-10 critical thinking questions, broken down as follows: 2-3 directed questions, followed by 3-6 convergent questions, followed by one diver-

gent question. These are called *Key Questions* because they serve to unlock the knowledge in a guided-inquiry activity for the students (Hanson, 2006).

In a process-oriented classroom, student teams usually work at different rates, and there can be a large variance in the amount of time required to complete an activity. Thoughtful use of critical thinking questions can lessen these differences and make it easier for faculty to manage classroom learning. *Directed questions* are placed first because they build a strong foundation and prevent teams from going off on tangents. A *divergent question* is placed at the end as an "equalizer" for faster teams who reach this question well ahead of the others. Some teams will get further into the divergent question than others. It is important to reward or acknowledge the efforts of the faster teams for their additional work, especially if it is of high quality.

Criteria for selecting and sequencing critical thinking questions include:

- **Relevant**: must help students meet performance criteria for activity
- **Growth-Oriented**: must promote growth for learners at multiple levels of development
- **Logical**: must be thoughtfully sequenced from lower- to higher-level questions

Directed Questions

Directed questions focus on Level 1 knowledge (2.2.1 Bloom's Taxonomy—Expanding its Meaning), consisting of information and facts. Directed questions point students to the information they need to start the activity. Such questions often begin with who, what, when, where, and which. The answers can be found by examining the model presented in the activity, using the information resources listed, or by drawing on personal experience and prior knowledge and activities. Such questions have a definite answer and build the foundation for more challenging questions.

Criteria for writing directed questions include:

- **Preparatory**: measure readiness for the learning activity
- **Exploratory**: require the learner to use the resources

needed for the activity (e.g., the model, reading, lectures, and real-life experiences).

- Accessible: motivate learners through initial success
- **Foundational**: deconstruct misconceptions and build infrastructure for future learning

Convergent Questions

Convergent questions build Level 2 knowledge (understanding of concepts) and help students elevate their knowledge to Level 3 (applying knowledge to solve problems) (2.2.2 Elevating Knowledge from Level 1 to Level 3). Convergent questions require students to organize, interpret, analyze, and synthesize. They many have more than one correct answer, and the level of difficulty progresses within a sequence of questions. A good convergent question makes important connections, links concepts together, leads to better understanding, and requires that students reach conclusions.

Criteria for writing convergent questions include:

- Challenging: answers are not directly available in the resources (e.g., in the model, readings, lectures, and reallife experiences)
- Rich: allow for more than one correct answer or approach
- **Integrative**: make links between key information in the resources

Convergent questions emphasize organization and interpretation, and ask students to understand key characteristics of new concepts or steps within a process. Such questions often require analysis, asking students to deconstruct a model to identify its components, describe their relationship, and consider alternatives. Examples include:

- What are the similarities and differences between....?
- What is the effect or consequence of?
- Why is it necessary to....?
- What idea explains....?

Convergent questions also can require synthesis, asking students to combine features in the model, identify the main idea, conclude which idea is better and why, and which idea is supported by the model. Examples include:

- What is the evidence that supports (contradicts)...?
- What trend is shown by....?
- How might x influence...?
- How would you summarize....?

Divergent Questions

Divergent questions send students in new and interesting directions. They may have no right or wrong answer, but require students to ponder, explore, generalize, and expand their current knowledge. Divergent questions require the highest level of thinking and produce outcomes and conclusions that vary among learning teams and individuals. They help identify holes in knowledge and test understanding by challenging the knowledge structure that was built. They can be used to help students confront common misconceptions. Criteria for writing divergent questions include:

- **Difficult**: require the learner to go beyond the performance criteria for the activity
- **Open-ended**: encourage learners to travel down different paths of inquiry
- Validating: motivate learners to test and generalize boundary conditions
- **Deep**: are possible research questions

Divergent questions are points of departure for wider application or debate. Examples include:

- What do you predict would happen if....?
- How can x be used for....?
- What is a situation that illustrates...?
- What would you recommend for....?

Concluding Thoughts

No matter how inspired you might be when you compose critical thinking questions, no matter how pleased with the results, you will benefit from taking time to review, refine, and resequence your questions and have them reviewed by a student and a faculty colleague (2.4.17 Assessing Learning Activities). You should also be aware of the message that the "white space" surrounding each question communicates about your expectations for response. Less space with bullets encourages students to work quickly toward a quantitative goal. More space encourages justification and debate. To the extent that critical thinking questions are an essential part of a learning activity, don't distract students with lots of other information and instructions.

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Section 13

Phase 3: Enhancing an Activity

Phase 3: Enhancing an Activity (overview)

Worksheet: Plan

Worksheet: Pre-Activity

Faculty Guidebook: 3.4.7 Using Reading and Lecture Notes Log to Improve

Learning

Worksheet: Sequencing of Critical Thinking Questions

Faculty Guidebook: 2.2.1 Bloom's Taxonomy—Expanding its Meaning Faculty Guidebook: 2.2.2 Elevating Knowledge from Level 1 to Level 3

Worksheet: Information and Resources

Worksheet: Prior Knowledge Worksheet: Glossary Terms Worksheet: Skill Exercises

Worksheet: Problems

Faculty Guidebook: 2.2.6 Overview of Problem Solving

Worksheet: Technology

Faculty Guidebook: 3.4.1 Overview of Effective Learning Tools

Worksheet: Validation

Faculty Guidebook: 3.3.5 Self-Validation of One's Learning.

Worksheet: Self-Assessment

Worksheet: Closure

The steps within this phase add to the quality of an activity as they are beyond the basic design. When an activity is critical to achieving the learning outcomes for the course, these elements should be considered with most of them being developed.

- The plan for the activity provides a set of numbered tasks to be performed by the learner. When there are multiple steps, this is always helpful.
- Pre-activities identify those things that a learner should do in advance to be prepared to successfully
 engage in and learn from the activity. If prior learning and/or experiences are going to be critical for
 the activity, this is a good step for having the learner ready to begin the activity.
- Sequencing of critical thinking questions is a step that will help the learner progress from the obvious to that which is new knowledge. When there are multiple questions, sequencing also serves to make the logic of the activity more apparent to the learner.
- Information needed for the activity should be considered and readily available to the learner whether it is within the activity template given to the learner or is accessible by way of an identified source.
- Identification of prior knowledge helps the designer to make linkages for learners so that they build upon that which they already know. The learner likely will not see this spelled out as such, but it can be included within the why statement, within the plan, or within the critical thinking questions.
- Glossary terms are important to include if language is being used that is either new or is common language but is being used with some unique meanings for this context.
- Skill exercises serve to reinforce that which has been learned as there is the opportunity to practice application of the new knowledge as it is developing.
- Inclusion of problems requires analysis and application to new situations, thus raising the level of knowledge that requires higher levels of thinking.
- Inclusion of technology wherever possible adds to the accessibility for learners and enhances the activity. We need to be ever vigilant of the extent to which younger learners have routinely been using technology to guide their own learning.
- Validation of learning can be achieved through an additional set of questions that require the learner
 to internalize the ownership of learning. When this is routinely included in activity design, learners
 come to trust that they know what it is that they know.
- Self assessment is critical in helping develop the habit of reflection for purposes of continuing to improve performance and for helping build confidence as strengths are articulated and thus more likely to be repeated. The insights identified have long term effects in enhancing the development of the learner.
- Closure is important to help the learner inventory what has been learned and provides the basis for future learning.

Plan

Describe the plan for execution of the activity

The plan is a numbered list of tasks or steps that detail what is to be done in the activity. A processoriented course is likely to be a new experience for the students, so at the beginning of the course, the plan should be explicit, thorough, and complete. As the course progresses, it should become less structured, providing broad guidance and challenging the students to devise the specifics. After the students have gained experience, the plan may be implicit, or the students can be asked explicitly to develop their own plan in order to achieve the stated objectives and meet the success criteria.

Plan for Execution				
	Inclusive		Provides necessary base of information	
	Comprehensive		Available to all	
	Specific		Identifies required homework	

Pre-Activity

Describe the	pre-activity	for prepara	tion
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(See 3.4.7 Using Reading and Lecture Notes Logs to Improve Learning, directly following this worksheet.)

Pre-activity				
	Language identified		Resources reviewed	
	Readings completed		Readiness assessed	
	Inquiry questions developed			



3.4.7 Using Reading and Lecture Notes Logs to Improve Learning

Ronald Miller (Computer Science, Western Michigan University)

Students who regularly use reading logs and lecture/lab notes logs increase their understanding and retention of course concepts and, at the same time, build their skills in self management, information processing, critical thinking, and assessment. Log forms provide room for taking notes, and they supply probing questions that direct students to reflect on the learning process. Although instructors may need to use a variety of motivating techniques to encourage students to use the logs, the students who use them will develop increased responsibility for their own learning, along with increased accuracy and efficiency in processing new information.

Key Features of Reading Logs

Reading logs may take many forms. They may be found in books like the Learning Assessment Journal (Apple, 2000). They may also be developed by individual instructors for a custom fit in a particular course, such as the Information Technology Self-Assessment Learning Journal (Krumsieg & Miller, 2004). Spiral notebooks in which students respond to prompts given by the instructor are yet another example of reading logs. Figures 1 and 2 show the layout of a general reading log. Figures 3 and 4 show the layout of a course-specific reading log. Whatever the form, however, all effective reading logs address two areas: what the student has learned and how the student has learned it. Reading logs challenge students to analyze their reading strategies, to demonstrate what they have learned from a reading assignment, to assess the quality of what they have read, and to develop an action plan for improving their reading skills.

A reading log should begin with pre-reading questions and activities that prepare students for the reading assignment. These typically include previewing the reading selection to determine topic, length, and general difficulty, compiling a list of questions that the reading is expected to answer, and activating prior knowledge. Logs often ask students to estimate how long it will take to read the assignment so that they can better manage study time, and logs usually provide space for students to identify objectives and performance criteria to help them select the reading strategies most appropriate to their objectives. Only after documenting that they have completed these activities are students ready to read the assignment for the first time.

After the pre-reading section, reading logs provide space for students to take notes as they read for the first time. Usually there is space to record unfamiliar terms and definitions, key ideas or reactions to the reading, and questions arising from the reading. After students complete a second reading, they use the logs to write down the author's main ideas and an explanation of how this new material integrates with their previous knowledge and experience.

Reading logs should include assessment questions related both to the reading selection and to the student as the reader. How accurately did the student estimate reading time? How much of the material can the student understand and remember? How effective were the reading strategies used? How can performance be improved in the future? As students learn more about how they manage the reading challenges that they face in a particular course, they can incorporate into their logs an action plan for targeting their specific reading and study issues.

A reading log addressing all of the above activities and questions for every reading would be too long and cumbersome for students. Instructors, therefore, need to carefully select what they require in a reading log, making sure that they include something to address pre-reading, something that requires student engagement while reading, and something that requires students to assess the results of reading. In each area, the reading log should have at least one question that addresses the content of the reading and one that addresses the student's reading process. Even when reading logs are relatively short, students will complain that the logs are time consuming, and they are. But using reading logs based on sound reading strategies provides benefits in the long run as students understand better, remember more easily, and require less time for review.

Key features of Lecture/Lab Notes Logs

Lecture/lab notes logs, like reading logs, help students know what they have learned and how they have managed the learning process. A sample course-specific lecture/lab note log can be found in Figures 5 and 6. Lecture/lab logs typically begin with a preview section that helps students build the habit of identifying lectures and labs by day and time as well as topic. Logs also provide space to note any reading assignments the students are expected to have completed. Too often students do not understand that their own preparation for a lecture or lab is as important as the preparation of the instructor or lab manager in terms of quality of learning. To emphasize the importance of preparation, note forms should provide space for students to report how well they have prepared for the lecture or lab.

Once the lecture or lab has begun, students jot down main points and copy figures, tables, or drawings either in note logs or in some other place. After the lecture or lab is complete, students should review what they have experienced by summarizing the main points in the note logs and writing down any questions they still have about the day's material. While rewriting their notes in summary form, students learn the material as they conduct a thorough review of their lecture or lab. They also identify new insights or understandings gained from the work of the day and connect that new learning to their prior knowledge and experience, thus increasing the relevance of the new material.

Note forms, like reading logs, include an assessment section that poses questions about how students learn. How can the student change his or her in-class note taking habits to improve learning? How much time did the student need to review his or her notes? How could the student capture this material more efficiently?

The final section in both reading and lecture-note logs should be a challenge to students to improve performance. One effective practice is to have students identify two major factors that influenced their reading or in-class learning effectiveness (positively or negatively) and then use those factors to create action plans for increased effectiveness. Creating action plans will give students practice in personal development skills like preparing and planning individual action, in management skills like evaluating performance and facilitating change, and in assessment skills like assuring completeness and presenting feedback. For help in identifying strategies to improve reading, note-taking, and thinking skills students and instructors can consult a wide selection of materials designed to improve study skills in higher education. Students in the sciences are especially directed to Essential Study Skills for Science Students (2000) by Daniel D. Chiras.

Motivating Students to Use Note Logs

Motivating students to use reading logs and lecture/lab notes logs without creating the image of busy work is the key to student acceptance. Students must be convinced they can improve comprehension significantly by analyzing their reading, listening, and note-taking habits and by applying new or expanded strategies to their readings, lectures, and labs. The list that follows offers suggestions for getting students to appreciate the value of reading and note logs.

- Allow students to use one of each type of log while taking quizzes
- Begin class sessions with discussion of reading logs

- Use class sessions for additional information, rather than repeating the information in the assigned readings
- Use material from the readings and note logs for exam questions
- Make lecture material available only during class sessions
- Use the logs to prepare study guides for exams
- Review logs in office with students who come for help
- Integrate logs into learning projects (3.4.5 Effective Design of Problem-Based Projects)
- Modify the questions on the logs to fit specific course contexts
- Connect the use of logs to course objectives and learning outcomes
- Show students how to use the logs to take responsibility for their own learning

Assessing the Benefits of Using Note Logs

Assessing the students' skill in reading or taking lecture notes and providing feedback to them is ideally done on an individual basis. In small classes, instructors can assess logs early in a term to emphasize learning skills development. Reviewing the logs can also help an instructor assess his or her teaching practices. Using reading and lecture/lab notes logs in large classes, however, is more difficult. The incorporation of reflection and assessment succeeds best in large classes when students are familiar with self-assessment journals (3.4.8 Practical Implementation of Self-Assessment Journals). Students can use the same self-assessment techniques that they use in problembased, self-assessment projects to improve their reading, listening, and note-taking skills.

Students Become Responsible for Their Own Study Guide

While some students may think the reading and lecturenote logs only provide a way of improving their grades on quizzes, their use of the logs causes many students to rethink how they can actually improve their information processing skills (2.2.5 Overview of Critical Thinking). But perhaps a greater benefit of using the logs, from the instructor's point of view, is that they permit the instructor to lay the burden and responsibility of learning directly on each student. For example, instead of the instructor providing study guides for large exams, students develop their own study guides using the logs. Requiring students to prepare their own study guides for quizzes and the comprehensive exams helps them realize the importance of creating complete and accurate notes on their reading and lecture/lab notes logs.

Concluding Thoughts

There are many ways to incorporate the reading and lecture/lab notes logs into a learning environment. Providing proper motivation and reward to students, however, is essential to obtain positive acceptance of a new tools like reading and lecture/lab notes logs. The benefits of getting student acceptance are significant because the logs can, in part, help students take ownership of their learning and successfully accomplish the course outcomes. Other advantages of the logs include growth in language development, critical thinking, and assessment skills, as well as further opportunity for students to apply the Learning Process and Information Processing Methodologies.

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Referenced Figures 1 through 6 appear on the following 6 pages.

Name	Reading Log
Before reading	Outline of Reading including key questions to be answered
My objectives are:	
My performance criteria are:	
Minutes I expect to spend reading:	
First Reading Notes and observations:	
Key Vocabulary	Use each key word in a new context or phrase.

Second Reading

Two additional inqui	ry questions that I have are:	
Summarize		
The most important no	pints of the reading were:	
The most important po	on the reading were.	
Integrate		
The relationship betwe	een the new information and my previous knowledge and experience is:	
Assessment o	f material and effort	
I suggest the author	make the following change(s) to the material or style of writing (explaining varieties)	why):
Actual time (minutes)	spent reading: This compares to my estimated ti	me:
The following affects	ed (positively or negatively) the quality of my reading performance:	
1		
2		
	Strengths:	
Instructor Feedback	Areas for Improvement:	
recuback	Insights:	
		Copyright © 2008 Pacific Crest

A.	Dooding	
Name	Reading L	.og
Lecture/Lab Instructor	Any fact facing us is not as ir	mportant as
Lecture/Lab—Day/Time	our attitude toward it, for that our success or failure.	t determines
Date	—Norman Vincent Peale	
Before Reading	1	Glossary
My learning objectives are:	Term	Definition, term used in context or a phrase
My learning performance criteria are:		
Estimated time to spend reading:		
First Reading Notes		
Preview, observations, and questions:		
(Headings, topic sentences, tables, illustrations)		
		

Second Reading Notes Inquiry questions to clarify my understanding of the material: Summarize Reading The most important points of the reading were: Actual time spent reading:_____ Integrate Knowledge The relationship between this new information and my previous computer knowledge and experience is: Assessment of Learning Performance I suggest the following change(s) in my reading habits to improve my learning performance: My reason for making this suggestion(s) is: The following two factors most affected (positively or negatively) the quality of my reading performance: **Rereading Notes** Significant new understanding of major computer technology concepts:

Name	
Lecture/Lab Instructor	
Lecture/Lab—Day/Time	Th in
Date	_
Before Lecture/Lab Class Reading	
Reading assignment(s):	
I did my reading before class:YesNo	
Lecture/Lab Class Notes (Competencies, overview, terms, meanings and questions))

Lecture/Lab Notes

The desire of knowledge, like the thirst of riches, increases ever with the acquisition of it.

—Laurence Sterne



Slide/IllustrationsFigures, tables, drawings, concept maps

Review/Rewrite Notes Inquiry questions to clarify my understanding of the material: Summarize Notes The most important points of the lecture or lab were: Actual time spent reviewing/rewriting notes: _____ Integrate Knowledge The relationship between this new information and my previous computer knowledge and experience is: Assessment of Learning Performance I suggest the following change(s) in my note-taking habits to improve my learning performance: My reason for making this suggestion(s) is: The following two factors most affected (positively or negatively) the quality of my in-class performance: Reviewing Notes Significant new understanding of major computer technology concepts:

Sequencing

Sequence critical thinking questions

Criteria for sequencing critical thinking questions include:

- Growth-Oriented: must promote growth for learners at multiple levels of development
- Logical: must be thoughtfully sequenced from lower- to higher-level questions

(See 2.2.2 Elevating Knowledge from Level 1 to Level 3 and 2.2.1 Bloom's Taxonomy—Expanding its Meaning, directly following this worksheet.)



2.2.1 Bloom's Taxonomy—Expanding its Meaning

by Paula Bobrowski (Associate Dean for Research and Faculty Development, Auburn University)

This module expands the usefulness of Bloom's taxonomy beyond its original intent of clarifying educational objectives to help faculty prepare better-designed courses, achieve more student-centered implementation, and establish outcomes-oriented evaluation criteria. Bloom's taxonomy is explored from a historical perspective and examined for its applications in Process Education. Pacific Crest's adaptation of Bloom's taxonomy includes five different "levels of learner knowledge." Each of these is defined and illustrated with key words and questions for use in designing curriculum and instructional materials.

A Description of Bloom's Taxonomy and its Significance

Educational objectives indicate what students should attend to and put effort into learning; they are "explicit formulations of the ways in which students are expected to be changed by the educative process" (Bloom, 1956). Bloom's taxonomy provides a well-accepted pedagogical framework for classifying vast numbers of educational objectives into useful structures. Benjamin Bloom's pioneering work on learning was initiated in 1948, when he headed a team of educators and psychologists investigating three major learning domains: cognitive, affective, and psychomotor. Over the last half-century, the theoretical framework produced by this team has facilitated analyses of learning objectives classification, criteria for performance-based learning, and levels of mastery in learning (Simon, 2000).

To the extent that the goal of education is the diffusion of knowledge through learning, a description of Bloom's taxonomy represents a seminal work in developing and implementing high quality instruction. There are six different levels in the cognitive domain of factual and conceptual knowledge progressing from elementary to complex. As demonstrated in Table 1, the levels include knowledge, comprehension, application, analysis, synthesis and evaluation.

Evolution of Bloom's Taxonomy

Over the past 40 years Bloom's work has been translated into more than twenty languages and has provided a basis for test design and curriculum development. Many modern interpretations of Bloom's taxonomy are found in the literature. Recently Anderson and Krathwohl (2001) expanded the single dimension of the original taxonomy into a two-dimensional framework consisting of factual/conceptual knowledge and cognitive processes. High quality educational objectives combine both elements as seen in the following example: "The student will learn to distinguish (cognitive process) among confederate, federal, and unitary systems of government (knowledge)." Apple

Table 1 **Description of Bloom's Taxonomy** of Educational Objectives

Knowledge of terminology, specific facts, ways and means of dealing with specifics, conventions, trends and sequences, classifications and categories, criteria, methodology, abstractions in a field, principles and generalizations, and theoretical structures

Comprehension in translation, interpretation, and extrapolation

Application of concepts in the use of abstraction in particular and in concrete situations

Analysis of elements, relationships, and organizational principles

Synthesis of ideas in the production of unique communications and plans

Evaluation leading to judgments about the value of materials and methods for given purposes

and Krumsieg (2001) clarified some of the definitions found in the original taxonomy by viewing it in terms of transferable knowledge that progresses in complexity through the six levels. The most basic level, using Apple and Krumsieg's labels, involves information (knowledge in Bloom), followed by knowledge (comprehension), knowledge skill (application), problem solution (analysis), new knowledge (synthesis), and finally evaluation (peer-reviewed knowledge). This model of learning has supported the development of a learning process methodology for efficiently and effectively advancing the level of student knowledge (Krumsieg & Baehr, 2000).

There is also extensive educational research aimed at moving beyond the cognitive domain in formal education by focusing more attention on the affective and psychomotor domains (Shank 1994; Tinto, 1994; Bobrowski & Molinari, 1992). Although this is not the focus of this module, it is important to be aware of these developments. Tinto (1993) and Shank (1994) have published significant works in this

area, arguing that academics must change the way teaching is performed, by paying special attention to the intrapersonal and interpersonal contexts of learning. Tinto examined learning communities in depth, while Shank promotes the perspective that the only way learning occurs is "by doing."

Levels of Learner Knowledge

Bloom's taxonomy has been adapted and transformed by Apple and Krumsieg (2001). According to their Learning Process Methodology, five levels of learner knowledge are observable in college classrooms. These are defined in Table 2 and represent increasing complexity in the way students formulate, connect, and present their thoughts. Information acquisition occupies the lowest level and is typified by memorization of information. Conceptual understanding represents the next higher level and is the result of combining information elements to achieve understanding and meaning. Application is the ability to apply knowledge in a new context. Working expertise is the ability to understand the logical constructs and apply knowledge without expert prompting. Research is the goal of graduate study and is the ability to create novel discoveries from basic elements and logical constructs. The "evaluation level" in Bloom is considered separately as part of assessment, which can take place at any level.

Brookfield (1987) argues that learning is promoted by asking questions that challenge students' understanding at the appropriate level. Good questions can also stimulate students' curiosity and allow the teacher to probe current understanding as well as assess the effectiveness of past instructional activities (Eggen & Kauchak, 1988). Inquiry as a learning method requires active participation both by the students and teachers. For this reason, Table 2 integrates Barton's (1997) hierarchy of critical thinking questions with the levels of learner knowledge. The combination of these two concepts creates a useful tool for teachers to use in classroom applications. It provides key words and questions that are appropriate to ask students at each level of learning and demonstrates the link with Bloom's taxonomy of educational objectives.

Classroom Application

Questions and key words in Table 2 can be used to set performance criteria for learning activities, to verify prerequisite knowledge, and to measure achievement against learning outcomes. Prompts in this table also provide guidance on which thinking skills are most developmentally appropriate for cultivation and suggest possible avenues to challenge students at the next higher-level of knowledge.

For example, introducing methodologies and studying their elements at Levels One and Two is a particularly effective way to accelerate the creation of transferable knowledge at Levels Three and Four.

Fundamental to all aspects of educational processes is the knowledge that results from experiencing applications of knowledge. To gain additional insights into the connections between the learning process and Bloom's taxonomy, see the modules 2.3.3 Classification of Learning Skills, and 2.3.7 Learning Processes through the Use of Methodologies. These modules clarify the role of educators in building stronger transferable skills at increasingly higher levels of learning.

Concluding Thoughts

This module provides an overview of Bloom's taxonomy and subsequent work, which offers a rational and holistic approach to defining academic quality. Table 2 is designed around Bloom's levels of knowledge model to help illuminate appropriate teaching/learning processes for different performance capabilities and to focus attention on the detail that is expected of students in order to accomplish learning objectives. The related components of the table will help faculty ask better questions, define clearer expectations for assignments, and compose exam questions that are matched to specific levels of learning outcomes.

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(continued)

Levels of Learner Knowledge

	Levels of Learner Knowledge				
Level I Information	 The learner can talk about a concept, process, tool, or context in words and can provide definitions or descriptions. 				
Bloom's Level 1:	The learner has some sense of what information is relevant and not relevant.				
Knowledge	 Limited comprehension makes it difficult for the learner to carry on an extensive dialog. 				
Key Words	who, what, where, when, which, find, choose, define, list, label, show, spell, match name, tell, recall, select, organize, outline				
Questions	What is? Which one?				
	Where is? Can you recall?				
	When did? Can you select?				
	What facts or ideas show? Can you list the three?				
	Who were the main? Who was?				
	The learner is able to construct a strong degree of comprehension about a concept, process, tool, or context.				
Level II Conceptual	 Information and relationships have been processed so that the learner can construct an appropriate model in his or her mind pertaining to the particular item of knowledge. 				
Understanding Bloom's Level 2:	 The learner can process answers to critical-inquiry questions and articulate what he or she understands as well as what remains confusing. 				
Comprehension	 The learner also has some understanding as to how the item of knowledge is linked to other forms within his or her knowledge base. 				
Key Words	relate, compare, contrast, how, illustrate, translate, infer, demonstrate, summarize, interpret, show, explain, classify, select, rephrase, why				
Questions	How did happen? How would you state or interpret in your own words?				
	How would you compare or contrast? What is the main idea of?				
	How would you describe? Which statements support?				
	How would you summarize? Can you explain what is happening?				
	How would you show an understanding of? What is meant by?				
L avel III	 The learner has the skill to apply and transfer the particular item of knowledge to different situations and contexts. 				
Application The learner has taken the time to generalize the knowledge to determine ways to apply it, testing and linkages to other information.					
Bloom's Level 3: Application	 The learner can recognize new contexts and situations to skillfully make use of this knowledge. 				
Арричини	 The learner is able to teach this knowledge to others; "knowing he or she knows" rather than just "thinking or she knows." 				
Key Words	apply, construct, make use of, plan, build, develop, model, interview, experiment with, identify				
Questions	How would you use? What examples can you find to? What would result if? Can you make use of the knowledge to? What approach would you use to? How would you apply what you learned to develop? What other way would you plan to? How would you structure an argument to show? What elements would you choose to change? What questions would you ask in an interview with?				

Level IV Working Expertise	 The learner has the ability to integrate application knowledge with other skills to perform in an experior fashion. 				
Bloom's Levels 4 & 5: Analysis and	 The learner is able to solve complex problems by applying and generalizing multiple concepts, processes, and tools to produce a quality problem solution. 				
Synthesis	The learner has the ability to produce a general problem solution which can be reused and transferred to similar situations with minimal adjustments.				
	Defines an "expert" in a particular field.				
Key Words	analyze, dissect, inspect, model relationships, di and testing assumptions, examine, applying a de	vide, simplify, solve, test for, connects function, making esign, creating themes, improving			
Questions	What motive is there?	What inference can you make?			
	What ideas justify?	What conclusions can you draw?			
	What changes would you make to solve?	What is the function of?			
	What would happen if?	How would you solveusing what you've learned?			
	Can you propose an alternative?	Can you construct a model that would change?			
	The learner has innovative expertise which can be used to develop new understanding.				
Level V Research	 Through the use of lateral thinking the learner makes new linkages among concepts and problem solutions, which have not been seen before. 				
Bloom's Level 6: Evaluation	 The learner knows how to validate and test his or her assumptions and hypotheses to build reliability in the knowledge structure. 				
	 The learner knows how to communicate this understanding to others so it can be shared as common knowledge. 				
Key Words	theorize, design, formulate, discover, make up, hypothesize, prove, disprove, invent, create an original work				
Questions	Can you formulate a theory for?	How feasible is the plan to?			
	Can you think of an original way to?	Can you create a design to?			
	How would you prove? Disprove?	Can you predict the outcome if?			
	Should you accept the hypothesis that?	Can you publish your findings?			
	What is necessary to discover?				

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2.2.2 Elevating Knowledge from Level 1 to Level 3

by Kip Nygren (Civil & Mechanical Engineering, United States Military Academy at West Point)

The process of elevating knowledge from Level 1 to Level 3 can be described in terms of Bloom's taxonomy beginning with Level 1, terminology and related information; moving to Level 2, comprehension and understanding; and then to Level 3, transferring and applying knowledge in new contexts. A methodology for elevating knowledge provides guidance to faculty as they facilitate the movement of learners to Level 3. A special matrix provides descriptions of how five types of knowledge vary as learners progress up the levels. Ten specific techniques for helping to improve learning performance are discussed. Finally, the focus of inquiry for each level is provided from both faculty and student perspectives to guide the formulation of critical thinking questions relevant for learning and assessment at each of the three levels of knowledge construction.

Transferable Knowledge

"All new learning involves transfer" (Bransford & Brown, 2000). This statement defines the essence of education as opposed to training. A broad education allows individuals to effectively respond in new situations instead of simply being trained to perform explicit tasks in consistent conditions. Because transfer of learning involves generalizing concepts that can be applied in a variety of contexts, measuring students' ability to transfer knowledge represents a true indication of the quality of a learning experience. However, the ability to transfer knowledge (Level 3) first requires preparation for learning and the attainment of knowledge Levels 1 and 2 (2.2.1 Bloom's Taxonomy—Expanding its Meaning). The focus of this module is on the elevation of knowledge from Level 1 to Level 3.

Preparation for Learning

Before knowledge can transfer successfully, educators must initially establish favorable conditions to support the attainment of knowledge at Level 3. Three steps of the Learning Process Methodology (why, orientation, and prerequisites) do just that (2.3.8 Learning Process Methodology). With both the student and teacher primed for success, pre-class preparation can proceed. Level-one knowledge (information) requires obtaining definitions, facts and information. The LPM divides this acquisition into two steps: vocabulary and information.

The next goal is to obtain Level 2 knowledge which is comprehending and understanding the concept. At this level, the learner should be able to pose and attempt to answer critical thinking questions as well as explain the topic effectively to someone else. Successful attainment of Level 3 means that one has the ability to generalize the new knowledge and transfer it for application in new contexts.

Elevating Knowledge

Knowledge is not dispensed by a teacher; rather it is constructed by the student. As previously discussed, the construction of knowledge requires a firm informational base which the facilitator can validate with directed questions. The foundation also requires cornerstones of prior knowledge to which the new knowledge can be connected. Understanding and comprehension of new knowledge emanates directly from the student's pre-existing knowledge. Teachers can help connect new concepts to the preconceptions that learners bring to the classroom with Level 2 (comprehension) links that correct, enlarge and organize the knowledge structure. Once this model of the new concept is in place, its reliability can be assessed with critical thinking questions that focus on the assumptions or logic of the model.

The new knowledge structure or model can be turned into "knowledge skill" for the learner through problem solving in a familiar context to reinforce the framework and to initiate the generalization and transfer of the knowledge. The knowledge expertise becomes stronger as the learner transfers and applies the skill in slightly different contexts. Eventually the learner will be able to use the skill in a completely new and unfamiliar context with the teacher acting as a consultant. The ultimate achievement of knowledge Level 3 occurs when the new knowledge can be generalized to apply in any appropriate context. Shown below is a formal methodology for elevating knowledge to Level 3.

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) *continued*

- 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)

Simple Example of the Methodology—Change Car Oil

- Establish and solidify an informational base— Identify the tools required to change the oil, find three possible facilities at which to change the oil; know how to add and measure engine oil; know the type of oil filter required, etc.
- 2. **Identify the cornerstones for the knowledge**Determine the student's prior knowledge about the need for lubricants in any type of machine, the basics of engine oil systems, and the purpose of the filter.
- 3. **Identify the key inquiry questions for comprehension**—What are the reasons for the order of the steps involved in changing oil? What would happen if a particular step were left out of the process? What happens to the old oil?
- 4. With the framework in place, test the conditions of the structure—What would happen if there were less oil than recommended? More oil?
- Find a context you are familiar with and transfer and apply the knowledge to that context—Demonstrate or explain in detail how to change the oil in your own car.
- 6. Transfer and apply the knowledge to another context that is similar—Demonstrate or explain in detail how to change the oil in a pickup truck.
- 7. Make a transfer and apply the knowledge to a context that is some distance from the original context—Demonstrate or explain in detail how to change the oil in a riding lawn mower.
- 8. Pick a totally unfamiliar context and, transfer and apply the knowledge with teacher as consultant— Explain why there is no need to change the oil in a chain saw engine.
- 9. **Generalize the new knowledge**—Discuss possible means to provide lubrication in a wide range of machines from air-conditioner units to turbo-jet engines.

Knowledge Forms

Knowledge forms include the following:

- **Concept**—an idea that represents a set of relationships
- **Process**—a sequence of activities

- Tool—an instrument to accomplish a task
- Context—conditions relevant to performance
- Way of Being—a set of attitudes, actions, or values

The summary table on the next page illustrates levels of knowledge from Level 0.5 to Level 4 based upon each of the knowledge forms.

The Most Difficult Steps in the Method

- 1. *The Pre-learning phase (Steps 1-5 in the LPM)*The learner and the teacher must agree why the learning objective is important, gain mutual orientation to the learning issues and context, and must resolve any barriers related to prerequisite knowledge.
- 2. Achievement of Level 2
 - Comprehension of the principles, theories, and models that have developed in an area of knowledge facilitates and enhances successful application. However, learners vary in their need for exposure to simple application opportunities as a way to clarify their Level 2 understanding and to motivate deepening of their understanding. Authentic learning is a constructivist education theory that emphasizes the connection of content to learner experience as the solution to achievement of usable Level 2 knowledge.
- 3. Generalization of the knowledge to higher Level 3
 Extensive experience with using knowledge in varied contexts is the basis for increasingly sophisticated internalization of both theoretical knowledge and problem-solving expertise.

Techniques for Helping Learners Improve

Make sure that the cornerstones to learning are in place—There are many ways to make sure that these foundational blocks of information are in place. Ask directed questions that require students to link personal experiences, prior knowledge, informational readings, or key aspects of examples that are provided. Use a reading log or reading quiz to assess students' preparedness for learning. Before starting a discussion in class, ask a couple of inquiry questions or have certain students summarize what they understand about the concept. Finally, ask the students to inventory what they think the key cornerstones are for this learning exercise.

Connect to previous knowledge by inventorying learner experience—Conduct a learning assessment survey to determine the level of student content knowledge, create tasks that will reveal preconceptions, and facilitate the organization of preexisting understanding into conceptual frameworks.

Levels of Knowledge	All Forms of Knowledge	Concept	Process	Tool	Context	Way of Being
Level 0.5 Pre- Informational (Language)	Structures in own words	Knows meaning of words	Follows grammar and syntax	Recognizes key symbols	Decodes acronyms	Recognizes critical words within disciplines and cultures
Level 1.0 Informational	Memorizes and repeats information Assesses quality of data	States facts and definitions Draws pictures and diagrams	Describes steps in a method Initiates use of a method	Uses step-by- step instructions Recognizes purpose and intended use	Repeats stories Describes events	Follows social conventions Responds to traditions
Level 2.0 Comprehension & Understanding (Why, significance, implications, meaning)	Produces good inquiry questions Analyzes models effectively	Articulates understanding Describes relationships and linkages	Rationalizes use of steps Knows criteria for quality outcomes	Comprehends instruction sets Knows full range of use	Condenses a story Shares implications	Values well-reasoned arguments Values accepted models and theories
Level 3.0 Application, low level	Applies in a familiar context Analyzes results	Combines with related ideas Links principles and practices	Documents use of steps in a method Links the steps together	Locates instructions Uses basic features and functions	Requires guidance Able to serve as a trainee	Notices mismatch of a principle and its application Accepts expected results
Level 3.5 Application, high level	Applies in new contexts Synthesizes new solutions	Clarifies boundaries Understands why a theory will work	Internalizes use of a theory Links methods together	Uses hidden features Adapts instructions	Responds to subtle prompts Able to serve as a teacher	Harmonizes theory with practice Collaborates for better outcomes
Level 4.0 Working Knowledge (Expertise)	Efficient in producing quality results Proposes criteria to define quality	Evaluates alternative models Generalizes understanding	Customizes methods for future use Monitors quality in real time	Debugs fluently Creates customized tools	Provides prompts for others Serves as a consultant	Serves as a role model Interacts with a larger community

Discipline the process—The most efficient and least frustrating learning occurs with a step-by-step process. This can be facilitated by testing understanding and having learners involved in judging when they can move to the next step. Be prepared to move back a level if the knowledge structure is not strong enough to add the next "floor."

Test the robustness of understanding with critical thinking questions—Step 4 requires that learners test the quality of their own learning before going to application. Is the frame strong enough?

Develop learner participation—Ultimately, students must take control of their own learning and monitor their own learning progress (3.4.6 Persistence Log). A powerful metacognitive strategy is to have students track their progress and use reflective essays to ask and answer their own critical thinking questions.

Understand the knowledge forms—Use the descriptions and guidance in Table 1 to clarify and assess the learner's current understanding and performance level.

Generalize understanding—Ask students to write a paragraph about applying their knowledge in a familiar context, then in another paragraph about applying their knowledge in an unfamiliar context, and finally in a paragraph that generalizes their knowledge by describing similarities and differences between the two contexts and identifying common underlying principles.

Transfer knowledge to a far context—For example, after learning about using oil in a familiar context, like a door hinge, and a slightly less familiar context, like a riding lawn mower, discuss how an airplane pilot might monitor the oil in the jet engines of an airliner to ensure that the engines operate efficiently in flight.

Motivate and inspire the learner while maintaining high expectations—Persistence to achieve learning goals is clearly affected by the student's motivation to learn. Pay close attention to the first five steps in the LPM to assure that the learner understands and is committed to the learning challenge. Assess prerequisite knowledge (Step 5 in the LPM) to ensure that the challenge is at the proper level of difficulty to avoid frustration that is beyond what is optimal for motivation. The usefulness of the knowledge skill and the social consequences of application are strong contributors to motivation. Authentic problems that are important in the learner's community or related to career goals are particularly stimulating.

Control the affective domain to limit frustration—

As discussed above, learner frustration, or boredom, is closely related to the level of the learning challenge and the time allotted to achieve it. Increase or decrease the allocated time to adjust the challenge. Let students assess the class at periodic intervals throughout the semester to vent frustrations, and suggest changes to improve future performance.

Essential Inquiry at Each Step

Critical thinking requires a healthy level of skepticism and a set of skills to validate sources of information, to monitor one's internal process, and to assess the quality of the resulting solutions, conclusions, decisions, or new knowledge. Critical thinking questions are central to the validation of new knowledge and can be differentiated as to the level of difficulty in both formulation and response. The scale below, which is based on the first three levels of Bloom's taxonomy, provides examples of the role inquiry plays in the achievement of knowledge levels.

Level 1—Informational

- 1. Inquiring about a specific fact in a specific context
- 2. Inquiring about a set of facts related to a specific area

Level 2—Comprehension & Understanding

- 3. Asking about an inferential relationship between two facts or a fact to a context
- 4. Determining the similarities or differences between things
- 5. Asking to clarify the meaning of implicit relationships in a model or a discussion
- 6. Making indirect inferences and connections (e.g., $a \rightarrow b$ and $b \rightarrow c$ then $a \rightarrow c$)

Level 3—Application

- 7. Identifying explicit assumptions when using this knowledge
- 8. Identifying implicit assumptions when using this knowledge in varying contexts

Concluding Thoughts

Faculty and students can become familiar with knowledge elevation for each type of knowledge by using the descriptors and suggestions in Table 1. Consistent use of the Methodology for Elevating Knowledge will enable them to facilitate learning that leads to Level 3. The concepts, processes, and tools described in this module will help faculty and students cooperate in raising learning levels to achieve the fundamental aim of education: the transfer and application of knowledge in new, unfamiliar contexts.

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Information and Resources

Identify the information and resources needed to succeed

The information and resources should help students answer the key questions and complete the activity. Information can be provided within the activity itself, by outside resources that are referenced for students, or by sources that they need to find or research for themselves.

Infor	Information and Resources			
	Relevant		Graphics	
	Well-written		Comprehensive	
	Organized			

Prior Knowledge

Identify prior knowledge required

Students and others who may use your activity need to know what prior knowledge and skills are needed to complete the activity and whether any reading assignments need to be completed in advance. We also know from the research that has been done on brain-based learning that when references can be made to what is already known, the brain automatically utilizes those dendrites and synapses that have already been created. By making such connections for the students, we are also facilitating their own brain growth as well as learning.

Prio	Prior Knowledge				
	Comprehensive		Relevant		
	Links provided		Mastery Level		
	Language Noted				

Glossary Terms

Select key glossary terms to be defined

List the new important terms and vocabulary required to complete the activity. You may also want to list terms that have been introduced as new in a previous activity, and which are used extensively in the current activity, for reinforcement and recognition purposes. Definitions may accompany the terms, or you may require students to find and write definitions in the glossary in their own words.

Glos	sary	
	New	Relevant
	Important	

Skill Exercises

Design 2 to 5 skill exercises

Students apply their new knowledge in simple situations and familiar contexts to build confidence and to strengthen understanding. Typically an activity should have two to five exercises. They often repeat the key questions in an identical or similar context as that presented by the model.

Skill	Skill exercises				
	Sufficient		Contextually relevant		
	Levels of complexity		Works toward generalization		
	Evidence of progression				

Problems

Design problems to be addressed

These problems present new situations that require students to transfer, synthesize, and integrate what they have learned. The purpose is to move them to the problem-solving level of knowledge. The problems often have a real-world context, contain superfluous or missing information, have multiple parts, do not contain overt clues about the concepts needed to arrive at a solution, and may not have a right answer.

(See 2.2.6 Overview of Problem Solving, on the following pages.)

Problem Solving				
	Uses level 3 knowledge		Relevant context	
	Appropriately scoped		Designed for teams	
	Focuses on problem solving			



2.2.6 Overview of Problem Solving

by Jim Morgan (Civil Engineering, Texas A&M University) and Barbara Williams (Biological & Agricultural Engineering, University of Idaho)

Problem solving is a process whereby a "best" outcome is determined for some situation, subject to certain constraints. Many models for problem solving exist, differing in their emphasis and in the sequence of steps employed. The steps in some of the models are more difficult to employ than others, making them less accessible to less experienced practitioners. There are two distinct types of problem solving: analytical and open-ended. Analytical problem solving yields one correct answer and therefore tends to be more discipline-specific, whereas open-ended or creative problem solving can lead to multiple solutions and therefore draws on a wide variety of cognitive, affective, and social skills. One can see important differences in the levels of skill development and skill integration required among these domains by noting the behaviors of novice and expert problem solvers.

Importance of Problem Solving

Many employers have long regarded problem solving, critical thinking, and the ability to work on teams as critical workforce competencies (SCANS, 1991). Despite the importance of problem solving, many educational analysts and industry representatives report that students leave higher education with an underdeveloped ability to solve open-ended problems (CAHE, 2005). In part, this arises because instructors of undergraduate courses prefer students to construct knowledge through single-answer analytical problem solving before they address more complicated open-ended problems that require higher levels of knowledge (2.2.2 Elevating Knowledge from Level 1 to Level 3). Both analytical and open-ended problem-solving methods are more effective when they have process steps that are well-defined and are carried out in a systematic fashion, when there are specific strategies that prompt the practitioner to effectively carry out the steps, and when these strategies invite practitioners to take stock of strengths and weaknesses in aspects of the problemsolving process (2.3.7 Learning Processes through the Use of Methodologies).

What Constitutes a Problem?

When most students, and many faculty members, think of problem solving, they imagine a homework exercise with a single correct answer. Working out homework exercises can be considered problem solving to the extent that this activity reinforces the use of standard equations and cultivates specific problem-solving skills such as pattern recognition. However, open-ended problem solving presents a higher level of challenge because it requires the problem solver to respond to situations which are completely new to him or her (2.2.3 Developing Working Expertise (Level 4 Knowledge)). The following definition by Woods captures this essence. "The problems that we focus on to solve are ones where there is no immediately apparent procedure, idea, or routine to follow; if one has an idea how to solve 'the problem,' then this problem

Table 1 Affective and Social Questions in Problem Solving

Divergent Questions	Convergent Questions
What can I/we do better?	Which problems do we have influence to change?
What information do you/we need to know?	What concerns can be grouped together?
Why haven't you/we already solved this?	Which problem do we want to work on?
What are some ways to do this differently?	Which ideas really appeal to you/us?
What are the key decision points?	Which idea is most relevant?
What are sources of assistance/resistance?	What steps need to be taken by whom and when?

is simply an exercise. What we call a problem is a real challenge; it is a situation where we really have to struggle to define it, figure out what it means, and resolve it".

Open-ended or creative problem-solving involves resolution of a discrepancy between one's expectations and the reality of one's situation; of a gap between participant expectations (future state) and participant preparation (current state). Newell and Simon stress the importance of this gap in their definition of problem solving; to them it is "a situation where a person desires to resolve a gap between a goal state and an initial state. Some blockage in the gap prevents the person from immediately seeing a course of action. If there is no blockage, then the situation is an exercise, not a problem" (Newell & Simon, 1972). Where analytical problem-solving tends to invoke cognitive skills primarily, open-ended problem-solving involves significant social and affective dimensions.

Inspiration Method	Polya Method	Woods Method	Myrvaagnes Method
Preparation	Define plan	Define problem	Define the problem
Incubation	Plan	Think about problem	Identify key issues
Inspiration	Carry out plan	Devise plan	Collect/assess information
Verification	Look back	Carry out plan	Identify assumptions
		Look back	Break problem into parts
			Model sub-problems
			Integrate solutions
			Test/validate
			Generalize the solution
			Communicate the solution

The affective and social dimensions resulting from having to address an ill-defined gap or blockage are presented in Parnes' (1992) survey of creative problem solving. Activities such as objective finding, fact finding, problem finding, idea finding, solution finding, and acceptance finding are framed in terms of divergent and convergent questions that connect with individual and group values. Sample questions are posed in Table 1.

Methods for Problem Solving

Many problem-solving methods are found in the literature (Woods, 2000). Four methods of varying complexity are summarized in Table 2. The *inspiration method* is described by Rubenstein (1975) and is attributed to Descartes. It consists of 4 steps as shown; the essential step (inspiration) is often depicted as a light bulb blinking on. Unfortunately this is how many students view the solution of open-ended problems: that only a genius can solve them. The other three methods have less ambiguous steps that are more easily conceptualized and practiced.

While the methods of Polya, Woods, and Myrvaggnes regard the first step in identifying a problem to be defining it, this is often not obvious. A problem solver may have only glimpses of symptoms and a request to "fix it." For example, when a medical doctor performs a diagnosis, he or she observes the symptoms, reviews possible causes of these symptoms, and looks for other evidence that points toward the same possible cause until the problem appears. Even when the problem to be solved is clear, one must practice to develop skills needed to determine the usefulness of the available information, realize what information is not given, subdivide the problem, model alternative solutions, test the viability of solutions, and generalize results. As a problem solver becomes more experienced, the titles of each step in the method are

sufficient to keep the process of solving the problem progressing. For novices, however, more scaffolding is needed for each step.

The benefit of Polya's "plan" step, the "carry out plan" step, and the implied iteration in the "look back" step is supported by the fact that "many a guess has turned out to be wrong but is nevertheless useful in leading to a better one." The "think about it" step in the Woods method (Stice, 1987) involves asking three critical-thinking questions that help to direct learning that is required to solve the problem, and actions that should be part of the plan:

What are the attributes of the problem? What area of knowledge is involved? What information should be collected?

Myrvaagnes (1999) further dissects the "think about it" step to include identifying key issues, assessing information, identifying assumptions, and subdividing the problem. His steps to "model sub-problems" and "integrate solutions" further explicate the "carry out plan" step. Similarly, his "test/validate" step, "generalize the solution" step, and "communicate the solution" step further inform assessment-minded thinking in the "look back" step (4.1.9 SII Method for Assessment Reporting).

What is often surprising to those observing a problem solver is the fact that obtaining the solution is not the last step. Ordinarily the relief at obtaining a solution would be cause for celebration, especially when the problem involves a new situation. However, the first solution identified is often not the best solution. For a solution to be defended as sound, it is important to validate the solution, look back, generalize, and document the solution for review by a wider audience.

Table 3 Problem-Solving Skills in the Cognitive Domain

Identifying the Problem	Structuring the Problem	Creating the Solution	Improving Solutions
Systems thinking	Defining knowns	Generating ideas	Establishing criteria
Identifying a problem	Defining unknowns	Applying prior knowledge	Applying criteria to potential solutions
Defining a problem	Partitioning	Selecting possible solutions	Validating solutions
Identifying key issues	Organizing information	Integrating solutions	Assessing solution implementation
Identifying assumptions	Engaging in project learning	Reusing problem solutions	Generalizing solutions to other problems
Identifying missing knowledge	Prioritizing sub-problems	Planning implementation	Soliciting peer review

Table 4 Problem-Solving Skills in the Affective Domain

Self Development	Emotional Management	Valuing Self	Valuing Others
Maintaining a positive attitude	Identifying emotions	Forming personal values	Forming shared values
Setting personal goals	Expressing emotions appropriately	Constructing an ethical code	Committing to others
Being open-minded	Coping with others' emotions	Maintaining a sense of wonder	Empathizing
Persistence	Managing stress	Self-confidence	Respecting
Producing humor	Nurturing	Assertiveness	Serving others
Curiosity	Courage	Commitment to self	Appreciating diversity

Table 5 Problem-Solving Skills in the Social Domain

Communicating	Inviting Interaction	Performing in a Team	Performing in an Organization
Reading body language	Taking interest in others	Goal setting	Accepting responsibility
Active listening	Paraphrasing	Achieving consensus	Being assertive
Responding	Assisting others	Planning	Documenting
Formatting a message	Expressing positive nonverbals	Cooperating	Influencing decisions
Checking perceptions	Being non-judgmental	Compromising	Communicating decisions & results
Identifying missing knowledge	Prioritizing sub-problems	Planning implementation	Soliciting peer review

Problem-Solving Skills

Problem solving is a complex performance that is built from a diverse set of cognitive and affective skills (2.5.3 Distinguishing Between Problem Solving, Design, and Research). Table 3 highlights learning skills drawn from the Cognitive Domain (2.3.4) associated with problem solving.

Woods (2000) recognizes the importance of what he calls "attitudes" that can promote or inhibit problem solving. As shown in Table 4, these are *Affective Domain (2.3.6)* skills that fall under self-development, emotional management, valuing self, and valuing others. To the extent that problem solving occurs in an interpersonal environment, a variety of *Social Domain (2.3.5)* skills, such as those outlined in Table 5, are also critical in problem solving.

Differences Between Novices and Experts

Stice (1987) and Woods (2000) suggest that successful problem solvers possess some or all of the following characteristics listed in the first column of Table 6. However, there are significant differences in the ways novices and experts manifest these characteristics.

Novices and experts differ significantly in their initial approaches to problem solving. When faced with a problem, the novice gets right to work, and is motivated not to waste time on mistakes or blind alleys. To an observer, the novice appears to be working hard. Ironically, the expert does not appear to be doing much, or making much, if any, progress. The expert rereads the problem multiple

Table 6 Differences Between Novice and Expert Problem-Solvers

Characteristic Novice		Expert
Initial approach to problem	Digs into details before assessing big picture	Reads and reflects; refines problem statement
Prerequisite knowledge	Little knowledge in problem area Unaware of need for learning	Some knowledge in problem areaAware of need for specific learning
Goals and motivations	 Externally motivated Searches for correct answer Internally motivated Self confident about estimates and quantifying their reasonableness 	
Strategy Locks onto one solution path		May pursue one solution path, but is prepared with one or more backup plans
Experience transferability		Applies experiences over a broad set of contexts
Ability to synthesize	Sub-solutions cobbled together without synthesis	Fluent in combining, generalizing, and simplifying ideas

times, draws pictures and sketches, invests time building a knowledge base surrounding the problem, and explores parallel solution paths. At some point, the expert may produce a solution that appears to come out of nowhere. The two other most significant differences between the novice and expert are in their use of reflective thinking and their level of confidence in their ability to ultimately find an acceptable solution.

Concluding Thoughts

Rarely do expert problem solvers stop to share their process for problem solving. This leads many to believe that problem solving is trivial, and others to believe it is innate and magical. By making explicit the methodologies one uses, along with the diverse array of cognitive, affective, and social skills that are invoked in creating a solution, one can give others the opportunity to see the process of problem solving more clearly and more deeply. The *Methodology for Creating Methodologies (2.4.16)* offers advice for capturing this type of expert knowledge and promoting reflective thinking for those who are learning the process.

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Phase 3: Enhancing an Activity

Technology

Determine if/where technology should be appropriately applied within the activity

Something to keep in mind:

Today's students.have spent their entire lives surrounded by and using computers, videogames, digital music players, video cams, cell phones, and all the other toys and tools of the digital age. Today's average college grads have spent less than 5,000 hours of their lives reading, but over 10,000 hours playing video games (not to mention 20,000 hours watching TV). Computer games, email, the Internet, cell phones and instant messaging are integral parts of their lives.

Prensky, M.(2001a) Digital natives, digital immigrants. On the Horizon, 9(5).

(See 3.4.1 Overview of Effective Learning Tools, on the following pages.)

Use	Use of Technology					
	Adds creativity		Playful			
	Increases learning		Engaging			
	Interactive					



3.4.1 Overview of Effective Learning Tools

by Carol Nancarrow (English, Sinclair Community College)

Central to the philosophy of process learning is the importance of growing learning skills to enable students to become self-growers. By using appropriate learning tools, students can improve key learning skills in the affective, cognitive, social, and psychomotor domains. Learning tools are primarily used by the learners, rather than by the facilitator, although the facilitator may certainly need to train the students in the use of the tools and monitor their use. Learning tools can reinforce desirable learning behaviors, such as class preparation, and/or provide a structure for thinking about content or self-assessment. Learning tools should also be integral to the assessment and evaluation of learning in a course. The modules in this section describe some important learning tools and their use to improve learning.

Defining Learning Tools

A learning tool is an instrument designed to be used by learners to provide a structure for growing learning skills and behaviors and/or systematically collecting and thinking about key information. While teaching tools are primarily used by faculty, learning tools are primarily used by students. Faculty provide appropriate tools and the necessary instruction in how to use the tools, but students use learning tools on their own. Learning tools may involve technology, such as computers and calculators, but they can also be pencil and paper tools.

Table 1 Principles of Effective Learning Tools

- 1. Effective learning tools must be learner-centered.
- 2. Learning outcomes and productivity can be increased by using learning tools.
- 3. Learning tools must be appropriate for the level of the learner.
- 4. A learning tool should be engaging.
- 5. Learning tools enhance the development of learning skills
- 6. The learning curve for using a learning tool should be appropriate for the learning benefits derived.
- 7. Learning tools should be adapted to accommodate diverse learners and situations.
- 8. Learning tools can provide a framework for meta-cognitive thinking and learning.
- Learning tools align with and support assessment and grading systems.
- 10. Learning tools should be designed for independent use by students and transfer to new applications.

Principles of Effective Learning Tools

1. Effective learning tools must be learner-centered.

While an instructor may design a tool, model its use, assess the process of using the tool, and possibly evaluate the results of using the tool, most of the time and effort involved with the tool's use should be the student's. Therefore, it is essential that the results of using the tools will be sufficient to motivate the students to use the tool and to carry the tool into future learning activities. Otherwise, a tool may be perceived as just busywork. The learner must get value for his investment of time and effort in using the tool.

2. Learning outcomes and productivity can be increased by using learning tools.

The persistence log (3.4.6 Persistence Log) is an example of a tool that increases learning outcomes by improving students' learning skills. The reading log increases productivity by enabling students to get maximum benefit from reading assignments. The tool is a means to an end, not an end itself.

3. Learning tools must be appropriate for the level of the learner.

Since learning tools are primarily used independently by students, the structure, vocabulary, and process associated with using a tool should be within the current skill set of the learner, or be learned with a reasonable investment of effort.

4. A learning tool should be engaging.

A tool that students perceive as fun and challenging will get a lot more use than one that seems like boring busywork. Of course, one can encourage students to use a tool by incorporating it into a course and by assessing and evaluating its use. However, if a tool is to become part of a student's repertoire across courses and learning tasks, it needs to be rewarding to use.

5. Learning tools enhance the development of learning skills.

These learning skills may rely on the future use of the tool, but tools also enhance the development of such learning skills as class preparation, attendance, and participation, as well as affective skills, such as self-assessment and goal setting. A tool can be chosen or designed to meet an assessed need for improvement of learning skills.

6. The learning curve for using a learning tool should be appropriate for the learning benefits derived.

It may take considerable time to learn and use a complex tool but it will yield commensurate rewards. If the tool is more trouble than it is worth, it will not be valued by anyone.

7. Learning tools can be adapted to accommodate diverse learners and situations.

A quality learning tool can easily be used in a wide variety of contexts and for various levels of learners. For example, the idea of tracking and rewarding desirable learning behaviors, as shown in the *Persistence Log* (3.4.6), could be used for any observable, defined set of desirable learning behaviors to enhance the way of being for many disciplines.

8. Learning tools should provide a framework for metacognitive thinking and learning.

Current research in learning and the brain strongly establishes that learning has to become part of an individual's cognitive network in order to be retained and applied to new situations (**Learning Theory**, Chapter 2.1). By providing a structure for thinking and recording thoughts, learning tools such as the *Learning Assessment Journal* and the *Life Vision Portfolio* encourage such metacognition and reflection.

9. Learning tools align with and support assessment and grading systems.

By embedding the use of learning tools in the course assessment (3.4.8 Practical Implementation of Self-Assessment Journals) and grading systems, the instructor sends the message that he or she values the use of the learning tools. Grading is a strong motivator for quality use of a learning tool such as the reading log. By providing the instructor with a written representation of a student's thinking process and self-concept, a learning tool can make assessment much richer and more individualized.

10. Learning tools should be designed for independent use by students, and transfer to new applications.

When a new learning tool is introduced, students may need considerable training in the use of the tool. Therefore, tools should be designed so that trained students can use the tools by themselves, and, even more significantly, recognize when the tool would be appropriate and helpful for their own learning process in diverse situations.

Issues in Developing and Using Learning Tools

1. Resources required for development of learning tools

Designing a learning tool can be a fairly complex process, especially since the tool should be tested, assessed, and revised to ensure its efficacy. However, some of that investment in time can be compensated by students being able to do more on their own, and by re-using it in other circumstances and courses. In addition, many learning tools have already been developed and can be used or adapted and used without a large investment in development time. This section of the *Faculty Guidebook* offers a good selection of cross-curricular learning tools that can be used with little development time and with significant return in increased learning. An instructor should be sure to use a tool to accomplish a task before introducing the tool to students.

2. Motivating students to use tools

At first some learning tools may be perceived by students as busywork. The first obstacle may be getting students to use the tools effectively. One way to overcome that initial barrier is to include the use of the tool in the class evaluation system. That sends an immediate message that the instructor considers the use of the tool to be an important part of success in the course.

Once the student has experience with a well-designed tool, the advantages of using the tool should become apparent. For example, the first time students are required to use a self-assessment form for a writing project, many students see it as just something to do to satisfy the instructor. Over the course of the term, though, as they see how thinking about their work process has enabled them to make positive changes, they begin to see other areas in their lives that could benefit from using self-assessment.

In some cases, students can begin a task without a tool and see for themselves that they need some systematic way to approach the task. Then a learning tool can be introduced and it will be valued immediately. The reading log may be used in this way when students are having trouble getting value from assigned readings.

3. Additional resources for finding learning tools:

- The Learning Assessment Journal
- The Faculty Guidebook
- Learning objects repositories, such as Merlot.org
- Textbooks and teachers' guides
- Networking and mentors
- Professional journals
- Students

4. Assessing the quality of a tool

Since a learning tool should be chosen to meet some learning need, it should be assessed by how well it meets that need. The time and effort required to use the tool, including both faculty effort and student effort, should be justified by real rewards in learning outcomes. In addition, the tool should show dividends in the students' way of being as learners and as practitioners of their discipline and profession. A helpful starting place for assessing a tool is the section in this module on characteristics of a quality tool.

5. Cost of the tool

Some technology-based tools, such as calculators, laptops, and instruments, can involve considerable monetary cost. Tools also have a cost in terms of time and effort, both in learning and in using the tools. The instructor will have to do some cost/benefit analysis to ensure that the value of the tool justifies its expense. An important consideration in this area will be whether the tool transfers into other coursework and into the professional lives of the students.

6. Faculty belief in the value of the tool

If the faculty member has used the tool for his or her own learning and has found it valuable, his or her level of commitment to the tool will be apparent to students. So it is a good idea for faculty members to try tools in an appropriate learning situation themselves before introducing the tools to students. For example, reading logs, learning journals, and self-assessment forms are easily and profitably test-driven by faculty. By using a tool before introducing it to students, the faculty member will be better able to anticipate student issues with use of that particular tool. If the faculty member is ambivalent about the value of a tool, that attitude is likely to be communicated to students and to sabotage their success with the tool.

7. Alignment of tool with student needs

Students are much more receptive to the effort involved in learning and using a tool if the tool has the potential to make their work more effective and efficient. Sometimes a period of struggling along without a tool will engender appreciation of a new tool when it is introduced. The value of the tool to students needs to be apparent rather quickly in order for students to commit to learning and using a new tool. Tools should promote defined and desired learning outcomes.

8. Complexity of tool

In general, tools should be as simple as possible. With the current push to employ technology, there is some risk of creating a tool that uses technology just for the sake of using technology, when a simple paper- and pencil-tool would do the same thing more easily. As tools become more complex, the investment of time and money to learn and use the tool also goes up. Since tools are a means to an end, and not an end in themselves, simplicity is a virtue.

9. Establishing a tool set for learning

Successful students are often resourceful in inventing their own tools for learning situations, such as making vocabulary flashcards. Sharing of such tools is a quick way to build a tool set for a course or discipline. A repertoire of learning tools forms a foundation for lifelong learning. Students with a good set of learning tools can readily adapt tools to meet future needs and to use their own learning styles. Students should be prepared to enter into their professional lives with proficiency in the regularly used tools of the practice.

10. Inhibiting creativity and originality

There is some danger in using tools that take away the student's need to think through problems and find creative approaches. For example, students often enter college so used to using the five-paragraph theme paradigm that they limit their writing unnecessarily. Part of learning to use a tool is recognizing the limitations of the tool and knowing when to deviate from it. Tool design and choice should be made with cognizance of the needs of the learners, and tools may need to evolve as students' skills develop.

Learning Tools and Technology

The huge growth in the use of technology in education has lead to an explosion of computer-based learning tools. Online courses and course enhancements provide a convenient way to access and work with learning tools. Repositories for sharing learning objects (**Glossary**) are growing rapidly. Many learning objects include learning tools that can be used in the context of the complete learning object or be extracted and adapted for other uses, including paper-and-pencil formats. Whether a learning object is delivered with technology or not, the same indicators of quality still apply.

Characteristics of a Quality Learning Tool

Table 2 presents characteristics that can be used for the assessment and evaluation of learning tools. Faculty should these factors when they choose a tool. Once students have gained some facility with a tool, they can provide valuable insights into whether the tool has these desirable characteristics.

Table 2 Characteristics of a Quality
Learning Tool

A quality learning tool is:				
Growth- Oriented	The tool leads to significant growth toward a desired learning outcome or learning skill. This characteristic is crucial			
Transferable	The tool is flexible so that it has applications to other courses and to professional life (Bean, 1996)			
Time-Efficient	Student and instructor time using the tool will be highly productive			
Results- Oriented Using the tool produces significant results Learning the tool is not an end in itself, but is a means to an end (Wiggins & McTighe 2005)				
Essential The tool meets a real need of students				
Feasible	Start-up and use costs, in time and money, are reasonable and in proportion to the learning value of the tool for faculty and students			
Engaging	The students find the tool fun and rewarding to use; it is not a boring chore (Fink, 2003)			
Functional	The tool is elegantly designed, so that results are readily achieved			

Concluding Thoughts

Success in using learning tools is highly dependent upon the faculty member's belief in the efficacy of the tools. Faculty members tend to work best with tools that they have used and have found valuable in their own learning process. If a tool is provided without sufficient training in the use of the tool, it may just add noise and frustration to the learning environment. Therefore, faculty should choose a few tools that they can fully implement, rather than overwhelming students with tools that are not fully integrated into the course. Often the full value of a tool is not apparent until it has been used over time in multiple applications. It is possible for faculty and students to give up on a valuable tool because they have not used it enough to develop facility with it and thus appreciate its value. Well-chosen and well-implemented learning tools provide significant dividends in increasing student learning and ability to apply skills in future contexts.

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Phase 3: Enhancing an Activity

Validation

Validation and Reflection of Learning

Validation can be obtained by reporting results to peers and to the instructor to get feedback regarding the content and the quality. When students are asked to reflect on what they have learned, their knowledge is consolidated, and they see that they have been rewarded for their hard work.

(See 3.3.5 Self-Validation of One's Learning, on the following pages.)



3.3.5 Self-Validation of One's Learning

Richard C. Armstrong (Chemistry, Madison Area Technical College, retired)

The ability to self-validate one's knowledge is central for lifelong learning and personal growth. Too often, there is a large gap between what students think they know or understand and what they have actually learned. Self-validation is a multi-faceted skill set that allows students to change their mindset from "thinking they know" to "knowing they know." By cultivating and using an array of validation skills, students will legitimately "own" their learning. This will facilitate their ability to soundly construct higher-level knowledge. This module examines barriers to practicing self-validation and offers proven classroom techniques for overcoming them.

Self-Validation Skills

This module guides faculty in identifying and strengthening the self-monitoring and self-correcting skills that can produce more enduring learning in disciplinary contexts. As such, this module is closely connected with 2.2.1 Bloom's Taxonomy—Expanding its Meaning, 2.3.4 Cognitive Domain, 2.2.2 Elevating Knowledge from Level 1 to Level 3, and 2.2.3 Developing Working Expertise (Level 4 Knowledge). The module is also complements 4.2.2 Becoming a Self-Grower which focuses on skills that promote self-directed learning and self-managed professional growth.

by

Each of the process areas in the *Cognitive Domain (2.3.4)* has a cluster of learning skills that underlie self-validation.

These learning skills can be related to different levels of learning as shown in Table 1. Note that these skills are hierarchical in the sense that skills identified with higher levels in Bloom's taxonomy depend on the existence of skills at the lower levels. It is also evident in Table 1 that there is no upper limit for strengthening one's validation skills. Opportunities exist at all levels in the curriculum and in all levels of professional practice.

There is often a major gap between students' level of understanding and the level of understanding that faculty expect. Often students prepare for tests by achieving Level 1 and Level 2 knowledge whereas faculty often test for Level 2 and Level 4 knowledge (2.2.1 Bloom's Taxonomy—Expanding its Meaning). This gap leads to student frustration and, too often, course dropout or failure.

Table 1

Learning Skills Related to Self-Validation

Bloom's Learning Skill Level	Supporting Process Area (from the cognitive domain)	Skill Cluster (related to self-validation)	Learning Skills (related to self-validation)
Level 1 Information	Processing Information	Validating Information	Testing perceptions Validating sources Controlling errors Identifying inconsistency Ensuring sufficiency
Level 2 Conceptual Understanding	Constructing Understanding	Validating Understanding	Ensuring compatibility Thinking skeptically Validating completeness Bounding solutions
Level 3 Application	Applying Knowledge	Validating Results	Complying Benchmarking Validating assumptions
Level 4 Working Expertise	Solving Problems	Improving Solutions	Generalizing solutions Ensuring robustness Analyzing risks Ensuring value
Level 5 Research	Conducting Research	Validating Scholarship	Defending scholarship Responding to review Confirming prior work Judging scholarship

These gaps have been identified by The National Task Force on Student Learning by the American Association of Higher Education in "Ten Principles of Learning" (1998). The first principle of learning is the importance of self-monitoring; this underlies many of the validation skills cited in Table 1. Self-monitoring requires individuals to monitor their own learning; to understand how knowledge is acquired, to discern their own capacities and limitations, and to develop strategies for learning based on them, and to be aware of their own ways of knowing in approaching new bodies of knowledge and disciplinary frameworks.

Barriers to Development

Many barriers may interfere with the development of self-validation skills. These include traditional relationships between faculty and students; students' self-concept of learning; and aspects of institutional culture, such as reward systems for faculty, traditional measures of student success, and learners' expectations of faculty. Table 2 delineates these barriers and suggests reasons why each exists. While the culture of an institution is more difficult to change, individual faculty members can change their relationships with their students, students' self-concepts of learning, and students' expectations of faculty.

When students can validate their own learning, they are more receptive to higher learning challenges and will have increased confidence that they have reached, and even surpassed, the learning expectations of their instructors. If faculty members are going to have a meaningful impact on validation behaviors, they must accept the challenge to do more in their courses than simply "cover the content to be covered." This requires faculty to move away from a mindset of "filling vessels with knowledge" toward becoming facilitators of student growth and development.

Role of Students

The first major challenge for students is to accept the notion that they are responsible for their own learning. If students do not accept this idea, they will find little need for using validation techniques. "After all," they may say, "It is the teacher's job to teach me what I need to know." To become empowered learners, it is crucial that the students change their mindset (1.2.2 Profile of a Quality Learner). A second challenge for students is to recognize and embrace the long-term goal of becoming self-directed learners. To act on this vision, students will want to improve their skills in validating their knowledge. This is a long-term commitment that takes considerable effort and repeated practice over an extended period of time. Recent research on student learning has concluded that the more actively involved students are in the learning process, and the more responsibility they take for their learning outcomes, the greater their learning results (Bransford, Brown, & Cocking, 1999).

Table 2 Barriers to the Development of Self-Validation Skills

Barrier	Reasons
Faculty-Student Relationship	 Teachers are viewed as dispensers of knowledge Teachers want to be popular Teachers want to feel helpful Faculty give in to students' demands for acquiescence
Students' Self-Concept of Learning	 Students have honed their classroom habits in traditional academic settings Students believe that knowledge is transferred, not constructed Students strive to attain credits rather than to learn Students believe that grades alone define success
Students' Expectations of Faculty	 Students view themselves as customers The teacher should provide students with the motivation to learn Faculty should tell students what they need to know and how they need to learn it
Institutional Culture	 Academic success is measured by retention rather than performance Evaluation systems reward teachers' popularity and encourage teachers to acquiesce to students' desires Driven by enrollment rather than learning

Role of Faculty

Faculty set the stage for the development of students' learning skills by making course expectations clear. Faculty members must set high expectations and then help students develop the skill sets needed to be successful in that particular course. Most importantly, faculty members must motivate them to become strong independent learners.

"Motivation is purposeful engagement in classroom tasks and study to master concepts and/or skills. Today's theories about motivation emphasize the importance of factors *within* the individual, particularly the variables of expectancy and value. If, for example, you believe expressing yourself well in writing is important (value) but you think you do not have the ability to do so (expectancy), then you will have little motivation to apply yourself to a task you think is doomed for failure" (Cross, 2001).

By enhancing intrinsic motivation in our students, we prepare them for the challenges of growing new learning skills. As faculty members, we must insist that our students accept responsibility for their learning and we must provide the culture and environment necessary to facilitate such substantive change in our students. "The Learning College engages learners in the learning process as full partners, assuming primary responsibility for their own choices and the Learning College creates substantive change in individual learners" (O'Banion, 1999). It is a difficult challenge indeed to motivate students to strengthen their learning skills if they are not held responsible for their own learning. When a college and its faculty acquiesce to student demands for easier instruction, it significantly lowers the bar on student learning, and a college degree does not prepare students for life beyond school (4.3.5 Differentiating Growth from Acquiescence). Instead, students need to be responding to the demands of the college and its faculty by rising to meet learning expectations. Doing so requires students to improve their learning skills. When students are struggling with their work, faculty members should resist the temptation to intervene by offering content. They should rather encourage students to try using more effective learning processes. Instead of validating students' work for them, faculty members can choose to help students further develop their own validation skills. Instead of modeling problem after problem, faculty members can choose to help students develop a better understanding of the Problem-Solving Methodology. Faculty members are responsible for ensuring that students understand their own current level of learning as well as the expectations of the course.

Self-Validation Techniques

There are seven self-validation techniques for learning:

- 1. Concretize the knowledge.
- 2. Transfer contexts.
- 3. Generalize the knowledge.
- 4. Create a general model.
- 5. Identify the critical issues.
- 6. Use the knowledge in a problem-solving situation.
- 7. Teach others.

These are synergistic with the natural processes of the brain (2.1.4 From Synapses to Learning—Understanding Brain Processes), with mastery of different levels of knowledge (2.2.1 Bloom's Taxonomy—Expanding its Meaning), and with steps of the Learning Process Methodology, (2.3.8 Learning Process Methodology). Some of the techniques are context dependent and would not apply to all learning situations. Nevertheless, a minimum of two validation techniques should be performed to ensure that a particular concept has been learned. By following self-validation techniques modeled by faculty, students

will be able to internalize the techniques and use them appropriately on their own.

The following learning scenario illustrates how all seven self-validation techniques may be used. In this situation, a person is learning how to set the time on a car radio. Each example is associated with a relevant validation skill from Table 1.

Concretize the knowledge.

By concretizing knowledge, a learner enhances his or her ability to test perceptions, validate sources, control errors, identify inconsistency, validate completeness, and set boundaries. Learners validate that they have concretized the knowledge by applying it in a very real example.

Pick a specific car (Neon) and find out where the clock control buttons are located. The car manual shows where the buttons are located and explains how to set the time. To set the time in this particular type of car hold in the required reset button and then set the correct hour by pushing in the hour button. Next, set the correct minute by pushing in the minute button. Check to verify that the time is set correctly.

Transfer contexts.

Transferring the knowledge to apply it in a different context enhances a learner's ability to ensure compatibility, to think skeptically, validate completeness, and set benchmarks. Learners validate their ability to transfer knowledge by applying it in three significantly different contexts.

Pick a different type of car, a VCR, and a microwave oven. For each device, determine whether you need to use the manual or if you can find the possible buttons (or menus) by scanning the options on the control panel. If necessary, look up the information (hopefully you will be able to find it), then follow the detailed sequence to set the appropriate time.

Generalize the knowledge.

By generalizing the knowledge, the learner enhances his or her ability to set benchmarks, to generalize solutions, and to ensure robustness and value. Learners validate that they have generalized the knowledge by testing whether they can find a situation or context in which they cannot apply the knowledge. If they can't find such a situation, they know that they have generalized the knowledge.

Brainstorm an exhaustive list of possible situations that involve setting clocks with different options and designs. Set up a prioritized sequence of steps that can be followed in any context. Test this strategy to assure that it is a general strategy. Verify that you will rarely need a manual to set a clock by setting clocks in three new contexts.

Create a general model.

This enhances a learner's ability to ensure sufficiency, think skeptically, generalize solutions, ensure robustness, analyze risks, and ensure value. Learners validate that they can produce a general model by constructing one that represents all the possible cases and can be used to teach others.

Write a "how to" pamphlet for others so that they can use it to learn how to set clocks.

Identify the critical issues.

This technique enhances a learner's ability to identify inconsistency, ensure compatibility, think skeptically, and set boundaries. Learners validate their knowledge by identifying the top key critical issues or assumptions in the knowledge (about five) and then testing these for understanding.

The following questions raise the most important issues: Where is the activation switch or button located? How do you access or activate the time settings? What is the sequence that is needed? What are typical problems that occur? How easy is it to find helpful information? For each issue, write an explanation that effectively communicates your understanding to others.

Use in problem solving.

Using the knowledge to solve problems enhances a learner's ability to validate assumptions, generalize solutions, analyze risks, and ensure value. Students validate their learning by demonstrating that they can use the knowledge effectively in a problem-solving situation.

For example, see if you can set the clock in a rental car within two minutes of leaving the airport without using the manual and without having an accident.

Teach others.

This technique enhances a learner's ability to test perceptions, control errors, ensure sufficiency, validate completeness, comply, and benchmark. Learning will be validated if students can effectively teach this knowledge to someone else.

Get other people to perform to the specified level of knowledge that meets future needs.

Concluding Thoughts

Shulman (1999) underscored the importance of selfvalidation when he observed that "learning flourishes when we take what we think we know and offer it as community property among fellow learners so that it can be tested, examined, challenged and improved before we internalize it." However, to develop the ability to self-validate one must make a change in attitude, acquire special skills, and employ the discipline to use these skills on a continuing basis. The journey is long, challenging, and filled with pitfalls. Many of today's students are not accustomed to the idea that they are responsible for their own learning and must develop the skill sets needed to succeed in higher education and in life. Yet, even within a single course, students can develop a profound respect for the skill of self-validation as can be seen in the following quotes.

"Because of the emphasis on self-validation in this course, I've dramatically increased my level of confidence in my work. Talking with others about validation is also a new and refreshing way to communicate with my friends, classmates, and instructors."

"During this semester I learned to take control and initiative toward my studies. I now recognize that resources provided through the course are not the only ones available. If I need more information I will go and find it."

"Being a self-learner is very important in my personal and professional life. If I don't push myself to learn to grow, nobody else will, and I won't excel to my full potential."

Faculty and administrators, working together, must exercise "tough love" when it comes to student development. A good place to start is to set high expectations, and then to help students cultivate the validation skills they need to be strong independent learners.

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Phase 3: Enhancing an Activity

Self Assessment

Determine how to include self-assessment in the activity

Students need to be encouraged to self-assess their performance and identify ways they can improve. Self-assessment should be done in a meaningful and interesting way, consistent with the learning objectives and success criteria.

Self Assessment	
Timely	Improves performance
Properly scoped	Aligned with performance criteria
Sequenced for development	

Phase 3: Enhancing an Activity

Closure

Decide how to bring closure to the activity

Clos	Closure					
	Learning is measured		Key issues addressed			
	Questions are inventoried		Foundation laid for future			
	Follow up action determined					

Section 14

Preparing an Activity Sheet

From Planning to Using: Activity Sections & What the Student Sees

From Planning to Using: Activity Sections & What the Student Sees

Section	Explicitly part of the Activity; SEEN by student	Implicit in the Activity; NOT SEEN by student	Explicit or Implicit, as needed
Purpose			\checkmark
Title	✓		
Type of Knowledge Form		✓	
Learning Model	✓		
Why	✓		
Learning Objectives	✓		
Performance Criteria	✓		
Learning Skills			✓
Critical Thinking Questions	✓		
Plan/Tasks for Execution	✓		
Pre-Activity			✓
Sequencing of Questions		✓	
Information Needed			✓
Prior Knowledge Required			✓
Glossary			✓
Skill Exercises			✓
Problems to be Addressed			✓
Technology to be Used			√
Validation of Learning			✓
Self-Assessment	✓		
Closure		✓	

Note: The order of activity sections is somewhat fluid and may vary depending upon author/instructor preferences.

Section 15

Facilitating for Student Success

(Note that this section applies to the Integration Step)

Ways to Help Learners Improve Performance in Learning Activities

Faculty Guidebook: 3.2.3 Facilitation Methodology

Faculty Guidebook: 3.2.5 Creating a Facilitation Plan

Faculty Guidebook: 3.3.3 Process-Oriented Guided Inquiry Learning

Ways to Help Learners Improve Performance in Learning Activities

Step 1: Prepare for the Activity

Most individuals love to perform well. Proper preparation is important for achieving high-level performance, and includes the following:

Assigns team roles by:

Identifying those wishing to assume responsibility for captain, recorder, spokesperson, and time keeper.

Rotating these roles with various activities so that individuals gain new experience with each role.

When the numbers are sufficient, also identifying a reflector, a skeptic, and a cheerleader.

Criteria for High-level Performance in a Learning Activity:

Understands the "why" for an activity:

Can rephrase what is to be learned.

Can identify how the content fits into the big picture.

Can state relevance and personal value.

Can enrich the "why" statement to meet personal learning goals.

Can link the activity to past activities.

Able to provide a systematic overview:

Can match the activity to appropriate goals set for the learning process.

Can identify the boundaries for the activity.

Can lay out and organize the structure and priorities for the activity.

Can draw upon past activities to help perform the current activity.

Can produce a framework/diagram of the activity with known constraints.

Obtains appropriate information and background:

Organizes the set of informational resources.

Produces a quality reading log of these sources.

Has a set of working questions of issues to be addressed.

Inventories prior relevant knowledge.

Relates personal experiences to the current learning situation.

Understands the current and future context and objectives:

Can rephrase the objectives.

Can clarify the current context for the activity.

Can clarify the future context for the activity.

Knows the liabilities for the given activity.

Knows the overall support and resources that are available for the current activity.

Understands the performance criteria and assessment/evaluation systems:

Can rephrase the performance criteria.

Can rephrase the supporting attributes.

Knows how the supporting attributes are going to be measured.

Can relate the components of the activity to supporting attributes that are being measured.

Sees the value of the activity related to bigger picture of assessment and evaluation.

Step 2: Activity Setup

Committing 2-5% of the total time for an activity to organization before beginning the activity will enhance performance during the activity.

Activity setup includes:

Assigning appropriate team roles.

Collecting and organizing resources.

Creating an efficient learning environment (e.g., ridding extraneous materials).

Defining the operating rules and parameters.

Obtaining shared meaning of key components or areas of the activity.

Step 3: Create a Plan for the Activity

This step is intended to increase the likelihood that desired outcomes and performance criteria are met.

A quality plan includes:

Identifying all of the critical tasks (those to be accomplished in order to meet the desired outcomes).

Sequencing the tasks in an order that promotes the flow of the work.

Identifying person responsible for each task.

Allocating time and resources for effectively performing each task.

Clearly identifying checkpoints of progress.

Considering contingencies (e.g., extra time for review and rehearsal for a final presentation).

Step 4: Execute the Plan

Once a plan is created, the team captain is in control of implementing the plan. It should be periodically reviewed as it is being executed. The team captain must make sure that the tasks are being accomplished and hold team members accountable for their performance. When major decision needs to be made for changing the plan, the team captain is accountable for any decisions made.

Executing the plan:

The team captain continually monitors progress against the plan.

The team captain is accountable for team performance and for implementation of decisions made by the team.

The team captain should apply extra resources when necessary.

The team captain is the one who is assessed with respect to the team's performance in meeting the plan.

Step 5: Assess Performance against the Criteria

Staying focused on the agreed-upon criteria is critical for high-level performance in a learning activity. Be careful when taking tangents. When contained within the overall objectives and performance criteria, they can be powerful and enriching. However, they can also become traps and waste time that leads teams away from the desired criteria of the activity. In order to limit wasteful tangents, review the performance criteria 2-4 minutes after taking a tangent, at 3-5 scheduled checkpoints during the activity, and anytime that a team member feels lost.

Monitor performance against the criteria:

Evaluate the value of the tangents.

Assess performance criteria periodically during the activity.

Make sure every team member is learning and that no one is lost or disengaged.

Produce consistency during the activity.

Step 6 and 7: Prepare for the Presentation and Deliver the Presentation

In many learning activities, a presentation is required of what has been learned. In such cases, it is a good idea to practice the presentation. The book, *Foundations of Learning*, provides helpful information for preparing and delivering presentations.

Step 8: Assess the Overall Performance

Following each activity, perform an activity assessment that looks at the performance of each individual, the team, the facilitator, and the activity. It is important to determine who is responsible for the strengths of the process and products, what can be improved in the future, and ways that improvement might occur. Whenever possible also seek insights that reflect additional learning that occurred during this activity.



3.2.3 Facilitation Methodology

Peter Smith (Mathematics & Computer Science, St. Mary's College, Emeritus) and Daniel K. Apple (President and Founder, Pacific Crest)

The Facilitation Methodology is a tool to help a faculty member prepare for, facilitate, and assess a learning activity/ process/learning experience. This methodology is helpful in situations in which one needs to shift from being a "sage on a stage" to being a "guide on the side." Examples of such situations include teaching students in a classroom, administering a grant project, chairing a department, and running a faculty development event. Faculty members have found increased confidence as facilitators with improved learning outcomes by following the Facilitation Methodology. The vital role of assessment appears as a thread throughout the methodology and the importance of defining learning outcomes, setting up the activity, and providing closure is emphasized. Additional modules discuss facilitation issues and tools.

Facilitation Methodology

Table 1 presents the Facilitation Methodology, which is applicable when one facilitates an activity, a process, or any learning experience.

Table 1 Facilitation Methodology

- 1. Define the key measurable outcomes.
- 2. Design and prepare for every activity.
- 3. Decide which strategies, processes, and tools are appropriate for each specific activity.
- 4. Pre-assess to determine participants' readiness.
- 5. Set up each specific activity.
- 6. Release individuals/teams to pursue the activity.
- 7. Assess team and individual performances.
- 8. Provide constructive interventions based on process, not content.
- 9. Bring all the individuals and/or teams back together at the conclusion of the activity.
- 10. Provide closure with sharing of collective results.
- 11. Use various forms of assessment to provide feed-back on how to improve everyone's performance.
- 12. Plan for follow-up activities.

Simple Example of the Methodology

The context for this example is a classroom activity taking place at the beginning of a semester or term. Students are put in teams where they introduce themselves and begin the process of building a new learning community.

1. **Define the key measurable outcomes**—Help each group member begin to recognize the special qualities of each other community member. Make the first team activity a confidence-building one. Emphasize the fact that learning is fun and everyone is accountable for their own learning.

- 2. **Design and prepare for the activity**—Decide to have each pair of team members introduce themselves, sharing their goals and learning styles with their partner; and then each introduce their partner to the team. Preparation involves deciding the team composition and identifying interview questions.
- 3. **Decide what is appropriate for each specific activity**—As described in Step 2, use a pair-share interview style activity. Team roles are not needed.
- 4. **Pre-assess and determine participants' readiness**Determine that all basic needs have been taken care of (such as registration, food, and materials) so the participants can focus on the activity.
- 5. **Set up each specific activity**—Describe the purpose and expectations for the activity. If there are an odd number of people on any team, describe a round-robin interview style. Specify the time limits, e.g., twenty minutes.
- 6. **Release teams to pursue the activity**—Start the team interview process.
- 7. **Assess team and individual performances**—Walk around and listen in on each team to make sure that the pairs are engaged, asking relevant questions that focus on the interview process, and making sure that each pair is making sufficient progress.
- 8. **Provide constructive interventions**—If teams are falling behind, ask if they are going to finish on time. If teams finish early, suggest additional tasks, such as choosing a team name.
- 9. Bring teams back together at the conclusion of the activity—Announce in your own style that it is time to bring closure to the activity.
- 10. **Provide closure**—Have each person identify and share a goal and a characteristic of their interview partner.
- 11. **Provide feedback**—Conduct a three-minute discussion of how people feel about the community that has been created.

12. **Plan for follow-up activities**. Collect interview sheets and prepare a group directory.

Discussion of the Methodology

Note that Steps 1-3 should be done prior to the event. Step 4 should be done either before or at the start of the event. Steps 5-11 should be done during the event and Step 12 should be done after the event.

Step 1—Define the key measurable outcomes.

This step is absolutely essential and the one most often omitted. When defining these measurable outcomes (two or three are sufficient), assess what your students need most in order to improve their learning performance. Avoid "over-scoping" what can be accomplished in the given time frame. Outcome-based learning is a very popular concept in higher education today, because if teaching cannot be assessed against a set of outcomes, its effectiveness cannot be measured, and therefore it cannot be improved (Astin, 1985).

Step 2—Design and prepare for every activity.

At this stage one must choose an activity that will help achieve the learning outcomes from Step 1. It is important to think carefully about what the designer of the activity was trying to accomplish. Be sure to plan for contingencies that may arise during the facilitation. What individual or team behaviors are expected? Determine which two or three learning skills will be focused on and assessed during the activity. Make sure the activity resources can be provided.

Step 3 — Decide which strategies, processes, and tools are appropriate for each specific activity, including the roles for participants (3.4.2 Designing Teams and Assigning Roles).

In this step the facilitator must decide what activity format is best suited to engage the participants based on the activity content and meeting the outcomes of the activity. It is best to incorporate at least ten different activity formats during a semester to ensure student involvement, which research (Angelo & Cross, 1993) has shown to be critical to student growth. Note that student-faculty and student-peer involvement have positive correlations with every area of student intellectual and personal growth (Astin, 2001).

Step 4—Pre-assess to determine participants' readiness.

To ensure that all participants are sufficiently prepared to perform well during the activity, it is important to determine their level of preparation and the extent of their prior knowledge about the activity content. This can be accomplished in a number of ways: a quiz, a short written assignment in which they discuss what they know or have learned from their preparation, a set of questions each has prepared from the pre-event reading, or the answers to assigned study questions.

Step 5—Set up each specific activity.

This is another highly critical step during which the facilitator ensures that participants know why they are doing the activity, and that they understand the learning objectives, performance criteria, resources, and general tasks for the activity. Performance criteria should be set in terms of both process and content. It is important that each participant know exactly what is expected, but the facilitator must be careful not to usurp responsibility for the learning by each participant. The extent of the setup also depends on the activity type, from discovery learning, which requires minimal content setup, to lecture, which involves extensive content description and is influenced by the personality of the facilitator. If the use of team roles is required, this is the point at which the facilitator ensures that each team member has a role to play.

Step 6—Release individuals/teams to pursue the activity.

Here we give control to the participants to start working on the activity and strive to promote learner ownership. In other words, participants should feel in control of the quality of their performance and the outcomes they produce. The first order of business for the teams is to set up a plan if one is not already provided in the activity description. One of the resources should always be the amount of time reserved for the activity.

Step 7—Assess team and individual performances (4.1.4 Assessment Methodology).

This step involves gathering information by listening to and observing the dynamics between individuals, based on verbal interchanges and body language, and written documentation from the activity; the recorder's report gives clues as to how well the participants are learning the content. The goal is to foster independent learning. Therefore, it is important to plan in advance, identifying the top three to five issues affecting performance. Link these issues with specific learning skills that can be improved and the outcomes from Step 1.

Step 8—Provide constructive interventions based on process, not content.

During this step, the facilitator uses the data collected during the last step to determine when to intervene, but avoids doing things for participants that they could do themselves, even if it may be the easiest way to remedy the situation. By making it harder to get information from the facilitator and by replying with questions rather than direct answers, you encourage participants to use and develop their information processing and critical thinking skills. Be careful not to intervene unless a team asks for help, because unwanted interventions can disrupt the flow of the team and even cause people to resent of the facilitator. When making an intervention, facilitators should focus on helping participants address the skill or process that is lacking rather than focusing completely on the content. Examples of appropriate times for an intervention include intervening after an extended period of struggling or frustration, when participants' actions stray too far from meeting the performance criteria for the activity, or when there is a complete breakdown in performance (Apple, Duncan-Hewitt, Krumsieg, & Mount, 2000).

Step 9—Bring all the individuals and/or teams back together at the conclusion of the activity.

This is not easy because teams work at different speeds. It may be necessary to assign enrichment exercises to some teams and stop others before they have fully completed the activity.

Step 10—Provide closure with the sharing of collective results.

This is a vitally important step and should not be skipped, even when time is short because participants need feedback. Have the teams share quality performances that others can benefit from as well as areas where performance needs improvement. Identify star performances and areas that need more discussion and discovery. Summarize what has happened and what has been learned, but do not spend time on what participants already know. Challenge them to articulate their discoveries at higher levels of knowledge beyond facts and information (2.2.2 Elevating Knowledge from Level 1 to Level 3).

Step 11—Use various assessments to provide feedback on how to improve everyone's performance.

Realize that participants want assessment feedback based on the activity performance criteria that will help them improve future performance. Make regular use of oral reflectors' reports.

Step 12—Plan for follow-up activities.

The written team products should be assessed and returned with comments to each team at the next class. If some points need clarification, a quiz or further discussion may be employed. The facilitator should assess his or her own

performance, striving for continual improvement. If the performance was peer coached, the facilitator and peer coach should meet after the facilitation for a mentoring session

Another Example of the Methodology

The context for this example is a faculty development activity where participants are to learn about using the Facilitation Methodology.

1. Define the key measurable outcomes.

- Prepare participants so they can complete a facilitation plan
- Enable participants to create criteria for assessing the quality of a facilitation plan
- Produce a model for facilitation that others can learn from

2. Design and prepare for every activity.

In the 1997 *Teaching Institute Handbook* (Apple & Krumsieg, 1997), Activity 4.3 was designed to help faculty understand the Facilitation Methodology, learn to assess the quality of a facilitation, and create a plan for becoming a better facilitator. Expect to spend an hour reviewing the activity and anticipating how it can help achieve the outcomes from Step 1. Focus on the following learning process skills: divergent thinking, analyzing differences, and managing frustration. These were chosen because it is anticipated that the activity will produce wide-ranging ideas which must be worked into a coherent report, a frustrating endeavor.

3. Decide which strategies, processes, and tools are appropriate for each specific activity.

The facilitation activity mentioned in Step 2 was designed as a guided-discovery activity. However, students often rebel against too many such activities, so convert to a fifty-minute problem-based learning activity (Barrows, 1994). With this format, the participants are presented with a problem and must establish their own learning objectives and performance criteria. In this case, the problem is to identify the issues involved with preparing and assessing a high quality facilitation plan. Decide to provide them with this facilitation plan as a model. Use standard roles and make use of reflector and recorders' reports.

4. Pre-assess to determine participants' readiness.

It seems best to give the activity and background information to the participants to read beforehand. Assess how many have done the reading and their level of understanding by giving a two-minute quiz that asks them

to name the three most difficult steps in the methodology and explain their choices. This will be an individual self-assessment quiz to let the team know the level of preparation of its members.

5. Set up each specific activity.

In two minutes, emphasize why facilitation plans are critical to successful facilitation and the role assessment plays in ensuring quality. Give the teams five minutes to review the activity and identify learning objectives and performance criteria; have them answer questions for two minutes at the end of this period. Also, state the learning skills identified in Step 2.

6. Release individuals/teams to pursue the activity.

Teams will have twenty minutes (with a planned fiveminute extension) to assess the model facilitation plan and to identify the issues they anticipate in developing such a plan for activities in their own disciplines.

7. Assess team and individual performances.

Look to assess the three learning skills: divergent thinking, analyzing differences, and managing frustration. Also assess the product: the quality of the facilitation plan's assessment, and the level of issues identified for developing a facilitation plan. Potential problems to be ready for include the perceived complexity of the Facilitation Methodology, and teamwork issues related to time pressure and doing several concurrent tasks, especially the reflector collecting data during the activity and the recorder making high-level discoveries before the end of the activity.

8. Provide constructive interventions based on process not content.

Typical interventions to anticipate include reminding learners to perform their respective team roles (especially the reflector), time management, challenging the level and quality of issues, and monitoring the recorder's ability to synthesize the multitude of issues raised.

9. Bring all the individuals/teams back together at the conclusion of the activity.

Make sure that all teams have recorded enough to be able to engage in class discussion; make sure they have produced three learning outcomes, two performance criteria, the reflector's report, an SII assessment (4.1.9 SII Method for Assessment Reporting) of the model facilitation plan, and five issues with developing their own facilitation plans. If some teams finish early, challenge them to improve the quality of their issues and/or assessment. Give other teams three minutes after the first team finishes.

10. Provide closure with the sharing of collective results.

Inventory the top two issues raised by each team. The facilitator will model the process of raising the level of some of the issues presented. Allow ten minutes.

11. Use various assessments to provide feedback on how to improve everyone's performance.

The reflectors' reports will be used to determine the quality of the team performance. Allow five minutes.

12. Plan for follow-up activities.

Provide fifteen minutes of consulting for each participant working on a facilitation plan for their own activity.

Concluding Thoughts

This module emphasizes the importance of following the Facilitation Methodology during each facilitation performance and highlights three critical steps: identifying outcomes, setting up the activity, and providing closure for the students. While it is true that once one gains experience with some methodologies they are no longer needed, even the most experienced facilitator would do well to step through this methodology when preparing for each facilitation because it is very hard to break ingrained sloppy facilitation habits. When implementing this module it is also helpful to use the module 3.2.5 Creating a Facilitation Plan since the latter contains a template which helps organize the facilitation before, during and after an activity. Taking the time to carefully apply this methodology for each facilitation is both a challenge and an opportunity for radical improvement.

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3.2.5 Creating a Facilitation Plan

Vicky Minderhout (Chemistry, Seattle University)

Facilitated activities are the public face of teaching. When preparing to facilitate learning, instructors can use a facilitation plan to maximize the effectiveness of face time with students or workshop attendees. Effective facilitation plans include time after each activity for the facilitator to assess his or her facilitation performance. To help instructors create facilitation plans, this module provides a universal template that can be applied in any discipline.

Need for a Plan

Careful planning lies at the heart of successful performance (Black, Harrison, Lee, Marshall, & Wiliam, 2004). The planning process recommended in this module will help instructors attend to facilitation principles (3.2.1 Overview of Facilitation), work through the facilitation methodology (3.2.3 Facilitation Methodology), and anticipate learner needs (3.2.6 Identifying Learner Needs). Since the needs of learners frequently arise from the way they take in and process information, most facilitators will find it beneficial to reflect on these issues and develop a written plan to address them. The preparation of a written plan before facilitating an activity serves as a prompt during facilitation, forms a permanent record of what was attempted by the teacher during the activity, and is a convenient tool for assessing facilitation performance.

Components of a Plan

A complete plan consists of three components. The first component encompasses planning prior to the facilitation (page one of the Facilitation Plan template). The second component involves recording data during the facilitation (page two of the template). And the third component assesses the quality of facilitation against learning outcomes, thus linking the facilitation plan to classroom execution and to outcomes. All three components are clearly identified in the template at the end of this module.

Part 1: Prior to the Activity

1. In preparing to facilitate a classroom activity, begin by establishing outcomes for the activity that emphasize the skills you intend to stress. The first example given in the *Facilitation Methodology (3.2.3)* module, introducing members of a new community to each other, illustrates this process. The desired outcomes for the activity are having each community member recognize the special qualities of every other member; making the first team activity a confidence-building one; promoting the experience of learning as fun; and emphasizing the fact that all students are accountable for their own learning. Note that to accomplish these outcomes, learners will need to use skills in empathizing and building self-esteem from the affective domain, skills in attending and rephrasing from the social domain, and skills in

making connections and using divergent thinking from the cognitive domain. Evidence that the outcomes are being accomplished includes respectful language as the teams interview each other, full participation of all team members in the activity, and smiles along with signs that no one is goofing around.

- Once outcomes are established, select an activity type to facilitate the outcomes (2.4.14 Designing Process-Oriented Guided-Inquiry Activities). Note that the outcomes or activity type selected may require different group sizes and roles.
- Define any roles needed to support the outcomes and activity type (3.4.2 Designing Teams and Assigning Roles). In the example above, the facilitator decided to use a pair-share interview activity, so roles were not needed.
- 4. Prepare students for the planned learning activity through some type of pre-assessment. Students can prepare for many activities by completing an assignment prior to class. Pre-assessment in this case might be a quiz to help each student determine how well he or she understood the material in that assignment. Another way to prepare students is to plan a discussion at the beginning of class to make sure everyone understands concepts or issues that will be important to the planned learning activity. If the class will need to use the skill of rephrasing, for example, facilitators might want to budget ten minutes to elicit definitions of rephrasing and ask participants what evidence would prove that they were successfully rephrasing. This also elevates student awareness of a skill that can improve performance.
- 5. In the activity set-up, give the students an overview of the activity, making sure to focus on the purpose, expectations, roles, and amount of time allocated, including closure time. Also identify the learning skills students should focus on during the activity. In the example of getting the class more comfortable with each other, the facilitator tells students that the purpose of the activity is to introduce them to each other and make them comfortable in their groups. The facilitator notes that all class members are accountable for their interview information, that the format of the activity will be pair-share for twenty minutes, and that each student should focus on attending and rephrasing. The

facilitator also emphasizes the centrality of rephrasing to the success of this activity, thus preparing students for their pre-assessment activity in rephrasing. If the pre-assessment indicates a need for improvement, students must be prepared to engage in activities that will elevate their skills in rephrasing.

- 6. Anticipate what to expect when observing the group work. List the skills on which learners should focus (listed in the outcomes) and anticipate situations during the activity when you might observe them performing the skill. This will result in better real-time observations, improve interventions on process, and help participants create meaning and improve skills (Johnson & Johnson, 2003). In the example of getting to know one another, attending and rephrasing were given as skills in the outcomes, so the facilitator would expect to see some interchange between the two in the pair share, rather than just nodding of heads.
- 7. Plan for closure of the activity by addressing a variety of questions: What will be shared between the teams? Will the facilitator participate in sharing? Will the data be recorded on an overhead, on a computer, or on sheets collected from the groups? Will groups report on and/or turn in reflector and recorder reports? In the example we have been exploring, each student might be asked to introduce his or her interviewee and share something unique about the interviewee with the class. For activities that involve more cognitive outcomes, sharing discoveries about the material can concretize understanding.

Part II: During Activity

- 8. Follow through with the set-up and timing plan made prior to class. In the example, the plan calls for the activity set-up, followed by some whole class brainstorming on the definition of rephrasing and on qualities of effective rephrasing. This work is reported and recorded, and the teams are instructed to begin the pair-share activity. In any facilitation plan, the facilitator needs to note the effectiveness of the assessment, of participant preparation, and of the activity setup. He or she also notes how much time was spent.
- 9. During the activity, monitor the teams for real-time data on the interactions in the groups. Collect data by focusing on the identified skills but remain open to other observations. Include evidence of outcomes being met, questions asked by team captains, and your responses. Record any interventions you make and the result (3.2.7 Constructive Intervention and 3.2.8 Constructive Intervention Techniques).
- 10. During the closure period, document the team's oral reports. The better your notes are during the

classroom session, the more real-time data you will have to improve your performance as a facilitator.

Part III: After the Activity

11. During an activity, considerable data is often generated in the form of recorder reports, reflector reports, and closure notes. Analyzing this data reveals the difference between what was planned for the activity and what actually occurred. If the activity went well, it is useful to identify the key factors that came together to make it a success. If the activity did not help students meet the desired outcomes, review the components of the activity. Were the outcomes too broad? Was the activity type appropriate? If the students were not prepared, what could be done about this in the future? Did closure result in significant learning growth? Make sure to store lessons learned along with your activity sheets.

Assessing Facilitator Performance

12. A facilitation plan is also useful for improving the facilitator's performance. If the activity outcomes are not met, the facilitator must decide if something is wrong with the activity and, if so, how to fix it. It is more important, however, to decide what to do in the next class session to improve the facilitation. For best results, the method used to assess the facilitator should generate strengths, areas for improvement, and insights about the facilitator's performance (4.1.9 SII Method for Assessment Reporting).

Concluding Thoughts

The template given here serves as a both a prompt and an organizer for facilitation planning. It will take strong discipline to complete the template for each class, especially the "during" and "after" activity portions. Faculty who use all components of the facilitation plan are often motivated by the opportunity to use a portfolio of their plans as research for publication and/or to enhance their tenure applications.

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Facilitation Plan—Prior to Class

1.	Outcomes (List 2-3 outcomes and underlying skills from different domains and describe anticipated evidence that each has occurred.)						
	•						
	•						
	•						
2.	Activity Type						
	(See Activity Types and select the one which best aids outcome achievement.)						
3.	Roles (See 3.4.2 Designing Teams and Assigning Roles)						
4.	Preparation Assessment Plan	ı	time allotted				
5.	Activity Set-up Plan		time allotted				
6	Group Work		time allotted				
0.	Identify issues that may affect performance, link them to learning skills, and describe your anticipated response.						
	Situation	Skill	Intervention				
Co	ognitive:						
Sc	ocial:						
Afi	fective:						
7.	Closure		time allotted				

Facilitation Plan—During/after class

8.	Pre-Assessment and Activity Set-up Notes			time spent			
9.	Group Work Notes Situation	Skill	Intervention	time spent			
10.	Closure Notes			time spent			
11. Reconciliation What evidence demonstrates that outcomes were met? Use data from group work to document.							
12.	SII of Class Period						



3.3.3 Process-Oriented Guided-Inquiry Learning

by David Hanson (Chemistry, Stony Brook University) and Richard S. Moog (Chemistry, Franklin and Marshall College)

Process-oriented guided-inquiry learning (POGIL, rhymes with "mogul") is both a philosophy and a strategy for teaching and learning. It is a philosophy because it encompasses specific ideas about the nature of the learning process and the expected outcomes. It is a strategy because it provides a student-centered methodology and structure that are consistent with the way people learn and achieve these outcomes. The goal of POGIL is to help students simultaneously master discipline content and develop essential learning skills. This module explains the relationship between three primary components of POGIL: cooperative learning, guided inquiry, and metacognition. It also offers advice on implementing POGIL in the classroom and provides evidence that POGIL instruction produces better understanding and higher grades compared with traditional lecture-style methods.

Research Basics

Studies reveal that traditional teaching methods in higher education are no longer meeting students' educational needs. This has led to several reform initiatives. Some of these initiatives focus on changing the curriculum and course content; others seek to utilize computer-based multimedia technology for instruction; and some promote more student involvement in class in order to engage students in learning.

Several key ideas about learning have emerged from current research in the cognitive sciences (Bransford, Brown, & Cocking, 2000). This research documents that people learn by

- Constructing their own understanding based on their prior knowledge, experiences, skills, attitudes, and beliefs
- Following a learning cycle of exploration, concept formation, and application
- Connecting and visualizing concepts and multiple representations
- · Discussing and interacting with others
- Reflecting on progress and assessing performance
- Interconnecting conceptual and procedural knowledge in large mental structures

POGIL is built on this research base, sharing the key premise that most students learn best when they are actively engaged in analyzing data, models, or examples and when they are discussing ideas; when they are working together in self-managed teams to understand concepts and solve problems; when they are reflecting on what they have learned and thinking about how to improve performance; and when they are interacting with an instructor who serves as a guide or facilitator of learning rather than as a source of information. To support

this research-based learning environment, POGIL utilizes self-managed learning teams, guided-inquiry materials based on the learning cycle, and metacognition (Hanson, 2006).

Role of Cooperative Learning

Learning environments can be competitive, individualized, or cooperative. Research has documented that relative to the other situations, students learn more, understand more, and remember more when they work together. They feel better about themselves and their classmates, and they have more positive attitudes regarding the subject area, course, and instructors. Students working in a team environment are also more likely to acquire essential process skills such as critical and analytical thinking, problem solving, teamwork, and communication (Johnson, Johnson, & Smith, 1998).

It should not be surprising that group learning environments are successful; individuals working alone in competitive or individualized instructional modes do not have the opportunity for intellectual challenge found in a learning team. As a learning team becomes involved in a lesson, the differences in various team members' information, perceptions, opinions, reasoning processes, theories, and conclusions will inevitably lead to disagreement. When managed constructively using appropriate interpersonal, social, and collaborative skills, such controversy promotes questioning, an active search for more information, and finally a restructuring of knowledge. This process results in greater mastery and retention of material and more frequent use of critical thinking and higher-level reasoning compared with the outcomes gained through learning in competitive and individualized modes (Johnson, Johnson, & Smith, 1998; Cooper, 2005; Hanson, 2006; Millis & Cottell, 1998).

Role of Guided-Inquiry

Much research documents that, in order to achieve real understanding and learning, learners must actively restructure the information they absorb. To restructure new knowledge, learners must integrate it with previous knowledge and beliefs, identify and resolve contradictions, generalize, make inferences, and pose and solve problems. Thus, knowledge is personal and is constructed in the mind of the learner (Johnson et al., 1998; Herron, 1996; Cracolice, 2005; Bransford, Brown and Cocking, 2000; Johnstone, 1997; Bodner, 1986). A POGIL learning activity engages students and prompts them to restructure information and knowledge; guidedinquiry activities help students develop understanding by employing the learning cycle. This learning cycle consists of three stages or phases: exploration, concept invention or formation, and application (Abraham, 2005).

In the "exploration" phase of the learning cycle, students develop their understanding of a concept by responding to a series of questions that guide them through the process of exploring a model or executing a task. Almost any type of information can be processed in this way: a diagram, a graph, a table of data, one or more equations, a methodology, some prose, a computer simulation, a demonstration, or any combination of these things. In this exploration phase, students attempt to explain or understand the material that is presented by proposing, questioning, and testing hypotheses.

The second phase may involve either "concept invention" or "concept formation." When the second phase involves concept invention, the exploration phase does not present the concept explicitly. Learners are effectively guided and encouraged to explore, then to draw conclusions and make predictions. Once learners have engaged in this phase, additional information and the name of the concept can be introduced. Instructors may be the ones to introduce the concept name (to ensure that standard language is used), but it is the students themselves who discover the patterns. Other activities are designed with a second phase that involves concept formation. In these activities, some representation of the concept is presented explicitly at the beginning. Students work through questions which lead them to explore the representation, develop an understanding of it, and identify its relevance and significance.

Once the concept is identified and understood, it is reinforced and extended in the "application" phase. In the application phase, learners use the new knowledge in exercises, problems, and even research situations. "Exercises" give learners the opportunity to build confidence in simple situations and familiar contexts.

"Problems" require learners to analyze complex situations, to transfer the new knowledge to unfamiliar contexts, to synthesize it with other knowledge, and to use it in new and different ways. "Research" questions identify opportunities for learners to extend learning by raising new issues, questions, or hypotheses.

The Role of Metacognition

"Metacognition" literally means "thinking about thinking." It includes self-management and self-regulation, reflection on learning, and assessment of one's own performance. POGIL requires students to use metacognition to help them realize that they are in charge of their own learning and that they need to monitor it (self-management and self-regulation), that they need to reflect on what they have learned and what they don't yet understand (reflection on learning), and that they need to think about their performance and how it can be improved (self-assessment) (Bransford et al., 2000).

Metacognition produces an environment for continual improvement. Students can be asked to assess their own work and that of each other. Instructors monitor the teams and, when appropriate, provide feedback to individuals, teams, and the class in order to improve students' skills and to help them identify needed improvements. It is possible to establish an atmosphere in which such assessments are safe, positive, and valued by all by making a distinction between assessment and evaluation. "Assessment" is the process of measuring a performance, work product, or skill and giving feedback to document strengths and growth and to provide directives for improving future performance. "Evaluation" is the process of making a judgment or determination concerning the quality of a performance, work product, or use of skills against a set of standards (4.1.2 Distinctions Between Assessment and Evaluation). Assessments are nonjudgmental and are designed and intended to be helpful and to produce improvement. Evaluations, on the other hand, are judgmental and are designed and intended to document the level of achievement that has been attained. Feedback provided during daily learning experiences is given in the form of an assessment, while course examinations provide the evaluation. The situation is similar in athletics: coaching during weekly practices and scrimmages is given in the form of an assessment; the big game on Saturday is an evaluation.

Metacognition has been shown to be especially effective in improving problem-solving skills. When students were trained in a five-step self-explanation self-regulation methodology, they were deemed to be more successful at solving problems. After encountering new material students were asked to identify the important concepts, to elaborate on and identify connections between the concepts, to examine a sample problem and to identify the steps needed to solve it, to identify the reason for and meaning of each step, and to relate the concepts presented in the initial material to the steps in the sample problem (Bielaczyc, Pirolli, & Brown, 1995). This methodology helps students construct the large mental structures that are essential for success in problem solving: those linking conceptual and procedural knowledge (Bransford et al., 2000).

Implementing POGIL

There are a variety of ways to implement POGIL to suit the instructor, the class size, the classroom structure, and the local culture. In some successful implementations, all lectures have been replaced with POGIL sessions (Farrell, Moog, & Spencer, 1999). In some, one lecture per week has been replaced with a POGIL session (Lewis & Lewis, 2005). At a large university, standard recitation sessions have been converted to POGIL sessions (Hanson & Wolfskill, 2000). And at several institutions with 100 to 500 students in a lecture hall, POGIL activities are being used with electronic student response systems for all or part of each session. All of these implementations typically employ the learning cycle: students work together in small groups on activities that have been carefully designed to guide them in constructing understanding and in applying this understanding to solve problems. In the POGIL classroom the instructor is not the expert provider of knowledge; he or she is a coach or facilitator who guides students in the process of learning, helping them to develop process skills and conceptual understanding, and to apply this understanding in solving problems. In this context, the instructor has four roles to play: leader, monitor/assessor, facilitator, and evaluator.

As a leader, the instructor creates the learning environment: he or she develops and explains the lesson and defines the objectives (both content objectives and process skill objectives), criteria for success, and expected behaviors. He or she also establishes the structure of the environment (i.e., the goal/reward structure, the team structure, the class structure, the room structure, and the time structure) (3.1.1 Overview of Quality Learning Environments).

As a monitor/assessor, the instructor circulates through the class monitoring and assessing individual and team performance and acquiring information on student understanding, misconceptions, and difficulties in collaboration. The instructor uses this information as a facilitator to improve performance.

As a facilitator, the instructor intervenes when appropriate

and asks timely critical-thinking questions to help teams understand why they may be having difficulty and to think about what they need to do to improve and make progress. Facilitators should intervene on process issues, not content issues, and they should provide the kind of input that encourages deeper thought. Questions posed by the facilitator should help the team identify why they are having difficulty. The first questions should be open-ended and general; further questions should be more directed and specific as needed. At the end of the intervention, the team should be asked to reflect on the process: What was the source of the difficulty? How did you resolve it? How might you avoid this difficulty in similar situations in the future? What generalizations can you make to help you in new situations?

As an evaluator, the instructor provides closure to the lesson by asking team members to report answers, to summarize the major points, and to explain the strategies, actions, and results of the team's work. Individuals and teams are evaluated on their performance, achievement, and effectiveness; general issues are shared with the class.

Case Studies

POGIL has been evaluated for its effectiveness in various courses over a wide range of institutions. In addition to formal published studies (Farrell et al., 1999; Hanson et al., 2000; Lewis et al., 2005), a number of more informal and unpublished evaluations also have been conducted. In general, similar results are obtained regardless of the type of institution, the course, and the size of course. Student attrition from POGIL courses is lower than that for courses using traditional methods ("attrition" in this case is defined as earning a grade of D or F or withdrawing from the course). Student mastery of content is at least as high or higher than that gained through traditional instruction. Students also generally prefer the POGIL approach over traditional methods, they have more positive attitudes about the course and their instructors, and their learning skills appear to improve over the semester.

For example, one study of a full POGIL implementation in general chemistry at Franklin and Marshall College compares the performance of over 400 students taught using the POGIL approach over a four-year period to a similar number taught in previous years using a traditional approach by the same instructors (Farrell et al., 1999). The attrition rate decreased from 22% (traditional) to 10% (POGIL). The percentage of students earning an A or B rose from 52% to 64%.

Similar results have been obtained when POGIL has been used as a component of large lecture classes. In general chemistry classes at Stony Brook University, graduate teaching assistants used a POGIL approach to facilitate the recitation sessions. Students performed better on examinations. These gains were exhibited uniformly in the performance of low through high-achieving students (Hanson et al., 2000). Another study conducted at a large urban university examined the effect of replacing one of three general chemistry lectures each week with a peer-led team learning session using POGIL materials (Lewis et al., 2005). They found that the students who had attended the group-learning sessions generally performed better on common examinations.

Concluding Thoughts

When they first hear about POGIL, many instructors are intrigued by the approach and can see its advantages, but they are concerned that the pace at which the material is covered will be significantly slower in a POGIL course than for a lecture-based course. Our experience is that this is not a problem. One way to measure this is to compare the standardized exam performance of students who learned using POGIL instruction, comparing the average outcomes against those of students from the same institution who experienced a traditional approach. Such comparisons show that students experiencing POGIL instructions scored higher on these examinations than students in traditional classes in both general chemistry and organic chemistry. It is inspiring that in evaluating POGIL at Stony Brook, instructors said, This is the way to teach! and many students responded, More time for workshops and less time for lectures!

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Section 16

Peer Assessment of Activity Design

Activity Design Criteria

Activity Design Template for Faculty

Activity Sheet (Table: Explicit versus Implicit Activity Sections)

Faculty Guidebook: 4.1.9 SII Method for Assessment Reporting

Faculty Guidebook: 4.1.2 Distinctions Between Assessment and Evaluation

SII Assessment Form (2)

Activity Design Criteria

Purp	Purpose							
	Supports performance criteria of course							
	Facilitates learner performance on specific course performance measures							
	Designed to support changing long term behaviors							
	Connected to one of course's learn	ing o	utcomes					
	Supports development of course th	emes	3					
Title								
	Concise Motivating and inspirational							
	Descriptive		Honest					
	Accurate		Does not use same word to define a word					
Туре	e of knowledge item							
	Concept							
	Process							
	Tool							
	Context							
	Way of being							
Prod	Produce learning model that is to be developed to correspond with activity type							
	Concept = concept model							
	Process = methodology							
	Tool = template or software application							
	Context = case study/story							
	Way of being = profile							
Why	Statement							
	Short, to the point		Three to four sentences in length					
	Understandable		1st sentence describes "what"					
	Does not overstate 2 nd sentence describes relevance to big picture							
	Personally relevant 3 rd sentence describes relevance to student							
	Relevant to course							
Lear	earning Objectives							
	Appropriate kind (competency, movement, accomplishment, experience, integrated performance)							
	Obtainable		Student-oriented					
	Specific, clear Road map for what's ahead							
	2-3 in number Realistic within constraints and resources							

Performance Criteria						
	Emphasizes quality		Measurable			
	1-2 in number		Realistic and obtainable			
	Clear, understandable		Relevant to learning outcomes			
	Includes attributes		Prioritized			
	Describes desired behavior and the	ought	process			
Lea	rning Skills					
	Aligned to course		Focused number			
	Relevant to activity		Integrated			
	Opportunity to improve					
Crit	ical Thinking Questions – Directed	d				
	2-3 in number		Builds the foundation			
	Motivational		Requires information, processing			
	Simple and basic		Steers learner to variety of resources			
	Relevant to learning outcomes					
Crit	ical Thinking Questions – Conver	gent				
	2-3 in number		Requires student to analyze & synthesize			
	Includes assessment		Allows for more than one correct answer			
	Contextual in nature		Requires making linkages to knowledge			
	Relevant to learning outcomes		Answer is not directly available in reading, lectures, etc.			
Crit	ical Thinking Questions – Diverge	nt				
	Open ended		Involves the research process			
	Provides challenges		Adds robustness and excitement			
	Can be used as a "bonus"		No solution readily available			
	No expectation for evaluation		Is beyond the performance criteria			
	Does not need to directly relate to	learni	ng objectives			
Plar	n for Execution					
	Inclusive		Provides necessary base of information			
	Comprehensive		Available to all			
	Specific		Identifies required homework			
Pre-	activity					
	Language identified		Resources reviewed			
	Readings completed		Readiness assessed			
	Inquiry questions developed					

Information and Resources						
	Relevant		Graphics			
	Well-written		Comprehensive			
	Organized					
Prio	r Knowledge					
	Comprehensive		Relevant			
	Links provided		Mastery Level			
	Language Noted					
Glos	ssary					
	New		Relevant			
	Important					
Skil	l exercises					
	Sufficient		Contextually relevant			
	Levels of complexity		Works toward generalization			
	Evidence of progression					
Prol	blem Solving					
	Uses level 3 knowledge		Relevant context			
	Appropriately scoped		Designed for teams			
	Focuses on problem solving					
Use	of Technology					
	Adds creativity		Playful			
	Increases learning		Engaging			
	Interactive					
	Validation					
	Self Assessment					
	Timely		Improves performance			
	Properly scoped		Aligned with performance criteria			
	Sequenced for development					
Clos	sure					
	Learning is measured		Key issues addressed			
	Questions are inventoried		Foundation laid for future			
	Follow up action determined					

Activity Design Template for Faculty

Design Team Members:
1. Identify purpose
2. Title
3. Type of Knowledge Item
Concepts (IA)
Processes (M)
Tools (T)
Contexts (CS)
Ways of Being (P)
4. Create the Learning Model / Instrument for the Knowledge Item
$\label{lem:methodology} \textbf{Methodology} (Process), \textbf{Profile} (\textit{Way of Being}), \textbf{Story/Case Study} (\textit{Context}), \textbf{Template} (\textit{Tool}), \textbf{Interactive Model} (\textit{Concept} - \textit{delay till step 10})$
5. Why?
What?
Big Picture
Relevance
6. Learning Objectives
7. Performance Criteria
8. Learning Skills
Cognitive
Social
Affective
Psychomotor

9. Key Critical Thinking Questions	
Directed	
Convergent	
Divergent	
10. Plan/Tasks for Execution of Activity	
11. Pre Activity	
12. Sequencing Critical Thinking Questions	
13. Information and Resources	
14. Prior Knowledge Required	
15. Glossary	
Previous Terms	New Terms
Previous Terms	New Terms
	New Terms
Previous Terms	New Terms
Previous Terms 14. Skill Exercises	New Terms
Previous Terms 14. Skill Exercises	New Terms
14. Skill Exercises 15. Problems to Be Addressed	New Terms
14. Skill Exercises 15. Problems to Be Addressed	New Terms
14. Skill Exercises 15. Problems to Be Addressed 16. Technology to Be Used	New Terms
14. Skill Exercises 15. Problems to Be Addressed 16. Technology to Be Used	New Terms
14. Skill Exercises 15. Problems to Be Addressed 16. Technology to Be Used 17. Validation/Reflection of Learning	New Terms
14. Skill Exercises 15. Problems to Be Addressed 16. Technology to Be Used 17. Validation/Reflection of Learning	New Terms

From Planning to Using: Activity Sections & What the Student Sees

Section	Explicitly part of the Activity; SEEN by student	Implicit in the Activity; NOT SEEN by student	Explicit or Implicit, as needed
Purpose			✓
Title	✓		
Type of Knowledge Form		✓	
Learning Model	✓		
Why	✓		
Learning Objectives	✓		
Performance Criteria	✓		
Learning Skills			✓
Critical Thinking Questions	✓		
Plan/Tasks for Execution	✓		
Pre-Activity			\checkmark
Sequencing of Questions		✓	
Information Needed			✓
Prior Knowledge Required			✓
Glossary			✓
Skill Exercises			✓
Problems to be Addressed			√
Technology to be Used			✓
Validation of Learning			✓
Self-Assessment	✓		
Closure		√	

Note: The order of activity sections is somewhat fluid and may vary depending upon author/instructor preferences.



4.1.9 SII Method for Assessment Reporting

Jack Wasserman (Mechanical Engineering, University of Tennessee at Knoxville) and Steven W. Beyerlein (Mechanical Engineering, University of Idaho)

Assessment results are most likely to be put into action by an assessee when they are concisely stated, supported by evidence, and delivered in a positive manner. This module outlines a format for informal assessment reports that meets these needs. Known as the SII method, it includes a thoughtful description of assessee strengths, areas for improvement, and insights that can be transferred to other contexts. The SII method is assessee-centered in its language, specific in its use of data from a specific learning context, and enlightening in its recommendations for future action.

The Role of Self-Assessment

Psychological studies of highly successful people across all domains of intelligence—linguistic, musical, mathematical, scientific, interpersonal, kinesthetic, intrapersonal, and spiritual—reveal that these extraordinary individuals share three behaviors that are the source of sustained personal growth (Gardner, 1998).

- These individuals stand out in the extent to which they reflect, often explicitly, on the events of their lives
- These individuals stand out less by their impressive "raw powers" than by their ability to identify and then exploit their strengths
- These individuals fail often and sometimes dramatically, but they stand out in the extent to which they learn from their setbacks and convert defeats into opportunities

Extraordinary individuals, therefore, possess a strong internal process of thinking about their circumstances, their performance capabilities, and their opportunities for effecting change. The SII method strives to make these attributes explicit in the dialogue between assessor and assessee. It embodies several characteristics known to improve critical thinking, including positiveness, processorientation, a recognition of contextual details, and the role of emotion as well as reason in human behavior (Brookfield, 1987).

Organization of the SII Report

While the assessee is performing, the assessor must collect information consistent with the chosen criteria (4.1.4 Assessment Methodology). It is important for the assessor to note the strong points of the assessee's performance (things done well) and why they were considered strong; the areas in which the assessee's performance could be improved, along with suggestions for how the improvement could be made; and any insights that might help the assessee in other contexts. The SII format provides a succinct way to communicate these findings in a cooperative learning environment.

Strengths—identify the ways in which a performance was of high quality and commendable. Each strength statement should address what was valuable in the performance, why this attribute is important, and how to reproduce this aspect of the performance.

Areas for Improvement—identify the changes that can be made in the future, between this assessment and the next assessment, that are likely to improve performance. Improvements should recognize the issues that caused any problems and mention how changes could be implemented to resolve these difficulties.

Insights—identify new and significant discoveries/ understandings that were gained concerning the performance area; i.e., What did the assessor learn that others might benefit from hearing or knowing? Insights include why a discovery/new understanding is important or significant and how it can be applied to other situations.

These statements should be delivered in the order given above first to affirm the assessee and then to apprise him or her of opportunities for additional growth. An assessor should take care to cast these statements in a succinct manner and avoid using judgmental language. As a matter of convenience in written SII reports, each statement can be identified with the appropriate letter (S or I).

Rubric for Elevating SII Reports

The following rubric has been developed to help students visualize different levels of assessment quality and to rate the sophistication of their SII reports. As assessments move up the scale, there is a discernible shift from assessing effort to meaningfully assessing performance.

Level 1—Observation

Strengths and areas for improvement are presented as simple statements. The following statements are typical of this level:

- (S) The presenter was energetic
- (I) The introduction was too long
- (I) The score was not the only goal

Level II—Comprehension of Key Issues

Strengths and improvements are clearly stated, and reasons are given for the strengths and suggestions for improvement. Insights tend to be related to the specific context of the assessment. The following statements are typical of this level:

- (S) The enthusiasm of the presenter inspired the audience to ask many questions
- (I) Much of the material in the introduction was secondary to the purpose of the talk
- (I) The team kept the problem statement in mind, not just the score

Level III—Application in a Related Context

This feedback builds on comprehension of key issues and gives specific ideas for improving performance in a related context. The following statements are typical of this level:

- (S) Taking time to practice your presentation can help you deliver your message in a confident and convincing tone
- (I) The introduction should highlight a single hypothesis and explain why it is justified
- (I) By focusing on the goal of good technical communication, rather than focusing simply on the score, the team reminded everyone about the educational objective of the project

Level IV—Transfer to a New Context

This feedback illustrates generalized understanding and is instructive in applying this understanding across a broad range of contexts. The following statements are typical of this level:

- (S) Researching the background of your audience can help you stimulate interest in and attention to your message
- (I) Section divisions appear to be seamless in a carefully planned and practiced presentation
- (I) By communicating your interpretation of the underlying purpose of an activity, you help everyone assess whether they could have learned more from the activity

Implementing SII Reports

SII reports represent a powerful formative assessment tool that can be used with a great deal of flexibility in the classroom. The following techniques have proven successful in elevating and adding variety to SII reports.

Prioritize findings—Students share only the greatest strength, the greatest area for improvement, and the best insight. This encourages participants to rank the significance of their observations and to defend their thinking.

Limit response time—This is especially valuable for sharing oral assessment reports from multiple teams. Challenge participants to limit SII reports (all three parts) to less than 30 seconds.

Build common understanding—Participants are asked to rephrase what they hear in others' SII reports. This process can help clarify muddy ideas as well as emphasize important discoveries.

Focus attention—The instruction directs attention to a narrow set of learning skills or performance criteria. Focusing the assessment helps to minimize motherhood-and-apple-pie statements; and instead connects the commentary with specific behaviors.

Rate performance on a scale—As a reference for writing SII statements, the instructor provides several scales or rubrics for ranking performance in key areas. Assigning numerical scores can trigger recollection of supporting evidence that adds more specificity to a written SII report.

Collective feedback—At the end of a reporting session (oral or written), the instructor may use the SII format to comment on the entire spectrum of reports. This serves to reiterate key findings and to establish performance expectations for future reporting sessions.

Concluding Thoughts

One of the driving forces for change in higher education is the need to develop students who are lifelong learners who can adapt to the ever-and-rapidly-changing world around us (Brookfield, 1987). Quality self-assessment provides a solid foundation for such self-growth (Gardner, 1998). By giving and receiving SII reports, learners at any level in the curriculum gain the practice and experience they need to become quality self-assessors and self-growers. SII reports support an assessment culture in which students are motivated to perform better and proactively seek to improve their own performance.

References

Brookfield, S. (1987). Developing critical thinkers: Challenging adults to explore alternative ways of thinking and acting. San Francisco: Jossey-Bass.

Gardner, H. (1998). *Extraordinary minds*. New York: Basic Books.



4.1.2 Distinctions Between Assessment and Evaluation

by Marie Baehr (Vice President for Academic Affairs, Coe College)

Educators use two distinct processes to help students build lifelong learning skills: assessment and evaluation. Assessment provides feedback on knowledge, skills, attitudes, and work products for the purpose of elevating future performances and learning outcomes. Evaluation determines the level of quality of a performance or outcome and enables decision-making based on the level of quality demonstrated. These two processes are complementary and necessary in education. This module draws important distinctions between assessment and evaluation, underscoring the need for both processes to occur at separate places and times, and ideally through different roles (4.1.4 Assessment Methodology and 1.4.7 Evaluation Methodology).

Inconsistent Use of the Terms

In the last fifteen years, much has been written about assessment and evaluation, but the terms have not always had distinct meanings. As accrediting agencies have become increasingly interested in improvement, it has become imperative to have a word that describes feedback for improvement that is distinct from one that describes the determination of quality. To add another layer of confusion from the literature, the word "formative" (used as an adjective with assessment or evaluation) has typically been used to describe an improvement process, while the word "summative" has been used to describe a decision-making process (Brown, Race, & Smith, 1996). However, the words "formative" and "summative" mean "as it is being created" and "addition of all things," respectively. A process to determine quality can both be accomplished either as a performance is being created or after it is completed, so other words should be used to distinguish the two processes.

In the literature of the last several years, assessment has usually been used to indicate that at least some hint of improvement is expected in the assessment process (Bordon & Owens, 2001; Palomba & Banta, 1999). Similarly, evaluation is usually used to indicate that some sort of judgment of quality will be made. The Faculty Guidebook is consistent in its delineation of these two processes of improvement and judgment. Assessment is the term used to look at how the level of quality of a performance or outcome could be improved in the future; it includes strengths that should be sustained as well as highpriority areas for improvement. The assessment process is not concerned with the level of quality; only with how to improve the level of quality. Evaluation is the term used to describe the determination of the level of quality. The evaluation process focuses only on the actual level of quality with no interest in why that level was attained.

Assessment and evaluation both have their purposes, and, when used correctly, both can add significant value to teaching/learning. However, there can be detrimental effects when the people involved have not agreed whether the process is evaluation or assessment, or when the Assessment Methodology gets confused with the Evaluation Methodology.

Key Attributes

Although assessment and evaluation are used for different reasons, they do have some similar steps. Both involve specifying criteria to observe in a performance or outcome. Both require the collection of data and other evidence by observing the performance or by looking at the outcome or product. Both require a performer and a person who collects information about the performance. Both processes also conclude with a report of the findings which include all the similarities and at least as many differences. The relationship between the people involved is different in the assessment and evaluation processes. In both cases a person (either evaluator or assessor) observes or collects evidence about a performance or outcome; another person (either assessee or evaluatee) performs or develops an outcome. In both cases a person (either the assessee or client) requests the process (either evaluation or assessment). In assessment, the locus of control rests with the performer; in evaluation, it rests with the observer. The report to the performer (assessee or evaluatee) is also vastly different. In the assessment process, the report includes information about why the performance was as strong as it was, and describes what could be done to improve future performances. In assessment, there is no mention of the actual quality of the performance; only how to make the next performance stronger. There is no language indicating the level of quality, such as "good," "terrible," "terrific," or "horrible." Conversely, in the evaluative report, only information regarding the actual quality of the performance is given. This might be in the form of a grade or a score or an evaluative comment, such as "good work." The purpose of the evaluative report is to report the level of quality and possibly any consequences based on the determined level of quality. It is not used to suggest improvements in future performances.

Table 1 clarifies the similarities and differences between the two processes. The modules 4.1.1 Overview of Assessment, 1.4.6 Overview of Evaluation, 4.1.4 Assessment Methodology, and 1.4.7 Evaluation Methodology give supporting explanations.

Table 1 Differences Between Processes of Assessment and Evaluation

	Assessment	Evaluation
What is the purpose?	to improve the quality of future performances	to determine the quality of the present performance
Who requests it?	assessee	client
Who performs?	assessee	evaluatee
Who observes the performance?	assessor	evaluator
Who sets criteria?	assessee and assessor	client (with possible consultation with the evaluator)
Who uses the information?	assessee (in future performances)	client (to make decisions)
When can feed-back occur?	during or after a performance	during or after a performance
On what is feedback based?	observations; and strongest and weakest points	level of quality based on a set standard
What is included in the report?	what made the quality of the performance strong; and how might one improve future performances	the quality of the performance, often compared to set standards
Who receives the report?	assessee	client
How is the report used?	to improve performance	to make judgments

Case Studies

Examples of the use of the assessment process or evaluation process can be found in *4.1.1 Overview of Assessment* or *1.4.6 Overview of Evaluation* respectively. This section addresses ways that evaluation and assessment can become confused.

Case 1: The person observing a performance believes he or she is assessing, but the performer perceives the feedback as evaluative because the performer has not worked with the observer to set up criteria and valuable feedback.

Dysfunctional Partners

One of the first steps in the Assessment Methodology is for the assessor and assessee to determine the performance or outcome criteria for which the assessee would like to gain feedback. If this step is skipped, no matter how well-meaning the person giving feedback may be, the feedback is likely to be perceived by the assessee as judgmental. Since the control in assessment rests with the assessee, feedback will be used for improvement only if the person receiving the feedback wants to use feedback from the assessor.

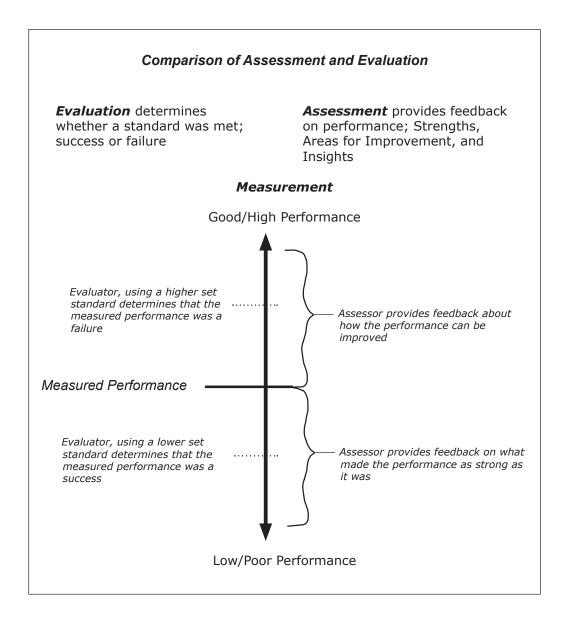
Parent-Child Relations

All parents want their children to improve. However, parents also want their children to perform at acceptable levels of quality. When a parent gives feedback for improvement using evaluative language to a child in an area in which the child has no desire to improve, the child will perceive this feedback as judgmental. For instance, there is a big difference in the message sent between saying, "Your room is a mess. Clean it up now or you will be punished," and "If you put your books away and make your bed, your room would look much nicer."

In-Class Assessment Exercises

Students are more used to feeling that they are evaluated by instructors, rather than assessed. Part of the reason for this perception is that instructors do evaluate students by giving grades. Part of the reason is that students are not often included in determining what should be fed back to them. In order for assessment of student learning to work effectively, students must participate in determining the criteria that will be used for their feedback. For example, after giving an assignment that requires a draft, you could ask students to tell you in what areas they would like feedback for improvement. In this way they would have to determine the areas where they feel improvement would make a difference, and it would help clarify that the purpose of the draft is not for a "free" grading cycle.

Figure 1



Case 2: A person, observing a performance and using the same criteria, gives assessment feedback as well as evaluative judgments.

Interim Feedback on Work Products

Students are often dismayed when they make all the suggested improvements on a paper that was turned in for comment as a rough draft and they do not receive an "A" on the final product. In this case, the instructor has given feedback for improvement without determining the quality of the paper. The student perceives that if he or she improves in the areas noted, he or she will have an excellent paper. One way to avoid this problem while strengthening the assessment process is to ask the students to request feedback on the draft based on set criteria.

Supervisor as Mentor

Often chairs of departments are expected to mentor their non-tenured faculty in their department at the same time that they are expected to make decisions on continuing employment. Although the individuals might agree on criteria to use, it becomes difficult for the assessee to feel in control of using or not using the feedback as he or she sees fit, since, at some point, the assessor will become the evaluator. Although this is sometimes unavoidable, the problem can be reduced by choosing the criteria differently in the two cases. In the mentoring situations, the non-tenured faculty member should choose the criteria for focus, while in the evaluative situations, the chair should. In both cases the criteria need to be known by both parties.

Case 3: A person who is more comfortable with the evaluator role is put in the role of assessor.

Expert Assessing a Novice

Sometimes, someone who is so ingrained in an area of expertise is unable to stop judging the quality of a novice performance. Though all criteria and scale are agreed upon, the expert as assessor can sometimes give the feedback in evaluative terms without realizing it. This sometimes happens when faculty start teaching right after they have earned their graduate degree. They are not prepared for the limited understanding and skills of the students who are taking their class. Rather than mentoring the students to help them build their knowledge and skills, the faculty members are sometimes apt to evaluate students as unmotivated and poorly prepared.

First-Time Assessor

Often, when one is used to giving feedback on the level of quality only, someone can feel uncomfortable giving "critical" feedback to an assessee, feeling that pointing out areas to improve is the same as criticizing the performance. This can cause even more problems when the assessee also perceives the feedback as evaluative (Case 1). Practice and building trust help this situation the most but it can also help if the assessor imagines what feedback he or she would have wanted if he or she had been the performer. It is important for the assessee to send the message that he or she would like to have the feedback from someone he or she trusts.

Concluding Thoughts

Discussion in this module is intended to strengthen outcomes from assessment and evaluation in teaching/ learning situations. Assessment is a process used to improve a performance or outcome. Evaluation is a process used to determine the quality of a performance or outcome and to make decisions based on the quality. Both processes can be formative (undertaken while an educational process is ongoing) or summative (taken at the conclusion of an educational process). Before starting either assessment or evaluation it is essential for instructors to clarify the purpose of the process. It is then critical to communicate this purpose to everyone involved and to establish whether this will be conducted as assessment or evaluation. Finally, one should be cautious whenever an assessor will ultimately be an evaluator or when assessment is initiated without buy-in of the assessee.

References

- Borden, V., & Zak Owens, J. L. (2001). *Measuring quality:* Choosing among surveys and other assessment of college quality. Washington, DC: American Council on Education and Florida State University—Association for Institutional Research.
- Brown, S., Race, P., & Smith, B. (1996). 500 tips on assessment. London: Kogan Page.
- Palomba, C. A., & Banta, T. W. (1999). Assessment essentials: Planning, implementing, and improving assessment in higher education. San Francisco: Jossey-Bass.

Name:
Performance/Situation:
Strengths Identify the ways in which a performance was of high quality and commendable. Each strength statement should address what was valuable in the performance, why this attribute is important, and how to reproduce this aspect of the performance.
1.
2.
3.
Areas for Improvement Identify the changes that can be made in the future, between this assessment and the next assessment, the are likely to improve performance. Improvements should recognize the issues that caused any problem and mention how changes could be implemented to resolve these difficulties. 1.
2
3.
Insights Identify new and significant discoveries/understandings that were gained concerning the performance area; i.e., What did the assessor learn that others might benefit from hearing or knowing? Insights include why a discovery/new understanding is important or significant and how it can be applied to other situations.
1
2.
3

SII Assessment Form
Name:
Performance/Situation:
Strengths Identify the ways in which a performance was of high quality and commendable. Each strength statement should address what was valuable in the performance, why this attribute is important, and how to reproduce this aspect of the performance.
1
2.
3.
Areas for Improvement Identify the changes that can be made in the future, between this assessment and the next assessment, that are likely to improve performance. Improvements should recognize the issues that caused any problems and mention how changes could be implemented to resolve these difficulties. 1.
2.
3.
Insights Identify new and significant discoveries/understandings that were gained concerning the performance area; i.e., What did the assessor learn that others might benefit from hearing or knowing? Insights include why a discovery/new understanding is important or significant and how it can be applied to other situations.
1
2.
2
3.

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Section 17

Developing a Plan for Implementation

Implementation Planning Worksheet

Implementation Planning Worksheet

HREE aspects with which I'm MOST COMFORTABLE	THREE aspects where I desire MORE COACHING
	o designing and imp

significant value to teaching/learning?

4.	Are you interested in designing a new course involving Process Education? If so, how might this course look to you?
5.	Are you interested in being part of a "Foundations Course" or being a part of an editorial team developing curricula for such a course?
6.	What are your goals for implementing what you've learned in this institute over the next 12 months?
7.	What are the top three issues that you need to resolve in order to successfully implement your plan?
8.	Please indicate if you are interested in the following:
	Being a mentor at a future Activity Design Institute Attending another Institute (which one?)
	Collaborating on a workshop/paper at a conference
	Joining the Academy of Process Educators
	Writing a module for the Faculty Guidebook
9.	What would you like to see happen as the next step with respect to faculty development at your campus? Why?

Section 18

Forms Appearing in this Handbook

Activity Design Assessment

Activity Design Criteria

Activity Design Template for Faculty

Activity Impact Assessment

Facilitation Plan: During/After Class

Facilitation Plan: Prior to Class

Implementation Planning Worksheet

Recorder's Report

Reflector's Report

SII Assessment Form (2)

Activity Design Assessment

Activity Title:							
Complete all applicable sections							
Scores:	5 exemplary	4 adequate	minor re nee	visions	2 major revisions needed	1 off target	NA not applicable
			Score		Comments	s and Example	es
	s on target with ng outcomes.	reference to					
	learning outcored with course of						
Activity elicits development or application of concepts.							
4. Activit	ty elicits clear a edge.	rticulation of					
5. Quest	tions are logica enced.	lly					
6. Activit	ty includes effe	ctive model					
	ned student pre	eparation					
	uate preparatio low-up assignn						
What are the strengths of this activity and why? What improvements would you suggest and how could they be made?							
What insi	What insights do you have about learning as it relates to the activity?						

Activity Design Criteria

Purp	Purpose					
	Supports performance criteria of course					
	Facilitates learner performance on specific course performance measures					
	Designed to support changing long	term	behaviors			
	Connected to one of course's learn	ing o	utcomes			
	Supports development of course the	emes				
Title						
	Concise		Motivating and inspirational			
	Descriptive		Honest			
	Accurate		Does not use same word to define a word			
Туре	of knowledge item					
	Concept					
	Process					
	Tool					
	Context					
	Way of being					
Proc	Produce learning model that is to be developed to correspond with activity type					
	Concept = concept model					
	Process = methodology					
	Tool = template or software application					
	Context = case study/story					
	Way of being = profile					
Why	Statement					
	Short, to the point		Three to four sentences in length			
	Understandable		1st sentence describes "what"			
	Does not overstate		2 nd sentence describes relevance to big picture			
	Personally relevant		3 rd sentence describes relevance to student			
	Relevant to course					
Lear	ning Objectives					
	Appropriate kind (competency, mov performance)	emer	nt, accomplishment, experience, integrated			
	Obtainable		Student-oriented			
	Specific, clear		Road map for what's ahead			
	2-3 in number		Realistic within constraints and resources			

Performance Criteria				
	Emphasizes quality		Measurable	
	1-2 in number		Realistic and obtainable	
	Clear, understandable		Relevant to learning outcomes	
	Includes attributes		Prioritized	
	Describes desired behavior and th	ought	process	
Lea	rning Skills			
	Aligned to course		Focused number	
	Relevant to activity		Integrated	
	Opportunity to improve			
Crit	ical Thinking Questions – Directe	d		
	2-3 in number		Builds the foundation	
	Motivational		Requires information, processing	
	Simple and basic		Steers learner to variety of resources	
	Relevant to learning outcomes			
Crit	ical Thinking Questions – Conver	gent		
	2-3 in number		Requires student to analyze & synthesize	
	Includes assessment		Allows for more than one correct answer	
	Contextual in nature		Requires making linkages to knowledge	
	Relevant to learning outcomes		Answer is not directly available in reading, lectures, etc.	
Crit	ical Thinking Questions – Diverge	ent		
	Open ended		Involves the research process	
	Provides challenges		Adds robustness and excitement	
	Can be used as a "bonus"		No solution readily available	
	No expectation for evaluation		Is beyond the performance criteria	
	Does not need to directly relate to	learni	ng objectives	
Plar	n for Execution			
	Inclusive		Provides necessary base of information	
	Comprehensive		Available to all	
	Specific		Identifies required homework	
Pre	-activity			
	Language identified		Resources reviewed	
	Readings completed		Readiness assessed	
	Inquiry questions developed			

Information and Resources						
	Relevant		Graphics			
	Well-written		Comprehensive			
	Organized					
Prio	r Knowledge					
	Comprehensive		Relevant			
	Links provided		Mastery Level			
	Language Noted					
Glo	ssary					
	New		Relevant			
	Important					
Skil	l exercises					
	Sufficient		Contextually relevant			
	Levels of complexity		Works toward generalization			
	Evidence of progression					
Pro	blem Solving					
	Uses level 3 knowledge		Relevant context			
	Appropriately scoped		Designed for teams			
	Focuses on problem solving					
Use	of Technology					
	Adds creativity		Playful			
	Increases learning		Engaging			
	Interactive					
	Validation					
	Self Assessment					
	Timely		Improves performance			
	Properly scoped		Aligned with performance criteria			
	Sequenced for development					
Clos	Closure					
	Learning is measured		Key issues addressed			
	Questions are inventoried		Foundation laid for future			
	Follow up action determined					

Activity Design Template for Faculty

Design Team Members:				
1. Identify purpose				
2. Title				
3. Type of Knowledge Item				
Concepts (IA)				
Processes (M)				
Tools (T)				
Contexts (CS)				
Ways of Being (P)				
4. Create the Learning Model / Instrument for the Knowledge Item				
Methodology (Process), Profile (Way of Being), Story/Case Study (Context), Template (Tool), Interactive Model (Concept – delay till step 10)				
5. Why?				
What?				
Big Picture				
Relevance				
6. Learning Objectives				
7. Performance Criteria with attributes				
8. Learning Skills				
Cognitive				
Social				
Affective				
Psychomotor				

9. Key Critical Thinking Questions					
Directed					
Convergent					
Divergent					
10. Plan/Tasks for Execution of Activity					
11. Pre Activity					
12. Sequencing Critical Thinking Questions					
13. Information and Resources Needed					
14. Prior Knowledge Required					
15. Glossary Previous Terms New Terms					
14. Skill Exercises					
15. Problems to Be Addressed					
15. Problems to Be Addressed 16. Technology to Be Used					
16. Technology to Be Used					

Activity Impact Assessment

When completing this, focus only on the activity you completed in class today.

Activity Title:						
Scores:	5 a great deal	4 a lot	3 some	2 a little	1 not at all	NA not applicable
			Score	Com	ments and E	xamples
	and assignmen are me for the ad					
	helped me achie earning objectives					
3. The activity understanding	improved my ng of concepts.					
	improved my prolor critical thinking					
The activity improved my communication skills.						
6. My group wa activity ques	as able to answe	r all				
7. The activity follow-up ho	prepared me we mework.	II for				
8. I feel confide materials.	ent that I can lea	rn the				
I encourage the continued use of this activity.		se of				

List two strengths of this activity and state the reasons for your answers:

List two improvements you would suggest and describe how they could be made:

What insights do you have about learning as it relates to the activity?

Facilitation Plan—During/after class

8.	Pre-Assessment and Activity Set-up Notes			time spent	
9	Group Work Notes			time spent	
0.	Situation	Skill	Intervention	Result	
	Situation	SKIII	mervention	Result	
10.	Closure Notes			time spent	
11.	Reconciliation				
	What evidence demonstrates that o	utcomes were met? Use	data from group work to	document.	
12. SII of Class Period					

Facilitation Plan—Prior to Class

1.	Outcomes (List 2-3 outcomes and underlying skills from different domains and describe anticipated evidence that each has occurred.)						
	•						
	•						
	•						
_							
2.	Activity Type(See Activity Types and select to						
	(Occ Activity Types and Scious	ne one when best alas eateem	o domevement.)				
3.	Roles (See 3.4.2 Designing Te	ams and Assigning Roles)					
4.	Preparation Assessment Pla	n	time allotted				
5.	Activity Set-up Plan		time allotted				
6.	Group Work		time allotted				
			skills, and describe your anticipated response.				
Co	Situation ognitive:	Skill	Intervention				
So	cial:						
Aff	ective:						
7.	Closure		time allotted				

Implementation Planning Worksheet

Name C		College/University			
	ut a check mark in the box beside the three aspects nost comfortable/knowledgeable.	of activity design liste	d below with which you feel		
	ut a check mark in the box beside the three aspects nore coaching/consulting.	of activity design liste	d below in which you desire		
	Aspects of Activity Design	THREE aspects with which I'm MOST COMFORTABLE	THREE aspects where I desire MORE COACHING		
	Organizing course content in a knowledge table				
	Identifying learning skills for a course				
	Prioritizing needs for learning activities				
	Selecting an appropriate activity type				
	Producing a learning model				
	Writing 'why' statements				
	Formulating learning outcomes for an activity				
	Specifying performance criteria for an activity				
	Composing critical thinking questions				
	Developing skill exercises				
	Using technology				
	Giving written instructions to students				
	Creating a facilitation plan				
	Assessing activity design				
	Assessing activity facilitation				
1i	Which course(s) would you like to focus on with respect ke those explored in this institute? What are three possible content areas in the above-ingrificant value to teaching/learning?				

4.	Are you interested in designing a new course involving Process Education? If so, how might this course look to you?
5.	Are you interested in being part of a "Foundations Course" or being a part of an editorial team developing curricula for such a course?
6.	What are your goals for implementing what you've learned in this institute over the next 12 months?
7.	What are the top three issues that you need to resolve in order to successfully implement your plan?
8.	Please indicate if you are interested in the following:
	Being a mentor at a future Activity Design Institute
	Attending another Institute (which one?)
	Collaborating on a workshop/paper at a conference
	Joining the Academy of Process Educators
	Writing a module for the Faculty Guidebook
9.	What would you like to see happen as the next step with respect to faculty development at your campus? Why?

Name Team	December 10 Deposit
Date	Recorder's Report
Activity	
Before the activity	
Record the basic agenda or plan as outlined by the team leader:	
During the activity	
mportant information to be documented:	

During the act	tivity	
Important information to be referenced. Where did you get key information?		
At the end of t	the activity	
State the three most i	mportant discoveries learned from the activity along with the significance of each and how each can be applied.	
1		
2.		
0		
3.		
_	Strengths:	
Instructor Feedback	Areas for Improvement:	
I CCUDACK	Insights:	

Name	
Team	Reflector's Report
Date	Reflector 3 Report
Activity	

Team Date	Market Ma	r
Activity		
Team Performance		
Our team's greatest strength and why:		_
Our team's greatest area for improvement and l	now the improvement can be made:	
An insight gained about learning during this acti	vity:	
Individual Performance		
Name:	Team Role:	
Strength:		
Area for Improvement:		
Name:	Team Role:	
Strength:		
Area for Improvement:		
Name:	Team Role:	
	Team Role:	
	Touri Noic.	

Instructor Feedback

Strengths:

Areas for Improvement:

Insights:

SII Assessment Form
Name:
Performance/Situation:
Strengths Identify the ways in which a performance was of high quality and commendable. Each strength statement should address what was valuable in the performance, why this attribute is important, and how to reproduce this aspect of the performance.
1.
2.
3
Areas for Improvement Identify the changes that can be made in the future, between this assessment and the next assessment, that are likely to improve performance. Improvements should recognize the issues that caused any problems and mention how changes could be implemented to resolve these difficulties.
1.
2.
3
Insights Identify new and significant discoveries/understandings that were gained concerning the performance area; i.e., What did the assessor learn that others might benefit from hearing or knowing? Insights include why a discovery/new understanding is important or significant and how it can be applied to other situations.
1
2
3.

SII Assessment Form		
Name:		
Performance/Situation:		
Strengths Identify the ways in which a performance was of high quality and commendable. Each strength statemen should address what was valuable in the performance, why this attribute is important, and how to reproduce this aspect of the performance.		
1		
2.		
3.		
Areas for Improvement Identify the changes that can be made in the future, between this assessment and the next assessment, that are likely to improve performance. Improvements should recognize the issues that caused any problems and mention how changes could be implemented to resolve these difficulties. 1.		
2.		
3		
Insights Identify new and significant discoveries/understandings that were gained concerning the performance area; i.e., What did the assessor learn that others might benefit from hearing or knowing? Insights include why a discovery/new understanding is important or significant and how it can be applied to other situations.		
1		
2		
2		
3.		

Section 19

Selected Glossary

Selected Clossary

Active Learning

Facutly Guidebook: 3.3.3 Process-Oriented Guided-Inquiry Learning

a mode of learning which puts learners in situations where they are asked to take responsibility for their own learning, thus becoming highly engaged in the construction of knowledge

Activity Sheet

Facutly Guidebook: 3.2.5 Creating a Facilitation Plan

a form comprised of one or multiple pages given to students which explains the purpose and relevance of the activity and which may include instructions or questions, or spaces for students to record their observations, results, and/or assessments.

ADDIE Model of Instructional Design

Facutly Guidebook: 2.4.6 Methodology for Program Design

a model of instructional design that begins with a consideration of the outcomes ultimately desired from the program, course, or activity, and uses them as a basis for design as well as measurement for success. ADDIE stands for the five stages of development: analysis, design, development, improvement, and evaluation.

Assessment/Assessing

Facutly Guidebook: 4.1.1 Overview of Assessment

a process for determining the quality of a performance, work product, or skill and giving feedback that documents progress (strengths) and suggests ways to improve future performance (areas for improvement) in ways that will help the performer improve his or her future performance

Assessor—the person who is giving the assessment feedback

Assessee—the person whose performance, work product, or learning skill(s) is being assessed

Continuous Assessment—assessment conducted on an ongoing basis during the process or performance

Course Assessment System—a mechanism by which students and faculty can track student performance during the course and identify opportunities for improvement. The assessment system should relate to the course performance measures

Formative Assessment—assessment given during the course of a performance or course to help the assessee to prepare better for a final or summative evaluation

Peer Assessment—feedback is given by a colleague or peer

Self-Assessment—is related to metacognition and insight, and has to do with looking objectively at one's own performance

Real-time Assessment—feedback is given at the time of the performance

SII Method (of Assessment Reporting)—a method of recording and reporting assessment findings which includes a description of the strengths of the performance, the areas in which the performance may be improved, and insights the assessor had while observing and reflecting on the performance

Best Practices

a management idea which asserts that there is a technique, method, process, activity, incentive or reward that is more effective at delivering a particular outcome than any other technique, method, process, etc.

Bloom's Taxonomy (of Educational Objectives)

Facutly Guidebook: 2.2.1 Bloom's Taxonomy—Expanding its

Meaning

a pedagogical framework for classifying explicit formulations of the ways in which students are expected to be changed by the educative process. Objectives are classified into domains (cognitive, affective, social, and psychomotor) and are ranked within those domains from simplest to most complex.

Knowledge
ightarrow Comprehension
ightarrow Application
ightarrow Analysis
ightarrow Synthesis
ightarrow Evaluation

Broad Learning Goals

general expectations of the course within a larger program that serve as a starting point for formulating learning outcomes.

Classification of Learning Skills

Facutly Guidebook: 2.3.3 Classification of Learning Skills

(for Educational Enrichment and Assessment)

an organizational scheme for instructional design that helps educators and learners identify transferable learning skills that apply to multiple disciplines and which are needed for successful performance in work and in life.

Domain: a sphere of functioning performance

Cognitive—skills related to thinking and attaining knowledge

Affective—attitudinal skills predominantly related to emotional (affective) processes

Social—interpersonal skills

Psychomotor—skills deal with one's physical development, wellbeing, and skill in working with objects and using tools

Collaborative Learning

Facutly Guidebook: 3.4.2 Designing Teams and Assigning Roles

an active learning method in which students learn in small groups. Group members are allowed to organize as they please, with little imposition of structure or team roles by the instructor.

Concept Model

any construct that illustrates a concept; can be formed using language, physical objects, mathematics, or pictures. Examples include Piaget's Stages of Cognitive Development, Maslow's Hierarchy of Human Needs, a model of a molecule, or a double helix.

Cooperative Learning

Facutly Guidebook: 3.4.2 Designing Teams and Assigning Roles

a method of learning which uses small-group activities to maximize individual and group learning in instructional settings. Each student has a specific responsibility within the group. Students complete assignments together and receive a common grade.

Course Design (see Instructional Design)

Facutly Guidebook: 2.4.8 Methodology for Course Design

the planning process and the product resulting from determining course learning outcomes, content, methodologies, and activities that will be included in the course as well as plans for assessment and evaluation.

Course Design Template

Facutly Guidebook: 2.4.8 Methodology for Course Design

a formal presentation of each of the items in the course design methodology for public discussion or individual study.

Course Intentions

rationale for a course (often not explicitly stated to students) that includes its relationship to other courses in the program, connection with faculty research interests, contribution to institutional service learning, role in recruiting mentors and graduate students, impact on department development activities, and importance in data collection for program accreditation

Critical Thinking

Facutly Guidebook: 2.2.5 Overview of Critical Thinking

thinking in a challenging or skeptical way by identifying ambiguities and assumptions, finding contradictions, examining the logic leading to a conclusion, judging whether a statement is overly general, critiquing the application of principles and concepts, deciding whether a definition is adequate, and determining whether a statement is relevant or reasonable

Critical Thinking Questions

Facutly Guidebook: 2.4.15 Writing Critical Thinking Questions

a tool used in designing guided-inquiry learning activities that guides students to explore and observe, then to invent or develop an understanding of relevant concepts, and finally to apply this new understanding. Three types of questions are used: directed, convergent, and divergent.

Design/Designing

a systematic, interactive, and iterative development of a process, system, or product to meet a set of specifications for a specific function or end

Empowerment

increased capability resulting from expanded ability, willingness, support, and resources required to act. Empowerment is the key that puts a person in a position of being in control of a situation rather than being controlled by the situation.

Evaluation/Evaluating

Facutly Guidebook: 1.4.6 Overview of Evaluation

a process of determining the quality of a performance, work product, or learning skill based upon a predetermined standard and mutually-understood criteria in order to decide whether or to what degree it meets a standard

Facilitation

Facutly Guidebook: 3.2.1 Overview of Facilitation

actions taken to help others learn or perform. In a learner-centered paradigm, facilitation takes the place of teaching, stressing the centrality of the learner's work in the learning process while the facilitator's role is to take actions to assist in this process.

Facilitator

the person who is in charge of pacing the activity, observing and assessing the process, and who is responsible for ensuring that the group or individual best meets the criteria set out in the activity

Facilitation Plan

Facutly Guidebook: 3.2.5 Creating a Facilitation Plan

a written plan, developed before a facilitation event wherein the facilitator anticipates and decides in advance how to address predictable learner needs.

Forms of Knowledge

Facutly Guidebook: 2.3.9 Forms of Knowledge and Knowledge Tables

classification of knowledge into one of five types:

Concepts—a generalized idea about something or a classification label.

Processes—sequences of steps, events, or activities that, over time, result in changes or products

Tools—any devices, implements, instruments or utensils that serve as resources to aid in accomplishing a task.

Contexts—the situation or background that is relevant to the understanding of a concept or process.

Way of Being—the thoughts, attitudes, and behaviors characteristic within a culture, discipline, or knowledge area.

Instructional Design

Facutly Guidebook: 2.4.1 Overview of Instructional Design

the determination and specification of the content, methodologies, activities, sequencing, evaluation, and assessment of the learning experience

Program Design—facilitating the fulfillment of program goals by laying out curricular and cocurricular learning experiences

Course Design—identifying and sequencing of course content and activities to meet course outcomes

Activity Design—the process by which learning experiences are planned to systematically take into account how learners make sense of new information, how they acquire new skills, or how they develop a new way of being, and design activities so that the learning leads to the achievement of the course and program outcomes.

Knowledge

Facutly Guidebook: 2.2.4 Differentiating Knowledge from Growth

awareness or possession of information about facts, ideas, skills, truths, and principles

Knowledge Skills/Learning Skills

Facutly Guidebook: 2.3.3 Classification of Learning Skills

strategies embedded in a learner's behavioral repertoire, transferable across disciplines and contexts, which enable him or her to improve mastery of subject matter. They are essential for constructing knowledge because they "modulate" or influence what learners can achieve at any level. These skills, once identified, can be consciously improved and refined, increasing the rate and effectiveness of learning.

Knowledge Table

Facutly Guidebook: 2.3.9 Forms of Knowledge and Knowledge Tables

(sometimes referred to as a knowledge map) a tool for analyzing specific cognitive schemes or frameworks within any particular area of knowledge, often for the purpose of setting learning goals. It is useful as a hierarchical inventory of the knowledge and skills students must master in order to achieve the learning goals for a program or course.

Learner-Centered

the idea in education that instructors and institutions should focus on what learners want and need.

Learning Activity

Facutly Guidebook: 2.4.13 Overview of Learning Activities

the core unit of instructional design which organizes a unit of time, in or out of class, to address a subset of course learning outcomes

Learning-Centered/Learning-Centered Teaching

a mode of instruction that views learning as a process worthy of explicit, conscious development. Due to the rapidly changing nature of our world, it is no longer enough for students to absorb a prescribed body of content knowledge and call themselves "educated"; they must be able to continue learning throughout life and to improve their skills in learning on a continuous basis.

Learning Communities

Facutly Guidebook: 3.1.2 Introduction to Learning Communities

formal and informal groups who share common values and beliefs and who voluntarily invest time to work together, and actively engage in learning together.

Learning Model

a demonstration of one of the knowledge forms (concepts, processes, tools, contexts, and ways of being) around which learning activities are built.

Concept Model (concepts)

Case Study (contexts)

Methodology (processes)

Template/Tool (tools)

Profile (way of being)

Learning Object

a self-contained learning tool that illustrates one or more ideas for independent study.

Learning Objectives

Facutly Guidebook: 2.2.1 Bloom's Taxonomy—Expanding its Meaning

"explicit formulations of the ways in which students are expected to be changed by the educative process" (Bloom, 1956). Educational objectives indicate what students should attend to and put effort into when learning.

Learning Outcomes

Facutly Guidebook: 2.4.5 Learning Outcomes

clear and precise articulations of what learners are expected to be able to do or achieve by the end of a learning experience.

Competencies—the collection of knowledge, skills, and attitudes needed to perform a specific task effectively and efficiently at a defined level of performance.

Movements—documented growth in a transferable process or learning skill.

Experiences—interactions, emotions, responsibilities, and shared memories that clarify one's position in relation to oneself, a community, or discipline.

Accomplishments—significant work products or performances that transcend normal class requirements and are externally valued or affirmed by an outside expert or client.

Integrated Performance—the synthesis of prior knowledge, skills, processes, and attitudes with current learning needs to address a difficult challenge within a strict time frame and set of performance expectations.

Learning Styles

Facutly Guidebook: 4.3.2 Student Learning Styles

automatic, habitual patterns of learning or processing preferences, which are based on habituation of routines and which are acquired over a learner's entire lifetime. Learning styles lead people to prefer and perform better in certain kinds of learning contexts over others.

Levels of Learner Knowledge

Facutly Guidebook: 2.2.2 Elevating Knowledge from Level 1 to

categorization of educational objectives to represent the increasing complexity in the way learners formulate, connect, and present their thoughts.

Level 1 Information—gathering facts in specific contexts

Level 2 Comprehension & Understanding—inferring relationships or connections between two facts or a fact to a context, identifying similarities and differences, understanding

Level 3 Application—identifying explicit and implicit assumptions while using knowledge in varying contexts

Level 4 Working Expertise—the ability to integrate knowledge with learning skills to produce a generalized solution to a problem, to solve complex problems by applying many kinds of knowledge and integrating these processes and tools, and to produce solutions that can be reused and transferred to similar situations with minimal adjustments

Level 5 Research—systematic, unbiased investigation used to increase knowledge and understanding Level 6 Assessment—reflecting on one's own or others' performances, against pre-set criteria, to try to find ways to improve

Long-Term Behavior

Facutly Guidebook: 4.3.2 Student Learning Styles

habitual behaviors and qualities educators want students to exhibit on their own after a course or program is completed. Long-term behaviors should align closely with expert profiles in various disciplines. Descriptions of long-term behaviors serve as the basis of instructional design, because they represent the ultimate goal of learning.

Methodology

an explicitly defined set of multi-step instructions for performing a complex process, designed to enable those who are novices in a skill area to work smarter without having to learn the steps through trial and error.

Model

- **n.** an example for imitation or emulation; a description or analogy used to help visualize something (as an atom) that cannot be directly observed
- v. to serve as an example or to demonstrate the way a process is done so that others may learn by emulating

Motivation

Facutly Guidebook: 2.2.7 Understanding Motivation and Self-Regulation Theories

a complex amalgam of all the factors at work in a given point in time that influence an organism's "movement" toward a goal.

Extrinsic Motivation—a condition that pertains whenever an activity is done in order to attain an outcome separate from simply accomplishing the activity (such as a reward)

Intrinsic Motivation—the internal influences or stimuli active at a point in time that result in an organism's "movement" toward a goal. Students who are intrinsically motivated to learn find value in the learning itself, not just the grades or credits earned as a result of learning.

Performance Criteria

Facutly Guidebook: 2.4.9 Writing Performance Criteria for a Course

areas of performance, clearly and explicitly defined, which allow all involved (performer, assessor, evaluator, etc.) to have a mutually understood set of expectations by which performance may be measured, assessed, and/or evaluated.

Performance Measures

Facutly Guidebook: 1.4.1 Overview of Measurement

indicators, derived from performance criteria, which allow for comparison of actual performance against the ideal performance (measurement of actual versus ideal).

POGIL (Process-Oriented Guided-Inquiry)

Facutly Guidebook: 3.3.3 Process-Oriented Guided-Inquiry

Learning

a philosophy and a strategy for teaching and learning encompassing specific ideas about the nature of the learning process and the expected outcomes, and a student-centered methodology and structure that are consistent with the way people learn and achieve these outcomes.

Problem Solving

Facutly Guidebook: 2.2.6 Overview of Problem Solving

a process whereby a "best" outcome is determined for some situation, subject to certain constraints, by finding, creating, or developing solutions to a question, matter, situation, issue, or person that is perplexing or difficult to deal with.

Process EducationTM

Facutly Guidebook: 2.3.1 Introduction to Process Education

a performance-based philosophy of education which integrates many different educational theories, processes, and tools in emphasizing the continuous development of learning skills through the use of assessment principles in order to produce learner self-development

Project Learning Facutly Guidebook: 2.5.3 Distinguishing between Problem Solving, Design, and Research systematic, unbiased investigation used to increase one's personal knowledge and understanding when undertaking project work

Research Facutly Guidebook: 2.5.3 Distinguishing between Problem Solving, Design, and Research

loosely, the methodology (multiple-step models for complex processes) used in the engagement of systematic, unbiased investigation within a discipline, used to produce new knowledge and understanding

Research Methods—Experimental, Correlation, Natural Observation, Survey, Case Study

Qualitative—Relating to the general qualities that can describe the level of performance or a product

Quantitative—Relating to the numerical values that can describe the level of performance or a product

Research-Based

established on principles determined through systematic, unbiased investigation used to increase knowledge and understanding

Rubric

Facutly Guidebook: 1.4.2 Fundamentals of Rubrics

a scoring tool for measuring the level of performance achieved which describes in words what performance looks like for every performance criteria at every level.

Analytic Rubric—requires the measurer to score the level of performance for each component of the performance criteria

Holistic Rubric—requires the measurer to score the overall process or product as a whole, without judging the components separately

SII Method (of Assessment Reporting)

Facutly Guidebook: 4.1.9 SII Method for Assessment Reporting

a method of recording and reporting assessment findings which includes a description of the strengths of the performance, the areas in which the performance may be improved, and insights the assessor had while observing and reflecting on the performance, and their significance. (see Assessment)

Strengths—identify the ways in which a performance was of high quality and commendable. Each strength statement should address what was valuable in the performance, why this attribute is important, and how to reproduce this aspect of the performance.

Areas for Improvement—identify the changes that can be made in the future, between this assessment and the next assessment, that are likely to improve performance. Feedback in this section should identify issues that caused any problems and mention how changes might be implemented to resolve these difficulties.

Insights—identify new and significant discoveries/ understandings that were gained concerning the performance area; i.e., What did the assessor learn that others might benefit from hearing or knowing? Insights include an explanation of why a discovery/new understanding is important or significant and how it might be applied to other situations.

Skill Exercises

Facutly Guidebook: 2.4.14 Designing Process-Oriented Guided-Inquiry Activities exercises within a learning activity that require students to apply new knowledge in simple situations and familiar contexts to allow them to build confidence and to strengthen understanding.

Theme

an implicit or recurring idea; a subject or topic of discourse or of artistic representation

Section 20

Selected Bibliography

Faculty Cuidebook Section 2: Intellectual Development

	Learning	Theory
	2.1.1	Overview of Learning Theory
	2.1.2	Adult Learning Theories in Process Education TM
	2.1.3	A Brief History of Neuroscience
	2.1.4	From Synapses to Learning—Understanding Brain Processes
	2.1.5	Multiple Intelligences
	2.1.6	Annotated Bibliography—Learning Theory
	Thinking	About Thinking
	2.2.1	Bloom's Taxonomy—Expanding its Meaning
	2.2.2	Elevating Knowledge from Level 1 to Level 3
	2.2.3	Developing Working Expertise (Level 4 Knowledge)
	2.2.4	Differentiating Knowledge from Growth
	2.2.5	Overview of Critical Thinking
	2.2.6 2.2.7	Overview of Problem Solving Understanding Motivation and Self-Regulation Theories
	2.2.7	Process Education TM as a Motivation and Self-Regulation System
		Processes
	2.3.1	Introduction to Process Education
	2.3.2 2.3.3	Framework for Implementing Process Education Classification of Learning Skills
	2.3.4	Cognitive Domain
	2.3.5	Social Domain
	2.3.6	Affective Domain
	2.3.7	Learning Processes through the Use of Methodologies
	2.3.8	Learning Process Methodology
	2.3.9	Forms of Knowledge and Knowledge Tables
	2.3.10	Knowledge Table for Process Education
	Instruction	onal Design
ŀ	2.4.1	Overview of Instructional Design
Γ	2.4.2	Instructional Systems Design Model, History, and Application
	2.4.3	Development and Use of an Expert Profile
	2.4.4 2.4.5	Long-Term Behaviors
	2.4.6	Learning Outcomes Methodology for Program Design
	2.4.7	Designing a General Education Program
	2.4.8	Methodology for Course Design
	2.4.9	Writing Performance Criteria for a Course
	2.4.10	Course Grading Systems
	2.4.11	Designing a Foundations Course
	2.4.12	Creating a Capstone Course
	2.4.13	Overview of Learning Activities
	2.4.14 2.4.15	Designing Process-Oriented Guided-Inquiry Activities Writing Critical Thinking Questions
	2.4.16	Methodology for Creating Methodologies
	2.4.17	Assessing Learning Activities
	2.4.18	Annotated Bibliography—Instructional Design
i	Research	and Scholarship
	2.5.1	Boyer's Model of Scholarship
	2.5.2	Research Methodology
	2.5.3	Distinguishing Between Problem Solving, Design, and Research
	2.5.4	Annotated Bibliography—Educational Philosophy



Introduction to Intellectual Development

The role of Intellectual Development is that perhaps most traditionally identified with centers of learning. Empowerment (increased capability resulting from expanded ability, willingness, and support to act) is achieved by this role through the construction of knowledge. Chapter 2.1, **Learning Theory**, examines the definition of learning from neurological, theoretical, and psychological perspectives. Chapter 2.2, **Thinking about Thinking** provides the vocabulary and conceptual models needed to think and speak meaningfully about thinking. Chapter 2.3, **Learning Processes**, places knowledge and thinking within a human context. This chapter introduces Process EducationTM and the role of methodologies in mastering procedural knowledge. Chapter 2.4, **Instructional Design**, weaves together the understanding of thinking, the meaning of knowledge within a field of study, and the profile of learners within the context of the institution. Because learning and scholarly development occur at the course and program levels, such is the focus of the modules within this chapter. Chapter 2.5, **Research and Scholarship**, examines how the pursuit of knowledge is performed within the context of a field of learning or a body of knowledge—the very definition of "scholarship"—and simultaneously serves to increase that learning and knowledge.

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(Section 2: Intellectual Development) from the Faculty Guidebook

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- We have created a robust search feature that allows you to access FGB content in a context-specific way. Imagine that you need to find or present content in a faculty development context that relates directly to a topic such as "Learner Development," "Measurement," or "Facilitation," and then imagine being able to choose instantly from all related scholarship within the FGB at the click of a button.
- Our Author & Editor Bio-sketches have been expanded to list and link to modules written by each individual.
- Specialized terms are also highlighted in the text, allowing you to view the Glossary definition of a word simply by hovering your cursor over it.

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