# The Assembly Plant of the Mind

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High-end learning is based on the ideas of a small number of philosophers, theorists, and researchers (e.g., John Dewey, Albert Bandura, Howard Gardner, Maria Montessori, Philip Phenix, Robert Sternberg, E. Paul Torrance, Alfred North Whitehead). The work of these theorists, coupled with our own research and program development activities, has given rise to the concept that we call "high-end learning." The best way to define this concept is in terms of the following four principles:

1. Each learner is unique, and, therefore, all learning experiences must be examined in ways that consider the abilities, interests, and learning styles of the individual.
2. Learning is more effective when students enjoy what they are doing. Consequently, learning experiences should be constructed and assessed with as much concern for enjoyment as for other goals.
3. Learning is more meaningful and enjoyable when content (i.e., knowledge) and process (i.e., thinking skills, methods of inquiry) are learned within the context of a real and present problem. Therefore, attention should be given to opportunities to personalize student choice in problem selection, the relevance of the problem for individuals and groups who share a common interest in the problem, and strategies for assisting students in personalizing problems they might choose to study.
4. Some formal instruction may be used in high-end learning, but a major goal of this approach is to enhance knowledge and thinking skill acquisition gained through *teacher instruction* with applications of knowledge and skills that result from *student construction* of meaningfulness.

Many educators have asked us to be more precise about the goals of enrichment clusters. They want answers to questions such as "What are the specific skills that define high-end learning and how are these skills different from the traditional goals of didactic learning?" To address these questions, we used an inductive rather than deductive approach—that is, rather than making a list from the theoretical literature or our own expectations about goals and outcomes, we examined activities taking place in clusters, evaluated student work and teacher involvement, and drew conclusions based on these actual experiences. In other words, we did exactly what we are recommending students do as they go about pursuing problems in their enrichment clusters.

After carefully examining the work of numerous students and questioning many teachers who participated in the enrichment cluster research project, we were able to identify the following list of specific outcomes. Not all outcomes occurred in every cluster, and the levels to which any individual or group achieved these outcomes varied. Taken collectively, however, we believe that these learning behaviors represent a fairly comprehensive list of outcome goals. We recommend that you include such a list in a proposal for or description of an enrichment cluster program. The specific skills that are the goals of high-end learning include developing the ability to:

- find and focus a problem that has personal relevance to the individual or group;
- distinguish between problem-specific, relevant and irrelevant information, identify bias in information sources, and transform factual information into usable knowledge that will help solve the problem;
- plan tasks that address the problem, sequence events in their most logical and practical order for attacking the problem, and consider alternative courses of action and their possible consequences;
- monitor one's understanding at each level of involvement and assess the need for gathering more advanced level information (content), methodological skills (process), and human or material resources;
- notice patterns, relationships, and discrepancies in the information gathered and use this information to refine tasks for addressing the problem and drawing comparisons and analogies to other problems;
- generate reasonable arguments and explanations for each decision and course of action;
- predict outcomes; apportion time, money, and resources; value the contributions of others to the collective effort; and work cooperatively for the common good of the group;
- examine ways in which problem-solving strategies from one situation can be adopted in or adapted to other problem-solving situations (Transfer of Learning);
- communicate in lively and professional ways to different audiences and in different genres and formats.

The ultimate goal of learning that is guided by the four principles and the specific goals or outcomes listed above is to replace dependence and passive learning with independence and engaged learning. Although all but the most conservative educators will agree with these principles and outcomes, much controversy exists about how these (or similar) principles and outcomes may be applied in everyday school situations. Some might view these principles as yet another idealized list of generalities that cannot be easily manifested in schools already overwhelmed by prescribed curriculum and deductive models of teaching. For this reason, we have provided guidelines for developing schedules that inserts enrichment clusters into the regular school week without forcing out other activities. By setting aside a time and following a simple set of guidelines, all students will have opportunities to participate in high-end learning experiences sometime during their school week.

The most difficult part of facilitating high-end learning is getting teachers to stop prescribing and to replace traditional instruction with the kinds of "guide-on-the-side" responsibilities that are used by mentors and coaches. People in these roles instruct only when there is a direct need to accomplish a task necessary for developing a product or service. Many teachers who have served in extracurricular activities as yearbook advisors, drama club directors, 4-H Club advisors, or athletic coaches already have the techniques necessary for high-end learning. The basic characteristics of extracurricular activities follow:

- Students and teachers select the area in which they participate.
- They produce products and/or services that are intended to have an impact on a particular audience.
- They use the authentic methods and advanced level content of professionals to produce their product or service. They may operate at a more junior level than adult professionals,

but their goal is exactly the same—to produce a product or service of as high quality as possible within their level of experience and the availability of resources.

The teacher's role in these activities is to guide students as they find and focus a real-world problem, lend a hand as they locate content and methodological resources, and help them understand how to use the resources. For example, in a cluster that examined the incidence of acid rain in the northeastern part of the United States, the teacher taught students how to prepare slides for microscope analysis and, with the aid of a microprojector, showed then how to identify contaminants in their rainwater samples. Direct instruction should take place *only* when the acquisition of a new skill needs some explanation and demonstration by the teacher.

## "Real-World Problem" Defined

The term "real-world problem" has been tossed around so freely and easily in education circles these days that it has become little more than a hollow cliché. Because a good deal of the focus of enrichment clusters is on the pursuit of real-world problems, we feel obligated to provide the reader with as precise a definition as possible about this often-used but frequently elusive (and illusive) term.

Enrichment clusters are designed to promote the kind of high-end learning described above, and a key concept in organizing and delivering services for this type of learning is *application*. High-end learning consists of *applying* relevant knowledge, research skills, creative and critical thinking skills, and interpersonal skills to the solution of real problems. But what makes a problem real? We define a real-world problem in terms of four essential elements.

1. **Personalization of the problem.** First, a real problem requires a personal frame of reference for the individual or group pursuing the problem. In other words, the problem must involve an emotional or internal commitment to action in addition to a cognitive or scholarly interest or simply wanting to find out more about something.

   Something that is a real problem for one individual or group may not be a real problem for others. For example, stating that global warming or urban crime are "real problems" does not make them real for an individual or group unless they decide to *do something* to address the problem. For these reasons, problems pursued in enrichment clusters must not be predetermined by the teacher or externally assigned.[2] Teachers might help in problem finding and focusing, but students within the cluster should be the main decision makers for selecting the problem and the ways in which it will be pursued. This self-selection provides the ownership and commitment that is needed to work on the development of a product or service for an extended period of time. Teachers and other adults can provide guidance, but they must avoid crossing the line from suggestion to prescription. Divisions of labor within clusters allow individuals to specialize in some aspect of the problem and product, thus increasing opportunities for students to place a personal stamp on any given problem and product.

2. **Open-endedness of the problem.** A second essential element of real problems is that they do not have existing or unique solutions for the groups or individuals addressing the problem.

If an agreed-upon solution, already existing right answer, or prescribed strategy for solving the problem exists, then it is more appropriately classified as a training exercise. Even simulations based on approximations of real-world events are considered training exercises if their main purpose is to teach predetermined content or thinking skills. Professionals solve problems in order to bring about some form of change in the actions, attitudes, or beliefs of a targeted audience or because they want to contribute something new to the sciences, arts, humanities, or other areas of human productivity. We use the word "new" here in a local rather than global way. It is not necessary for young people to make contributions that are new for all humankind. Replications of studies that have been done many times before can be new in a relative sense if they are based on new data gathered locally or a new wrinkle in the data that makes the study different from the work of others. For example, a group of young people who gathered, analyzed, and reported on data about television-watching habits in their community were contributing information that was new, in a local sense, even though similar studies had been done in other communities.

3. **Authentic methodology and advanced content.** The third essential element of a real problem is that the problem is addressed using authentic methods that applies advanced content—that is, by employing the methodology, knowledge, and materials typically used by investigators and creative producers in the various disciplines. Enrichment clusters ask students to assume the roles of practicing professionals to develop the skills of first-hand investigators as they apply cutting-edge knowledge and content from the area of study. These roles and skills may be at a more junior level than adult journalists, historians, artists, environmentalists, filmmakers, or other professionals, but they are clearly different from the typical school role of student as lesson-learner. Using authentic methods is critical because one of the goals of inductive learning is to help young people extend their skills beyond the usual kinds of products that often result when teachers and students view "research" as merely looking up and reporting information. Authentic methodology lends itself to authentic products.

   Similarly, in an enrichment cluster, students construct meaning and consult advanced references and sources as professionals would. Though some reporting of previously known information is a necessary part of most investigations (in the professional world, the pursuit of new knowledge should always begin with a review of what is already known about a given topic), the end result should be a creative contribution that goes beyond existing information that can be found in encyclopedias, on the web, or in the "all about" books that occupy most library shelves.

   Every field of organized knowledge can be defined, in part, by its methodology, and the methodology of most fields can be found in certain kinds of guidebooks or manuals. These "how-to" books are the key to escalating studies beyond the traditional report writing approach that often passes for research. In a book based on this approach to teaching (Renzulli, Gentry, & Reis, 2003), we describe in detail examples of these books and the ways in which teachers can access various sources of methodological information. Likewise, the content of a field is often organized in books about the specific topic, found on the web, and in current journals of the field. To obtain advanced knowledge, students and cluster facilitators alike can connect with experts in their areas of pursuit.

Every field of knowledge can also be defined in part by the kinds of data that represent the raw material of the field. New contributions are made in a field when investigators apply well-defined methods to the process of making sense out of random bits and pieces of information. Although some investigations require levels of sophistication and equipment that are far beyond the reach of student investigators, almost every field of knowledge has entry level and junior level data-gathering opportunities.

4. **Authentic audiences.** The final essential element of real problems is that they are directed toward real audiences. Real audiences are a major part of the *raison d'être* of the practicing professional upon which this model of learning and teaching is based. Professionals produce creative products for specific clients and audiences. Writers hope to influence the thoughts and emotions of their readers, scientists do research to find better ways to cure diseases or make better products, and artists create products to enrich the lives of those who view their works. Students within enrichment clusters also need to develop their work for a real audience. Audiences may change as the work evolves, but they serve as targets that give purpose and direction to the work. Any teacher who has been involved in the production of a school concert or play knows how anticipation of opening night focuses the preparation, precision, and quality of the performance. The same striving for excellence can be found in groups responsible for publishing a school newspaper, yearbook, or developing a community action project. A sense of audience contributes greatly to task commitment and concern for excellence.

Real audiences consist of people who voluntarily attend to information, events, services, or objects. What one group of students did with the results of their local oral history project illustrates the difference between a real and a contrived audience. Although this group first presented their findings to classmates, they did so mainly to rehearse presentation skills. Their authentic audience consisted of members of a local historical society and individuals who read about the student research in the local newspaper and a historical society newsletter.

## The Goals of Investigative Learning

Investigative Learning consists of investigative activities and the development of creative products in which students assume roles as first-hand investigators, writers, artists, or other types of practicing professionals. Although students pursue this kind of involvement at a more junior level than adult professionals, the overriding purpose is to create situations in which young people are thinking, feeling, and doing what practicing professionals do in the delivery of products and services. Student-driven should achieve the following five objectives:

1. Students receive opportunities, resources, and encouragement to apply their interests, knowledge, thinking skills, creative ideas, and task commitment to self-selected problems or areas of study.
2. Students acquire advanced-level understanding of the knowledge and methodology used within particular disciplines, artistic areas of expression, and interdisciplinary studies.
3. Students develop authentic products or services that are directed primarily toward bringing about a desired impact on one or more specified audiences.

4. Students develop self-directed learning skills in the areas of planning, problem finding and focusing, organizational skills, resource utilization, time management, cooperativeness, decision making, and self-evaluation.
5. Students develop task commitment, self-confidence, feelings of creative accomplishment, and the ability to interact effectively with other students and adults who share common goals and interests.

Investigative Learning focuses on the pursuit of real problems and should be viewed as the vehicle through which everything—from basic skills to advanced content and processes—comes together in the form of student-developed products and services. In much the same way that all the separate but interrelated parts of an automobile come together at an assembly plant, we view this form of learning as an assembly plant of the mind. This kind of learning represents a synthesis and an application of content, process, and personal involvement. The student's role is transformed from one of lesson-learner to first-hand inquirer, and the role of the teacher changes from an instructor and disseminator of knowledge to a combination of coach, resource procurer, mentor, and, sometimes, a partner or colleague. Although products play an important role in creating these authentic learning situations, the development and application of a wide range of cognitive, affective, and motivational processes are the major goals of this type of learning.