Design Knowledge: Broadening the Content Domain of Art Education

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In the November/December 1998 issue of *Arts Education Policy Review,* I introduced readers to the concept of design-based education and how design is being used by American teachers in a variety of subject areas. The article described teachers' success using the methods of professional designers (architects, industrial designers, landscape architects, planners, and graphic designers) to achieve learning outcomes that meet the goals of education reform.

In the last issue of *AEPR,* I discussed the inherently interdisciplinary nature of design and its relevance for integrating subjects across the curriculum. As part of that discussion I cited the absence of design education in the preparation of art teachers and the need for greater attention to the range of issues that compose an education in the arts.

In this final article of the series, I address the ease with which teachers in subjects other than art incorporate design into their curriculum, the nature of design knowledge, and the implications of this broadening of responsibility for creative problem solving within education.

The Walt Disney Company is currently running a television spot announcing its American Teacher Awards Program. A young student proudly displays his brightly painted, octagonal design for a cereal box, describing his calculations of volume and surface area and speculating that his next design projects will be the kitchen cabinet and the spoon. He praises his mathematics teacher for helping him achieve his newfound mastery over the physical world.

A current Microsoft television promotion shows students marching into the desert with their science teacher to measure the circumference of a barrel cactus and returning to their classroom to visualize changes in the plant over the course of the rainy season. Of course, Microsoft software aids them in this visualization process.

It is significant that those examples of design-based learning (inventing objects and communicating visually within a set of constraints, modeling, and diagramming) appear on network television sponsored by two companies not especially known for risk taking. It is evidence that the use of design in American classrooms is sufficiently grounded in current learning theory and the desire to connect school subjects to everyday life to serve as a symbol for good teaching. In the age of sound bites, design's value can be understood by general audiences in thirty seconds and reflects favorably on companies concerned with broad support for their corporate agendas.

What is also significant, however, is that the teachers in those commercials represent the disciplines of math and science. Improvement in student performance in those two disciplines has been a national preoccupation since the days of Sputnik. Yet past media representations of math and science teachers have been parodies of monotoned, lab-coated men standing at the blackboard pointing to formulas (remember the science teacher on *The Wonder Years* explaining how volcanoes are formed?). The Disney and Microsoft commercials, on the other hand, promote math and science as fun, useful, and connected to everyday life; the mechanisms for this transformation of teacher and subject image are design projects.

As demonstrated by the 1992 National Endowment for the Arts (NEA) study of the use of design in American classrooms, disciplinary background has little to do with who employs design strategies in instruction.[1] In fact, as I discussed in my first article, the national voluntary content standards in various subjects (especially in science and technology) actually encourage a design-based approach by describing how disciplinary skills and content must be put into action and applied to solving problems in everyday life. The New Standards Project at the University of Pittsburgh goes a step further by using

design problems as an assessment strategy for *applied learning*, evaluating students' ability to integrate problem-solving skills from across the disciplines through hands-on projects that model real situations.

Yet the responses to the NEA survey were notable for the lack of participation by art teachers. Fewer than 5 percent of the 160 submissions to an organization dedicated solely to the arts came from teachers whose primary responsibility was to teach art, and the responses that did come from art teachers reflected a very limited concept of design.[2] Although college art education curricula have paid little attention to the issues of design, absence of instruction cannot be blamed entirely for the lack of interest in design on the part of art teachers. Science, mathematics, and social studies teachers receive no more preparation in teaching design, yet they show markedly higher interest (and sometimes ability) in addressing design issues in their classrooms.

A cursory review of the tables of contents of popular textbooks used in college art foundation courses reveals no mention of communication, function, or context.

What is the nature of design knowledge? And given that the problem-solving skills exhibited by designers are seen as critical to the success of adults in the twenty-first century, how prepared are art educators to lead students in the acquisition of such knowledge and skills in K–12 classrooms?

Design Knowledge and Knowledge as Design

As early as the 1970s, the United Kingdom began efforts to introduce design and technology in its schools.[3] Funded by the central government's School Council, Project Technology made a strong case for a national technology curriculum, while the Design and Craft Education Project sought to revise existing subjects with a new emphasis on design and technology. At the same time, the government's Department of Education and Science funded research on design in general education (Royal College of Art 1976). Led by Bruce Archer and Ken Baynes, that project analyzed the characteristics of designing in an attempt to describe a category of human endeavor analogous to the sciences and the humanities (Davis et al. 1997, 11).

By the late 1970s design/technology was a recognized part of the curriculum at all grade levels in the United Kingdom, and in 1981 the Department of Education initiated a series of studies to develop and evaluate techniques for assessing student performance in the subject. The most comprehensive of those was developed under the direction of Richard Kimbell at the University of London from 1985 to 1991 (Davis et al. 1997, 11). Kimbell's Technology Education Research Unit (TERU) continues its study of how designers think and publishes on the topic.

The conclusion across nearly thirty years of British research is that design is a third way of knowing, not an aspect of the humanities or science. Archer defined design as

> the area of human experience, skill, and knowledge that reflects man's concern with the appreciation and adaptation of his surroundings in light of his material and spiritual needs. In particular, it relates with configuration, composition, meaning, value, and purpose in man-made phenomena. The design area of education embraces all those activities and disciplines which are characterized by being anthropocentric, anthropological, aspirational, and operational; that is, they are man-related, have a value-seeking feeling or judging aspect and have a planning and making aspect. (Baynes 1985, 238).

Herb Simon, British author of *The Sciences of the Artificial*, distinguishes design from other types of knowledge by saying that "the natural sciences are concerned with how things are. . . . Design, on the other hand, is concerned with how things ought to be, with devising artifacts to attain goals" (Simon 1981, 132–133).

Others expand on Simon's definition. Hong Kong Polytechnic University professor Clive Dilnot, in writing for a conference on doctoral education in design, described design as "(the cognitive space) of being able to think about thinking-differently-about the present; a space of thinking about the possible in a quite different way than can be offered through the sciences or the humanities." He goes on to say that design is neither about numbering and narrating (the work of the sciences and the humanities) nor about analyzing and evaluating the already-made or world-given. Instead, he views design as a praxis of the artificial, a means for negotiating and shaping artifice (whose defining characteristic is that it *could be something else or have other characteristics*). Design is oriented essentially to possibility (Dilnot 1998, 71).

David Perkins, codirector of Project Zero and associate of the Educational Technology Center at the Harvard Graduate School of Education, discusses the curricular value of design and proposes that we think of knowledge itself as design (versus knowledge as information). He says thinking of knowledge as design would mean "viewing pieces of knowledge as structures adapted or connected to a purpose." He calls for a theory of understanding reflecting the theme of design in which the following questions reveal the nature of any information:

1. What is its purpose?
2. What is its structure?
3. What are model cases of it?
4. What are arguments that explain and evaluate it? (Perkins 1986, 5)

Design and the Domain of Art Education

How does this nature of design knowledge fit within the traditional domain and practices of art education? What are the prevailing attitudes toward art knowledge by art educators and how do they influence the way in which those teachers view design?

It is reasonable to consider the *National Standards for Arts Education*, developed in 1994 by the Consortium of National Arts Education Associations (including the National Art Education Association), as evidence of what arts education leadership believes "every young American should know and be able to do in the arts." Achievement standards for each of three grade levels guide readers to more specific understanding of desired competencies, but there are six areas of general content knowledge described by the visual arts standards:

1. Understanding and applying media, techniques, and processes
2. Using knowledge of structures and functions
3. Choosing and evaluating a range of subject matter, symbols, and ideas
4. Understanding the visual arts in relation to history and cultures
5. Reflecting upon and assessing the characteristics and merits of their work and the work of others
6. Making connections between the visual arts and other disciplines (Consortium of National Arts Education Associations 1994)

The first two standards describe dominant strategies for the teaching of art in the United States. Content standard 1 refers to student mastery of materials and techniques. The accompanying achievement standards imply that the term *processes* refers to physical procedures and the manipulation of media, not to cognitive skills such as planning or the invention of methods for generating ideas. Although the achievement standards mention understanding the communicative effectiveness of various media, it is noteworthy that this is the first standard in a numbered list, appearing before what little discussion exists of ideas, function, and context. Wording in the grade 9–12 achievement standard states that "communication [of ideas] relates to media, techniques, and processes." The implication is that ideas *follow* the choice of materials and processes, not that medium and methods are in the service of ideas. Advanced students are expected to master at least one medium, with the implication that more would be better and that emphasis is on physical competency, not on cognitive skills that may be independent of specific materials.

The Fit between Design Education and the Demands of the Next Century

Although experts disagree on the educational paths for preparing students for successful adult lives in the twenty-first century, there is some consensus about what knowledge and skills will be in demand. Productive adults must be able to do the following:

- Use their minds well, demonstrating the ability to acquire and use knowledge within a variety of contexts as needed, rather than amassing specific facts that may eventually become irrelevant
- Deal successfully with high degrees of uncertainty in problems, suspending judgment until aspects of the problem have been viewed from multiple perspectives
- Invent new paradigms for problem solving that account for increasing levels of complexity and interconnectedness
- Master technology and make sense of information to serve larger social goals
- Work in teams, drawing on the expertise and creativity of others to solve problems that are too large for a single discipline

Those skills describe the learning outcomes of a design education. For decades, the problem-solving education in design has developed professionals who exhibit those abilities in their day-to-day practices. They must acquire a thorough knowledge of their client's business; address problems with constantly changing parameters; manage the complex interplay of environmental and human factors; think in terms of physical, social, cultural, technological, and economic systems; prioritize competing values; invent and use appropriate technology; communicate effectively in written, oral, and visual presentations of information; and manage clients, teams of designers, and a cadre of production specialists in executing a project.

The pedagogy that produces such individuals involves project-based, situated learning that is evaluated across time through portfolios of work. Projects have a context and require the integration of skills and knowledge from a variety of disciplines. In other words, design education employs the very strategies that mainstream educators now acknowledge as consistent with how children learn best. For this reason, it has garnered the attention of teachers in all disciplines.

It makes sense, therefore, to study the long tradition of design education for insight into practical approaches to achieving the goals of education reform and to preparing students for life in the next century. It would be wrong to assume, however, that because design education is generally studio based and involves students in hands-on, creative problem solving that the teaching strategies of design are the same as those of the fine arts. If K–12 art teachers are to become primary experts in design-based teaching and learning strategies, a deliberate effort must be made by art educators to understand the pedagogy of design and the methods of design professionals.

I believe this to be the perspective imparted in many American art classes: that ideas spring from what can be made in certain materials and that competency is defined by mastery of physical forces. Some of that attitude can be attributed to the efficiency of having every child in the classroom use the same materials at the same time or the expediency of having all students focus on a single demonstration. Under such conditions, however, problem solving centered in human needs and context rarely forms the organizing principle for art experiences and is seen as less relevant to the critique of products than maximizing the formal potential of the particular medium.

In contrast, tools and materials in the science standards (explained in *Benchmarks for Science Literacy* [AAAS 1993]) are presented as a means for extending and comparing human observations. Technology and processes of discovery and invention are described in very specific terms as composing a delicate balance between improving the human condition and causing change in the systems of which they are a part. The evolution of those technological processes is viewed as significant in understanding current perspectives in science. In other words, the standards that relate to the medium and processes of science are nested in discussions of purposeful choices that shape and reflect the social and physical contexts in which we live or hope to live. Given that situated view of ways of doing things and evaluating what they mean, it is understandable that many science teachers show great skill in creating design experiences for their students.

Visual arts content standard 2, on "structures and functions," never fully explains what is meant by those terms. The achievement standards lead one to believe that they refer to principles of visual and spatial organization. The term *function* is never linked to human or social needs and could easily refer to the communicative role played by a particular formal element in an overall composition. Despite claims by the leadership that art education no longer focuses on "the elements and principles of design," this standard appears to talk about the formal language of art, and such instruction can be found in almost every school district in the country.

It is not surprising, therefore, that preoccupation with learning a visual vocabulary also shapes most basic college 2-D and 3-D design courses (not to be confused with the other meanings of *design* used in this article) taken by art education majors. A cursory review of the tables of contents of popular textbooks used in college art foundation courses reveals no mention of communication, function, or context. The knowledge assumed to compose the "form and structure" agenda of beginning art classes is learned first, without communicative or functional purpose and without the mediating influences of context or audience.

The legacy of Bauhaus instruction permeates these beginning visual studies. Points, lines, and planes are manipulated by students according to a yet unknown set of rules for organizing form on a blank page. Students learn a preferred, western European, early-twentieth-century aesthetic by detecting a pattern among visual compositions, which earns them praise from their professor, but whose origins or alternatives outside the canon of Western art history they never discuss. Consequently, the only student reference points for determining success are critiques that reward craftsmanship (mastery of materials and processes) and fluency in applying this particular aesthetic devoid of context, content, and audience.

Generations of college faculty have passed down variations of the classic Bauhaus assignments, along the way losing their original connection to improving living conditions and the quality of manufactured products for the European working class, a design agenda. A pedagogy for teaching a stylistic language intended to complement Germany's worldwide industrial reputation in the first decade of this century now reigns as the dominant strategy for teaching formal principles to American college art students at the turn of the millennium, and subsequently their K–12 protégés for decades to come. Because most art education majors take no additional courses titled *design*, communication, function, and a concern for the cultural, social, economic, and technological contexts in which work is seen become "add-ons" to an already well-established system of formal aesthetics.

Whereas good designers build their language of form from the conditions of the design problem, many contemporary art teachers see design simply as applying an aestheticized formal language to objects and environments of daily life as a means of elevating the ordinary from low to high art (e.g., a chair that challenges the boundaries of sculpture, a sleeker set of garden tools). This is not to degrade those objects; but they represent only one aspect of design and not the issues deemed central to the problem-solving abilities necessary for success in the twenty-first century. Most museum collections of design objects (usually curated by art historians) reinforce the notion of design as a language of form disconnected from its use and context. Among the rare exceptions are the Cooper Hewitt National Design Museum, whose exhibit *Mechanical Brides*

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explored the ways in which the design of kitchen appliances in the middle part of this century reflected cultural attitudes about women, the home, and technology; and the National Building Museum, which has addressed topics such as the growth of suburbs and technological innovation in housing following World War II. In these institutions, a Sunbeam Mixmaster is as likely to be displayed as a George Nelson vase.

For many teachers of other subjects, such as science, language arts, or social studies, there is sufficient richness in the cultural, social, economic, and technological issues involved in good design problems to place such problems at the center of study and to use physical form as a means to explore and resolve conflict among the competing aspects of the problem. For example, how can a cup design be both elegant and disposable, be delicate and yet retain heat, or be stackable but not easily spilled?[4] In other cases, those teachers' assignments focus on the cognitive dimensions of arriving at appropriate form, such as understanding the conceptual differences between designing a teapot and designing a means for heating water. Yet such problems are rarely the content of the art class, where meaningful constraints are seen as limiting creativity.

Visual arts content standard 3 of the *National Arts Education Standards* focuses on subject matter and ideas. In grades nine through twelve, students are expected to "*apply* subjects, symbols, and ideas in their artworks and use the skills gained [presumably in application] to solve problems in daily life" (emphasis added; 70). That curious phrasing again reinforces the idea that the object is something to which meaning is added, rather than an artifact that owes its very existence to visual form as an extension of thought and language. The standards state that advanced students are expected to trace the origins of specific images and sources of ideas, as though meaning is codified for all time, in some universal way, at the moment of conception and not mediated by context or audience experience.[5]

The power of visual and spatial form as a represent*ed* world and as a represent*ing* world, as a means of reasoning about things too complex to hold only in our minds, is a central focus of design. One sees similar concern for representation in mathematics, basic sciences, and social sciences; the diagramming and modeling of abstract, as well as physical, relationships receive increasing attention in the instruction of students in those disciplines. In many cases, visualization is a step in the process of inquiry, not just a method of recording data, illustrating conditions, or reporting conclusions. For example, discoveries of the double helix of DNA and the "snakes chasing their tails" form of the benzene ring resulted from moments of visual insight, long before scientists articulated the minute details of those structures. In other cases, visual representations are intended as discourse, as "arguments" that invite dialogue among viewers. For example, the typographic experiments of the Futurists in the early part of this century were intended to shock readers into discussions of the pure structure of writing as a contributor to meaning. Yet these ideas about concept, meaning, and representation appear nowhere in the visual arts standards.

The same type of analysis can be extended to the remaining three visual arts standards, but space does not permit that exercise in this article. My intent is not to parse the language through which expectations of student achievement in the arts are communicated or to challenge why suggestions from designers were not incorporated during the drafting of the standards. Instead, my purpose is to reveal the real distance between how art educators and design educators currently view their respective domains, and how practices in art education discourage the incorporation of design instruction. A more direct approach to revealing that distance would have been simply to ask which sections of the standards explicitly direct art teachers to the following issues: (*a*) physical, cognitive, and cultural human factors; (*b*) determining the fit between form and context; (*c*) the process of defining situated problems and resolving competing values; (*d*) the role of prototyping, diagramming, and modeling as ways of reasoning and revealing patterns and relationships in information; and (*e*) the significance of audience in the construction of meaning and perceived use. The answers would further illustrate just how far off art education's radar screen design actually sits.

Neither is it my intent to argue in favor of a new subject in schools, as is the case in the United Kingdom, or for abandoning traditional content in arts education. Most advocates for design-based learning believe that it is best used as a "delivery system" for a wide range of content, including the arts.

My real concern is for the readiness of art educators to assume responsibility as repositories of design knowledge in K–12 schools—as individuals who will impart that knowledge to students within their own discipline, who will take leadership roles in defining cross-disciplinary collaborations that are organized around design perspectives, and who will guide teachers in other subjects to find design opportunities within their own disciplinary teaching.

In support of that concern, I offer four recommendations for art educators.

First, create a clear distinction in the minds of (K–12 and college) students between experiences in basic two-dimensional and three-dimensional design and experiences that address the creative problem solving employed by architects, graphic designers, industrial designers, landscape architects, and interior designers. Stop equating design problem solving with the manipulation of abstract form (point, line, and plane/rhythm, balance, and unity) and suspended or absent concern for meaning, function, audience, or context.

Second, seek and approve access for art education majors to courses in design and design history, and make available literature to support them. Build relationships between college art education and design programs. Reveal disciplinary perspectives toward the interpretation of design and make them the subject of critical discourse.

Third, in K–12 art and college art education classes, explore some problems and experiences that do not place tech-

nique and self-expression at the top of a hierarchy of critical values. Examine problems that privilege audience, use, and context as part of the mix of curricular experiences.

Fourth, encourage art teacher leadership in planning interdisciplinary activities and studies that are built around the cognitive aspects of design problem solving, as well as the content and aesthetics of design artifacts. Use such activities to illustrate the unique problem-solving contributions that the arts and design make to curriculum and as responses to the demands of life in the next century.

It is clear from the NEA study that teachers of subjects other than art willingly accept responsibility for developing students' understanding of design; in growing numbers, science, mathematics, language arts, and social studies teachers use design projects to teach concepts in their disciplines. Although they may not label such experiences *design*, they exhibit a command of design content and skills, incorporate them explicitly in their national standards and goals, and remain open to designerly ways of knowing and learning within and among their disciplines. At the same time, the absence of design in the pre-service education of art teachers and in their curricular practices in schools, as well as an arbitrarily limited definition of the domain of art, creates a blind spot for art educators who wrongfully assume expertise in all things visual and spatial.

There is a window of opportunity for art education to claim a leadership role as the movement toward design-based teaching grows. To do so would improve the long-term viability of arts instruction in schools as parents, educational policymakers, and employers strengthen their support for learning outcomes associated with design-based education. By collaborating with design educators, art education programs can broaden their base of advocacy and secure a position of relevance in the minds of the public well into the future.

Notes

1. That study resulted in *Design As a Catalyst for Learning*, which I coauthored with P. Hawley, B. McMullen, and G. Spilka.

2. Most art teachers who submitted project briefs in the NEA study reduced the concept of design to "the elements and principles of design" such as line, color, texture, rhythm, balance, unity, and so forth. They did not see the use of design for problem solving or for seeking preferred outcomes that result from the physical form of objects, communication, and/or environments. Nor did they acknowledge that design problems model situations in real life. None of the art teachers made connections between suggested projects and the work of practitioners in architecture, industrial design, planning, landscape architecture, interior design, graphic design, or fashion design.

3. The definition of *technology* in the United Kingdom is similar to what we would call *design* in this country. It refers to designing technology: ways of doing things and the objects and communication that facilitate them. It is not synonymous with computers, as it is in the United States.

4. That design problem appears on the 1997 National Assessment of Educational Progress in the arts and was initially rejected by arts content experts at the Educational Testing Service as "being about science." Science experts, on the other hand, saw the problem as "being about art."

5. Postmodern notions of meaning as open and constructed by the viewer have shaped contemporary discourse in art and design since the 1970s, but appear not to have influenced discussions in art education.

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