Models of Curriculum Integration

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The notion of curriculum integration is not new. Dewey and Kilpatrick advocated forms of integration early in the century (Vars, 1991). More recently, however, educational theorists have been advocating curriculum integration for a number of reasons. The challenge has been for those who attempt to put theory into practice. The purpose of this paper is to define curriculum integration, discuss selected research related to curriculum integration, present several curriculum models for integration, and discuss some of the implications curriculum integration will have on education.

Integrated Curriculum Defined

"The very notion of 'integration' incorporates the idea of unity between forms of knowledge and the respective disciplines" (Pring, 1973, p. 135). In practice this can take many forms. Those who consider astronomy, biology, chemistry, geology, and physics as distinct disciplines consider a general science course a step in the direction of integration. They use the metaphor of a marble cake versus a layer cake to signify different levels of integration. The layer cake means each of the sciences maintains an identity in a general science course while the marble cake is more problem based with the various sciences contributing to the solution of the problem. They argue that the layer cake is more of an interdisciplinary approach to curriculum because the boundaries among the disciplines are maintained. Therefore, if one is discussing curriculum integration with a science educator, one must first determine the context because integration could refer to integration within the sciences rather than integration among a wide range of disciplines so that the learner experiences a number of interconnections among disciplines.

An interdisciplinary curriculum can be closely related to an integrated curriculum. Most educators represent the view that knowledge in interdisciplinary studies is a repackaging and, perhaps, enhancement of discipline-based knowledge (Kain, 1993). In Jacobs' (1989) definition, interdisciplinary means conscientiously applying methodology and language from more than one discipline to a theme, topic, or problem.

Whether a curriculum is interdisciplinary or integrated is not the main issue. Rather, the focus should be on designing a curriculum that is relevant, standards based, and meaningful for students. At the same time, the curriculum should challenge students to solve real world problems.

Research Supporting Curriculum Integration

During this decade, cognitive scientists have been able to use advanced imaging technologies to study the operation of the brain.

Much of this research has yet to be directly translated into curriculum and pedagogy. This research is spawning a dynamic educational philosophy referred to as "constructivism" which refers to engaging students in constructing their own knowledge. "The single best way to grow a better brain is through challenging problem solving. This creates new dendritic connections that allow us to make even more connections" (Jenson, 1998, p. 35).

And one of the best ways to promote problem solving is through an enriched environment that makes connections among several disciplines (Wolf & Brandt, 1998).

Educational researchers have found that an integrated curriculum can result in greater intellectual curiosity, improved attitude towards schooling, enhanced problem-solving skills, and higher achievement in college (Austin, Hirstein, & Walen, 1997; Kain, 1993). Barab and Landa (1997) indicated that when students focus on problems worth solving, motivation and learning increase.

Some schools have used an integrated curriculum as a way to make education relevant and thus a way to keep students interested in school (Kain, 1993). In a traditional program, relevancy can be a problem. One of the most common questions in a mathematics class is, "Why are we learning this math?" And the common response is, "Because you will need to know it in your math class next year." This response seldom satisfies the learner. Schools report higher attendance rates when students are engaged in an integrated curriculum (Meier & Dossey, unpublished manuscript). Having the opportunity to utilize knowledge and skills from several disciplines does offer increased opportunities for making the curriculum relevant. A word of caution is in order, however. Just because a curriculum is integrated does not automatically mean that it is relevant.

A number of organizations support integrated learning. Project 2061's benchmarks for science literacy calls for an interdisciplinary, integrated development of knowledge organized around themes that cut across vari-

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ous science disciplines, mathematics, social studies, and technology (American Association for the Advancement of Science, 1993). The National Science Education Standards (National Research Council, 1996) and the Mathematics Standards (National Council of Teachers of Mathematics, 1989) also promote integrated learning. The pending Technology Education Standards (International Technology Education Association, 1998) actually include a major section on making "technological connections." This section refers to ways that technology education relates to other disciplines.

Another premise supporting the move towards integrated curricula is that the current system of discipline-based education is not as effective as it must be. The assumption is that most real world problems are multidisciplinary in nature and that the current curriculum is unable to engage students in real world situations. Thus, a discipline-based curriculum should be replaced with an integrated curriculum (Kain, 1993).

Models of Curriculum Integration

Over the past decade, several models of curriculum integration have evolved. A review of the literature revealed that far more curriculum integration occurs at the lower levels of education (K–8) than at the high school and college levels. The emerging trend is for elementary schools to build interdisciplinary curricula around themes, whereas in high schools and colleges integrated curricula are more likely to be based around problems. An example of a theme at the elementary level could be "Our Community," which affords a relevant setting to specify distance, area, and quantities in the community; to read descriptions of the development and growth of the community; to interview and write about senior citizens who live in the community; to focus on the resources needed to sustain a community; to recognize the blend of ethnic influence on community life; to investigate community festivals and other cultural activities; and to engage in some of the technologies important to individual and community growth. On the other end of the spectrum, a university capstone course might involve students in solving a real world problem such as the design, development, and installation of automated tooling in a manufacturing plant. A solution of this problem would naturally lead the students into mathematical, scientific, and technological issues that would have to be addressed.

The following integrated curriculum models are presented in generic format.

In the interdisciplinary model, schools group traditional subjects into blocks of time, assign a given number of students to a team of teachers, and expect the teachers to deliver an interdisciplinary or integrated curriculum. For example, in Figure 1 the core team consists of

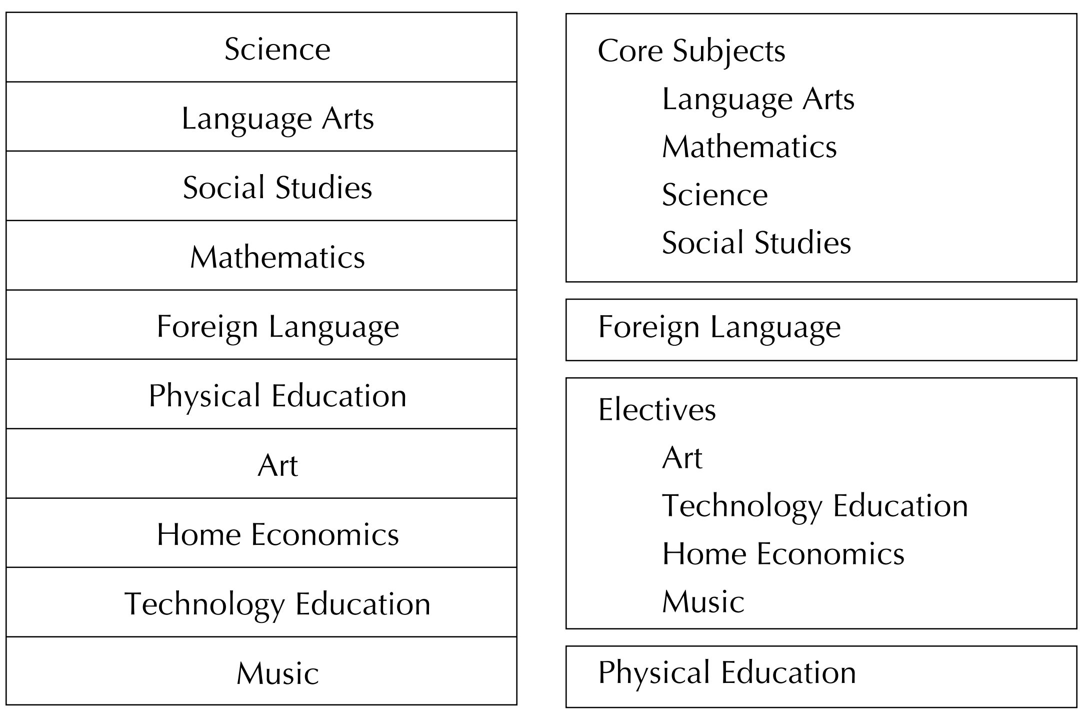

***Figure 1*. The interdisciplinary model.**

four teachers who have approximately 110 students for a block of four periods a day. They are given one hour of common planning time and another hour to learn on their own. The administration empowers them to use their block of time (approximately 175 minutes) in any way they wish. The most typical daily schedule involves groups of approximately 30 students rotating through the four disciplines. Occasionally, the teachers may decide to introduce a new theme to the entire group at the same time. Or, they may take all of their students on a field trip. In practice, this model is being used with greater and greater frequency at the middle school level. This model offers several advantages: Teachers are given time to work together, they have a limited number of students, and this model can support a traditional curriculum while offering scheduling flexibility to the team. One disadvantage is that it is easy for teachers to simply continue doing what they have always done with little or no attention given to the interdisciplinary or integrated curriculum. The biggest disadvantage is that standards-based, integrated curricula across the disciplines are scarce, which means that teachers need to develop the curriculum on their own. Since the process of curriculum development is so time consuming, they are able to implement an integrated curriculum for only a small portion of the school year.

Another curriculum integration model can be referred to as the problem-based model. Ideally, this model places technology education at the core of the curriculum. Since we live in a highly technological society and technology is a human endeavor, this is a natural way to design the curriculum. With a technological problem at the center, disciplines lend their support in helping to solve the problem. An example problem might be to determine how the waste produced in a community could be turned into an asset. In this instance, the social studies class can address the role of local government in collecting and disposing of waste; in science the emphasis could be on reducing materials to their basic elements and recombine them; and in mathematics one could study measurement, area, volume, and so forth. In technology education, the focus might be on the various technologies used to separate waste into categories as well as the transformation of waste into usable materials.

An advantage of this model of integration is that it offers high potential for the identification of relevant, highly motivating problems. On the other hand, a disadvantage of this model is the difficulty of assuring that state frameworks and/or national standards are fully addressed in a given grade level.

An example of the application of this model is the Technology, Science, and Mathematics (TSM) Project directed by LaPorte and Sanders (1996). The project resulted in 17 connection

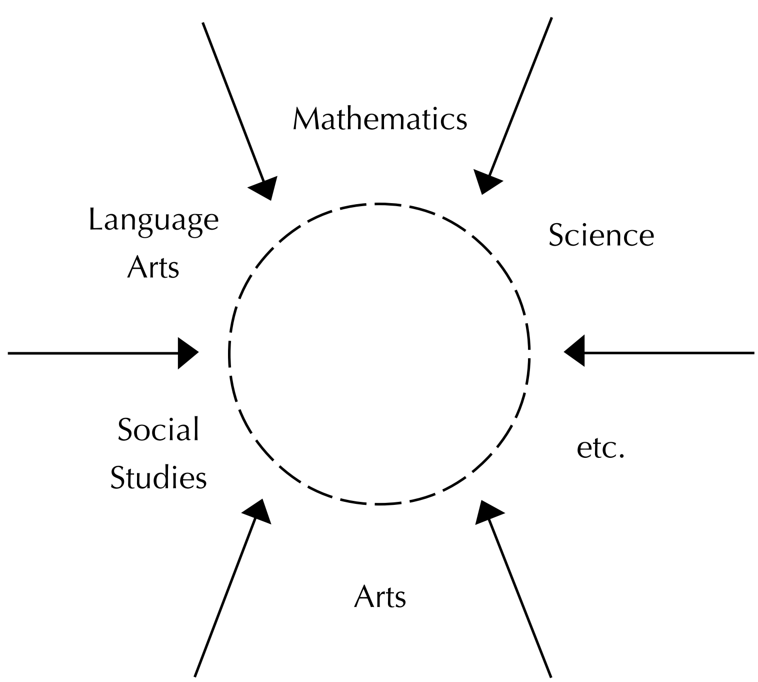

Figure 2. **The problem-based model.**

activities that encourage middle school students to learn the concepts of science and mathematics by motivating them with real world situations of interest to them. The activities use design-under-constraint and hands-on technology (in contrast to hands-on science) to motivate the learning of science and mathematics. The goals are to increase the ability of students to apply concepts of science and mathematics to real world situations; to strengthen communications among science, mathematics, and technology teachers; and to explore the role and effectiveness of technology-based activities.

The third model of integrated curriculum is referred to as theme-based education. Advantages of this model are that teachers can still identify with a given discipline, it is easier to connect the curriculum with national standards and state frameworks, and students are able to make connections among objectives from various disciplines. There could be a tendency, however, for a given theme and/or key concept to have little relationship with a specific discipline, causing the tendency for teachers to engage students in shallow or irrelevant learning.

An example of the use of this model is the Integrated Mathematics, Science, and Technology (IMaST) Program. IMaST is a two-year integrated mathematics, science, and technology curriculum for the middle grades. The program is composed of 10 modules, which provide the full curriculum for each of these disciplines. The program is designed to be taught by a team of three teachers for approximately 120 minutes per day for the full year.

The IMaST program integrates mathematics, science, and technology into a coherent theme-based curriculum; promotes experientially based, hands-on learning set in a learning cycle; promotes teaming among teachers from three or more disciplines; provides an opportunity for students to apply the concepts and skills to new situations using problem-solving strategies; utilizes authentic assessment; makes frequent use of student group work; fulfills benchmarks, national standards, and state frameworks in mathematics, science, and technology; connects to other disciplines, such as social studies and language arts; and responds to the latest research in teaching/learning as well as to systemic reform initiatives. This project is funded by the National Science Foundation with headquarters at Illinois State University.

After reviewing the aforementioned generic models of curriculum integration, one can readily see that researchers and practitioners must have a strong belief system in favor of the integrated curriculum if, in fact, they are to succeed in a sustained manner.

Implications of Implementing an Integrated Curriculum

No matter which model is selected, there are several common factors that tend to emerge. First, teachers must shift their belief system from one that is primarily didactic in nature to one that has a foundation in constructivism. Rather than asking students to follow the steps of procedure, memorize facts, or verify given principles or laws, students work together to discover knowledge, applying their knowledge as they solve real world problems.

Second, an extensive amount of professional development is needed for teachers. This includes a significant intervention of two

THEME
3-5 Key Concepts.

Mathematics	Science	Technology	Language Arts	Social Studies

Objectives

______	______	______	______	______
______	______	______	______	______
______	______	______	______	______
______	______	______	______	______

*Note: Standard-based objectives are selected to address the key concepts within the theme.

Figure 3. **The theme-based model.**

or three weeks of knowledge development in curriculum areas other than the one they are certified to teach. Also, this professional development must include extensive practice in the use of constructivist-oriented pedagogy.

Third, the teachers need to become members of learning communities. At one level this means working with one's peers to improve education. At another level teachers work with their students in solving problems that have multiple answers.

Fourth, teachers need to become skilled in facilitating small group learning. Research has shown that learning is a social process and that students learn a great deal by interacting with one another.

Fifth, teachers need to manage experiential-oriented instruction. This includes inventorying and storing materials; the safe operation of instrumentation, machines, and equipment; and leading students toward efficient progress.

Sixth, teachers need to learn to use authentic assessment strategies such as portfolios, performance exams, and rubrics to document student progress.

Seventh, administrators and school boards need to be oriented so the necessary resources and ongoing support can be provided to the teachers.

Eighth, public information strategies need to be implemented in order to inform the community and parents that a new paradigm of education is being used. The expectation is for education to be provided as it has always been, and unless the public is informed of changes to be made, there is likely to be resistance.

Finally, changing to an integrated curriculum requires systemic reform. This includes the way teachers are prepared, certified, and assessed. Attention must also be given to statewide assessment of students and the process whereby teacher credentials are renewed.

Conclusion

Given the implications listed above, the prospect for moving to the implementation of an integrated and/or interdisciplinary curriculum on a nationwide basis is bleak. On the other hand, research in the area of education as well as in cognitive science suggests that some form of an integrated curriculum is likely to promote more learning. This being true, the topic of integrated curriculum is destined to receive a lot of attention soon.

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