Integration: A sexy buzzword or substance?

'Integration' is a buzzword in educational circles. Comments such as "*everything should be integrated*" fly fast and frequently. People often nod their heads in agreement (perhaps to be politically correct) but may not understand what integration means in practice or even if it is pedagogically wise to integrate everything. And, they may not realize that integrating mathematics requires us to be honest about what is mathematics and what is not; and to be honest about what is significant mathematical activity.

Consider this example of "integration". A grade 6 French Immersion classroom was applauded for integrating mathematics with language development. The reason for the applause was that the students played chess while conversing in French. Doing so is likely useful for learning French. However, to call playing chess a significant mathematical activity is like calling tiddlywinks a significant physical activity. Most of what chess is about is thinking logically, projecting a course of action into the future, and remembering winning/losing situations. These are quite general processes that can be helpful when doing mathematics.

What is significant mathematical activity? It depends, of course, on grade level and individual students but we can illustrate what it is. Imagine a soccer ball. Significant mathematical activity could involve determining its volume, determining how to put pentagonal and hexagonal panels together to make it, and determining the best way to pack soccer balls into a box to minimize wasted space. Significant mathematical activity would not entail kicking the ball around a field and saying something like; "*Look, we are kicking an almost-sphere and therefore integrating mathematics and physical education*."

Integration can be seen as: (1) making connections between this and that and (2) using knowledge from one subject area as a tool in another subject area. The heart and soul of integration is making connections between this and that. As far as students are concerned, connecting mathematics to their experiences is likely more meaningful than integrating mathematics with school subjects such as art or science. Unless students have had powerful experiences in these school subjects, experiences that motivate them to see value in the integrated mathematics, they are likely to see that mathematics as unnecessary clutter or even to ignore it.

Making meaningful connections between mathematics and students' experiences is not an easy thing to do. Students' out-of-school experiences only infrequently lead them to think about and ask questions about mathematics. The reason is that most mathematical concepts, symbols, and relationships tend to be well-buried in the world around children. Except for simple matters such as the shape of a circle, mathematics does not smile and say; "*Hi, here I am. Think and ask deeply about me*." For example, it would be difficult to find a grade 3 student who naturally begins to think about the relationship between the vertices, faces, and edges when holding a three-dimensional object. Simply touching and looking at the object is not likely to invite the child to probe below the surface features of the object and to consider deeper mathematical matters.

A less powerful, but easier to accomplish, type of integration is using knowledge from one area as a tool in another area. This type of integration concerns the MAINTAIN stage of teaching. For example, a student may need to use existing geometry skills to generate a series of shapes and then use existing arithmetic skills to find a number pattern in the series. These skills are integrated with each other and with the Patterns and Relations strand of the curriculum. If the student did not have these skills, the patterning activity would be a disaster.

Even though there are issues and concerns, integration does make good pedagogical sense. Given this, should we always integrate or should there be a combination of private and integrated time for mathematics? A metaphor may help with the answer to this question.

The human body has many parts to it: heart, liver, lungs, blood cells, etc. These parts are all integrated into a functioning body. Yet, each part is identifiable and distinct. For example, the heart is a heart and not a liver. And, when the heart is in jeopardy, we do not operate on the liver. The relationship between mathematics and non-mathematics is similar to that of the human body and its parts. Mathematics, a cultural invention, is distinct from such endeavors as speaking English or doing science. If the mathematics cannot be identified, then it likely is not present. Illusions are not useful for teaching mathematics; nor are they useful for empowering students mathematically.

Mathematics will require private time for development. By this we mean separated time, that focuses on mathematical skills and concepts, is necessary to help students learn mathematics well. While there should be private time for learning mathematics, the reason for learning it should emerge, whenever possible, from a connection to something else (preferably the world of students but the world of other subject areas and the world of adults can be helpful). A DEVELOP lesson should strive to help students make connections between this and that and to see a purpose for learning the mathematics.

The MAINTAIN stage of teaching is well suited to the second type of integration: using knowledge from one subject area as a tool in another subject area. This stage is used to provide students with rich-tasks (problems, activities, projects) that ask them to use their existing mathematical knowledge as tools in new and more complex situations. This can encourage transfer of learning and deepen students' understandings of their existing mathematical knowledge. It also helps them understand that mathematics is not an isolated island. Rather, it is involved in other arenas of human endeavor.

A favourite planning strategy for teachers is a thematic unit. You may have realized that a thematic unit of learning is an artificial devices for integrating subject areas. At the very least, such a unit can help a teacher with the daunting task of planning learning experiences for diverse subject areas, but, in the final analysis, it is the student who makes the connections, not the theme. From the perspective of mathematics, it does not matter how creative the thematic unit is or whether the theme is interesting if the student does not learn or do much worthwhile mathematics. If the theme does not fit well with mathematics, it may be wiser to do mathematics outside of the theme. Integration cannot be a dogma of reform. Integration is only a teaching strategy that may or may not be useful for empowering students mathematically (or otherwise).