Curriculum Design and Technology Integration

A model to use technology in support of knowledge generation and higher-order thinking skills.

By Robin Beaver and Jean Moore

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Over the past few years, we have worked with teachers to help them better integrate technology into their classrooms, and we have come to realize that more attention needs to be paid to this during the planning process if it is to be the result of good curriculum design. As we designed professional development workshops to address this need, we realized that a brief review of educational hierarchies and methodologies was often helpful.

Technology-centered professional development has moved beyond the "Here is this application, and here is how it works" to adding "Here are some integration ideas." Obviously we have to start with the basics. We cannot expect teachers to see the integrative potential of a particular piece of software or hardware without showing them how to use it. However, if we expect educators to use technology wisely, we need to apply the same expectations we would have for traditional educational methods.

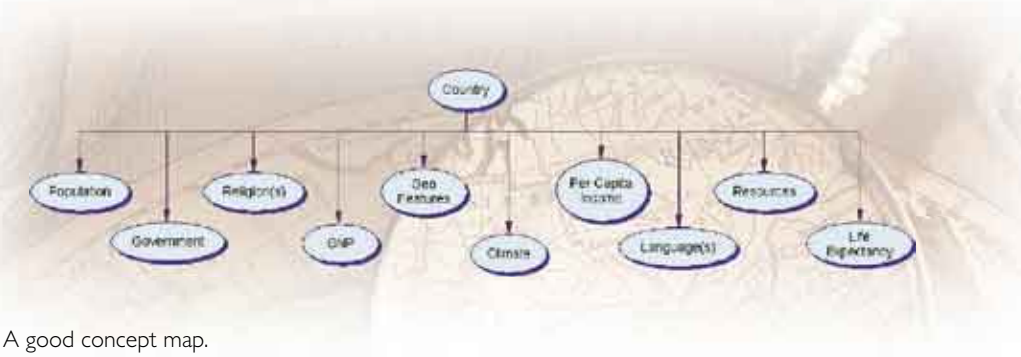
One of the problems with classroom technology integration is that teachers often focus on the technology aspect. When designing a traditional unit or lesson, teachers rarely stop with simple information gathering. They ask students to compare and contrast, synthesize, or apply the information. Why would we then not expect them to do the same with technology? In much the same way, good teachers rarely use only one method of teaching a concept. Instead, they teach it in a variety of ways to reach all learning types in their classes. Technology should be used in the same manner.

Many teachers assume that because they are using presentation software or an electronic whiteboard to demonstrate a concept, they are integrating technology. Although using technology to deliver instruction can be useful, it is not true integration.

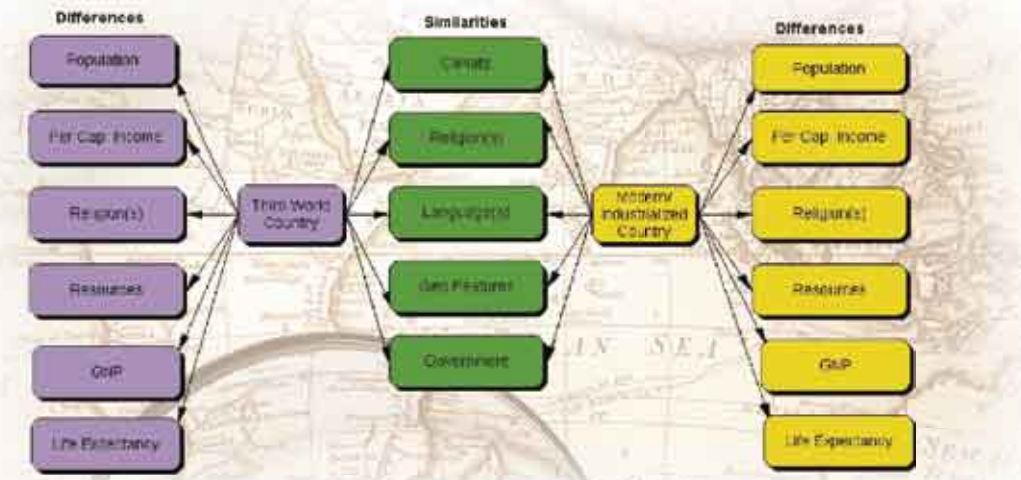
A wide range of valuable educational software products are available. Yet we aren't always applying their full potential to encourage higher-level thinking and to accommodate different learners. For instance, concept mapping products can be an amazing classroom resource. Using them to organize information is good, but using them to analyze information—for example, to compare and contrast information—is better. Another example is the use of spreadsheets. Spreadsheets are a great way to manage data and information, but a better use is to show students how to use them to make inferences and predictions, or even better, to develop new ideas.

Students could be given a country and asked to find certain facts about that country and put them in a concept map. This is not necessarily a bad assignment but it should be a stepping stone for deeper exploration. We would not stop here using traditional methods.

A deeper assignment and better use of the application might be to ask students to create a chart comparing the country they have researched with a third-world country. This is reaching higher, but we can do even better. Students could be asked to create their own country based on what they have learned. This assignment asks students to analyze, synthesize, and create something new. It is not



A good concept map.



A better concept map that compares and contrasts.

The best concept maps include student creativity and assessment potential.

Solar System Unit Outline

Knowledge

Questions. List the planets of the solar system and their position in it. Explain how the planets move.

Activities. Draw a diagram illustrating this information. Create a model illustrating the solar system. Write a poem to help remember the planets and their positions. Choreograph a dance demonstrating the motion of the planets.

Comprehension

Questions. Find the distance between Earth and another planet. Estimate the time it would take to travel to that planet by bike, airplane, and space shuttle.

Activities. Create a chart illustrating the travel times.

Application

Questions. Calculate your weight on each of the planets.

Activities. Create a chart comparing this information. Draw a scaled diagram illustrating the information. Create scaled clay models that demonstrate the comparison.

Synthesis

Questions. Plan a trip to another planet, taking into consideration the characteristics of that planet as you prepare. What would it be like to travel through the solar system?

Activities. Create a brochure for the trip. Create a print or video advertisement for the trip. Write a play about the visit. Write a diary of the trip including information about your experiences and feelings. Listen to *The Planets* by Holst. Describe how the theme of each movement relates to its planet's characteristics.

Evaluation

Questions. Which planet should the United States explore next? Why?

Activities. Have a classroom debate on the issue. Write a letter to NASA explaining your position.

so much the technology that changes but what we ask our students to do with it.

We have worked with a wide variety of talented, insightful teachers. However, as we presented the workshops it became evident that many of the teachers we were working with had not revisited Bloom, Gardner, or any educational theorist in quite some time. They were all instinctively applying good pedagogical practice but had not looked to their origins in the recent past. And they certainly had not thought to apply these methodologies to their use of educational technology. We work to help teachers find ways to apply the same thoughtful educational practices they have always employed in instructional design to their use of technology as well.

We propose a model that asks teachers to aim for higher-order thinking skills and address varied learning styles as they plan new lessons or update previous ones, and then use that information to look for technology integration opportunities. The model asks teachers to:

- Consider goals/objectives or outcomes/standards for their lesson or unit
- List possible questions and activities for each level on Bloom's taxonomy and each learning style in Gardner's theory of multiple intelligences
- Look for areas where technology might support the lesson or activity

The following is an example of how the model has been applied to a fourth grade unit on the solar system.

The first step, of course, is to outline our goals and objectives for the unit as defined by our school curriculum or state standards. For this project, they were taken from the Pennsylvania Department of Education Academic Standards.

- Students will develop an overall understanding of the composition and structure of the universe and Earth's place in it.
- Students will be able to identify the planets in the solar system and their general characteristics.
- Students will be able to describe the motion of the solar system.

The next step is to list each of the levels of Bloom's taxonomy and brainstorm possible questions and activities for each level. (***Editor's note:*** A grid that the authors provide teachers to assist them with this step is part of the supplement available at http://www.iste.org/ll/.) We want to create more activity on the higher end of the hierarchy. However, we also realize that activities on the lower end are often necessary before students can move to the higher levels. In other words, we can't expect students to analyze and synthesize information unless they gather it first.

We would create an outline for the unit. Ours is included in A Solar System Unit Outline on this page.

Next, we would review the list of possible activities to be sure that each of the learning styles listed in Gardner's multiple intelligences is represented. (Also included in the online supplement.)

Keeping in mind the software available to us, we would go through the list of activities and projects to find places where technology might support or enrich the activity. This requires some knowledge of available software. Teachers do not have to know all the ins and outs of a program, but they must at least be aware of its capabilities.

Reviewing our lists, we might propose the following:

- Use appropriate Internet sites to find information.
- Use a concept mapping application to: draw a diagram illustrating the planets and their positions, in the solar system; create a chart showing travel times from Earth to

another planet by bike, airplane, and shuttle; create a chart comparing weights on different planets; do prewriting for the writing activities, brochure, advertisement, and debate.
- Use a spreadsheet to: create a chart showing travel times from Earth to another planet by bike, airplane, and shuttle; create a chart comparing weights on different planets; use the auto filter feature to analyze the travel time and weight information.
- Use a page layout application to design a brochure and create a print advertisement for a trip to another planet.
- Use musical notation software to write a jingle to go with a video advertisement for a trip to another planet.
- Use a word processing or creative writing program for any of the writing activities.
- Use video equipment to record poetry, diary entries, plays, dance, or other performances and then to create the video advertisement.

Once the outcomes have been defined and the activities and projects developed, assessment tools can be created. Methodically designed instruction makes creating rubrics easier. These rubrics should be directly tied to and clearly define the objectives or outcomes.

Teachers who have completed our training and applied this model have reported a variety of learning gains. The lower school science teacher who worked with us to develop the solar system unit described above reported that she had used the model as she prepared her first grade unit on ocean habitats for this year. She used Kidspiration to help students compare and contrast the plant and animal life in different ocean habitats. She then had students use Kid Pix to create scenes of various ocean climates with appropriate plant and animal life in each scene. This teacher saw a great improvement in students' mastery of the concepts taught as compared to her past experience with the unit.

A middle school language arts teacher told us that although she had always designed instruction in such a way as to encourage higher-level thinking skills and meet the needs of a variety of learners, using this model helped her to find ways in which technology could support her efforts.

The value of this model is that it begins with the goals/objectives or outcomes/standards—which is where we should be focused. This model finds ways for technology to support the instruction rather than ways for instruction to support the technology. This model also helps with overall curriculum design, not just technology integration. When filling out the grids, teachers become more aware of holes in their teaching styles. They are encouraged to seek ways to fill these gaps while increasing opportunities for technology integration. Thus, technology integration ceases to be an isolated process, but becomes an integral step in curriculum design.

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This is a supplement to "Curriculum Design and Technology Integration" by Robin Beaver et. al.

Bloom's Taxonomy Grid

Knowledge	
Question(s)	Activity
Comprehension	
Question(s)	Activity
Application	
Question(s)	Activity
Analysis	
Question(s)	Activity
Synthesis	
Question(s)	Activity

Evaluation	
Question(s)	Activity

Gardner's Multiple Intelligences Checklist

Visual/Spatial	
Possible assignment/project/activity:	
Verbal/Linguistic	
Possible assignment/project/activity:	
Logical/Mathematical	
Possible assignment/project/activity:	

Bodily/Kinesthetic	
Possible assignment/project/activity:	
Musical/Rhythmic	
Possible assignment/project/activity:	
Interpersonal	
Possible assignment/project/activity:	
Intrapersonal	
Possible assignment/project/activity:	

Multiple Intelligences Checklist

Visual/Spatial Learners. Draw a diagram illustrating the planets and their positions in the solar system. Create a chart illustrating the time it would take to travel from Earth to another planet by bike, plane, and space shuttle. Create a chart comparing weights on different planets. Draw a scaled diagram comparing weights on different planets. Design a brochure for a trip to another planet.

Verbal/Linguistic. Write a poem to help remember the planets and their positions. Create a print or video advertisement for a trip to another planet. Write a play about a visit to a planet. Design a brochure for a trip to another planet. Write a letter to NASA explaining your position on which planet to explore next.

Logical/Mathematical. Find the distance between the earth and another planet. Estimate the time it would take to travel to that planet by bike, plane, and space

shuttle. Calculate your weight on each of the planets.

Bodily/Kinesthetic. Create a model illustrating the solar system. Choreograph a dance demonstrating the motion of the planets. Create scaled clay models that demonstrate the comparison of weights on different planets. Create a print or video advertisement for a trip to another planet.

Musical/Rhythmic. Write a jingle to go with a video advertisement for a trip to another planet. Listen to "The Planets" by Holst. Describe how the theme of each movement relates to its planet's characteristics.

Interpersonal. Have a classroom debate on the issue of which planet to explore next.

Intrapersonal. Write a diary of a trip to another planet, including information about your experiences and feelings.