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## WHAT'S THE BIG ISSUE? CREATING STANDARDS-BASED CURRICULUM

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A student in my methods class recently presented an engaging lesson to his classmates. He asked about a **technology** used in sporting events using video camera images. The system, made by Ques Tec, uses a series of cameras, computers, and sophisticated tracking **technologies** to create computer-generated virtual replays in a number of venues including tennis, golf, and baseball. The students quickly recognized applications: tennis balls barely hitting the white line, slow motion analysis of golf swings, and pitches entering the strike zone of batters.

The discussion continued with the baseball application: How could the **technology** actually help the game? Suggestions included: batters scouting the pitchers for their tendencies; pitchers scouting batters for their tendencies; pitchers scouting umpires for their tendencies in calling strikes; and the league using the results to help umpires improve. Ultimately, the discussion settled on whether or not umpires should be replaced outright by the new **technology**. A lively debate presented issues from several points of view. I knew right away this would be a great topic for a recently finished curriculum entitled Technological Issues.

**Technological Issues** is one of a series of **standards**-based curricula being developed through the Center for the Advancement of Teaching **Technology** and Science (CATTS). The curriculum, which should be available to CATTS Consortium members this fall, has been developed by this author over the past year and a half. Surprisingly, it seems that many issues, such as the one that surfaced in my class, appear to be an excellent fit within this curriculum.

Given a topic as broad and far-reaching as technological issues, how then do you begin to develop a curriculum that is **standards**-based, relevant but not dating itself, and that can please the many consortium constituents? This indeed was a challenge, and one that I would like to share with the readers. The simplest approach is to look at this curriculum development as a system: inputs (guiding principles), processes (how to develop **standards**-based curriculum), output (the curriculum), and feedback (what the reviewers reacted to). Knowing there are readers who will examine this from different perspectives, Figure 1 shows the system model and what each section refers to (feel free to skip to the section that most affects you).

### [Inputs](#)

Obviously, for **standards**-based curriculum, we need to start with the **standards**. This is easy to say, but a bit more difficult to put into practice. Fortunately, we have national **standards** that have been developed through ITEA with the collaboration of other nationally recognized organizations (NSF, NASA, AAAS, NAE). **Standards** for Technological Literacy (ITEA, 2000/2002) provides the starting point. But which **standards** and benchmarks should be included, and how many should the curriculum include?

The first step in the process was to identify organizing principles. In other words, what are the major ideas that a technologically literate person should be able to articulate? A discussion of this process was presented by Barry Burke in the May/June 2005 issue of *The Technology Teacher* (Burke, 2005), and has been identified by ITEA as the Engineering by Design™ model. This process resulted in the identification of course content organizers. The next step involved the use of experts to identify which **standards**/benchmarks represented each of the organizing principles. The final result is a series of courses, which, taken as a whole in the high school sequence, will ensure that all **standards** are covered. Not all **standards** are covered in any one course, and some **standards** may be in more than one course, but all **standards** are addressed within the collection of courses.

The next detail was to identify specific benchmarks for each course curriculum, and the intensity of their use. Should they be covered in detail and drive the lesson, covered with some detail, or merely be supportive? Additionally, **standards** and benchmarks for mathematics and science were also identified for each curriculum by content specialists. Once this matrix was completed, and a title was identified based on the organizing principles, an author was sought to develop the curriculum. With a little coaxing, this is the point at which I entered into the system.

## Process

With a large collection of **standards**/benchmarks from three disciplines, and a succinct title, Technological Issues, how does one start to develop a **standards**-based curriculum? The natural tendency of someone who has been developing curriculum for years was to start with the activities to meet the **standards**.

However, as Burke (2005) exposes, that would result in a **standards**-reflected rather than **standards**-based curriculum.

What is necessary is a rewiring of that part of your brain that controls curriculum development. Here's a good analogy: Many of us trained in industrial arts years ago were "wired" to use three-view drawings in our approach to design. We are able to see a device in each of the three views. Along came parametric modeling, or 3-D visualization. Young students today pick up this approach to design quite quickly; it is close to how the brain visualizes devices. However, those of us wired for the three-view approach require a rewiring to begin to use this new design paradigm. The same is true for curriculum development.

The first step in this new process was a detailed examination of the **standards** recommended for this course. With the concept of issues in the background, a brainstormed list of potential topics, links, concepts, impacts, specific problems, and other technological experiences was generated. This list was massaged, rearranged, and generally bantered about for a while. The goal at this juncture was to determine the ultimate experiences we want students to leave with following their exposure to this course, based on these specific **standards**. In other words, what were the Big Ideas we wanted students to leave with and be able to apply to future situations?

The process for developing **standards**-based curriculum is shown in Figure 2 (a more detailed explanation can be found in *Planning Learning*, ITEA 2005). It is important to note that this is not a linear process. I didn't discover this until after I went through the process and started to reflect upon it. My analogy of the process is to the design process: a circular process whereby, if need be, you can revisit earlier steps based on knowledge gained later in the process. Some examples may help shed light on this process.

The organization of content into the big ideas was one area that had to be revisited over several iterations. It required continuous questioning: Were the big ideas representative of the **standards**? Were the big ideas inclusive enough to welcome all of the ideas brainstormed around the course concept of technological issues? And, were the big ideas representative of the course concept as envisioned by the consortium members? It should be noted that system feedback (from consortium members) was used at various stages in the development process (see Figure 1).

Another area that required some reexamination was the initial selection of **standards**, or specific benchmarks. Some strongly suggested benchmarks (ones that should drive the lessons) appeared initially out of place within the organization I had developed. Other

benchmarks, though not identified as important to this course, I felt were major ones that fit my big ideas. For example, I was charged with including the following benchmark (STL-5 I): "With the aid of **technology**, various aspects of the environment can be monitored to provide information for decision making." Although this is more specific than my Big Idea for that unit would include, I did add a lesson that addresses that standard specifically. In another case, the benchmark (STL-3 G) was pertinent to a Big Idea, which stated: "**Technology** transfer occurs when a new user applies an existing innovation developed for one purpose in a different function," which must be done thoughtfully to avoid causing issues. Interestingly enough, additional technological concepts were explored that are not even in the **standards**, but perhaps should be. One example is the examination of engineering design failures, an important learning tool for many engineering-based programs.

Additionally, input was provided from consortium members from over a dozen different states, each with their unique requirements and desires. The initial design of the curriculum, based on consortium requests, was a curriculum that could be used as a standalone course, or integrated into existing courses. That original curriculum evolved through several iterations into the current stand-alone, full-year, high school level course, with a variety of compromises to meet the consortium needs. The resulting curriculum is described in the next section.

## Output

**Technological Issues** is a **standards**-based (rather than **standards**-reflected), full-year high school curriculum. The technology, mathematics, and science **standards** and benchmarks identified for this curriculum are included in a matrix in the appendix of the document. They were the building blocks that were used to develop a curriculum centered on the topic of technological issues, as discussed in the last section.

Topics, links, concepts, impacts, specific problems, and other technological experiences that addressed the identified **standards** were molded into five units. The five units represent five Big Ideas, or major concepts all students should be able to understand and apply. The goal is to help students become technologically literate; students should be able to understand and apply these big ideas not only in the course, but in future situations they encounter.

The five units and corresponding Big Ideas are shown in Figure 3. Units one through three progress from recognition of issues and identifying sources to examining some current issues. Unit four allows students to tackle technological problems that are aimed at avoiding the creation of issues. Finally, unit five allows students to use tools of predicting (and hopefully avoiding) technological issues with future **technologies**.

Each Big Idea is then broken down into supporting ideas. Each of the supporting ideas represents a lesson organizer (20 lessons total). The **technology standards** are listed for each lesson, and mathematics and science **standards** are tied to the lesson objectives. The lessons provide background information for the teacher and student, suggestions for teaching the unit, assessment tools, a listing of resources, and student assignment/activity handouts. Lesson titles are shown in Figure 4.

Another important part of each lesson is Additional Extension Activities, which allow students to explore additional topics/activities and provide suggestions for teachers to use students' work to help promote their program and link their solutions to the community. For example, Lesson 4-2, which has the class developing a model city using themes of recycling and green products, can be presented to local or regional planning groups in the community.

One important output for this type of curriculum development is the types of lessons that occur. The assignments/activities may not look like your traditional **technology** course. Students are engaged in research and presentations for most of the activities. They are involved in examining some designs, suggesting and modeling design changes, and developing, prototyping, and packaging other designs. They are asked extensively to relate **technology** to their other subjects and to real-world problems. They are challenged to take a critical look at the application of **technology** and, in one case, even debate a current issue. The last unit encourages them to apply predictive tools to examine how **technology** may be applied in the future without creating major issues.

The output, or product, of this curriculum development may appear different than what is currently taught in a **technology** program. Every day I continue to see issues in the news that could be addressed in this course. Hopefully, this guide will help teachers present the **standards** and big ideas in active, real-world programs. As teachers gain experience with this course, they will be able to add additional activities to suit their needs. This was the case at a workshop for teachers in the Baltimore area this summer, where additional activities were created for each unit based on their experience and expertise. I believe this enrichment will help reduce the main negative feedback to this course, as discussed in the next section.

## Feedback

Consortium members were involved in feedback to the curriculum throughout the process. This began with an early proposal of how my outline and big ideas would meet the intended **standards** for this course. Originally, the consortium members requested a flexible type of curriculum, one that could be used as a stand-alone course, or able to be integrated into existing **technology** courses. The resulting curriculum is intended as a full-year, stand-alone **technology** high school course (although parts of it could be integrated into existing courses).

The current version of the curriculum was reviewed by consortium members in various regions of the country. Many of their concerns were addressed in the most recent editing period. For example, the mathematics and science **standards** are referenced more clearly in each lesson, and additional questions were added to the pre/post test questions — questions that are more open-ended in nature and more directly assess students' mastery of the **standards**/benchmarks.

Two feedback issues, however, are still not resolved. First is the issue of "hands-on" activities. It was apparent from the start that a **standards**-based course entitled Technological Issues would be difficult to develop that matches our current activity-driven curriculum. Believe me, it was difficult. However, I would argue that researching, examining, and presenting on technological issues is an alternative method of hands-on (just doesn't have the traditional smoke and chips).

The second issue is related to the first — how will teachers in the field react to the curriculum? This remains to be seen. I believe if teachers are given introductory instruction on the delivery of this course, and gain experience adapting it to their class and students, it will be a rewarding experience for both. It should be apparent for the reader to see many things that are not currently in this curriculum that easily could be incorporated. That is truly the goal of technological literacy — applying knowledge and skills to new and future situations.

## Last Remarks

Getting back to the issues presented in my introduction: Should umpires be replaced by a proven, more reliable **technology**? Obviously this scenario has already happened in other work situations, displacing many jobs (and creating others). As with most technological issues, there are not simple yes or no decisions to be made. This may be a new concept for both students and teachers. Examining and avoiding issues can be a complex and challenging activity.

Hopefully, the reader now has a better understanding of the product — a curriculum entitled Technological Issues. Equally important, the reader should now have an appreciation for and understanding of the process required to develop **standards**-based curriculum. As a profession, I believe we are on the forefront for this type of curriculum development, and as such, are in uncharted waters. Thus, I would welcome any critique to the process or the product, as would the CATTs consortium members.

Legend for Chart:

A - Unit

B - Big Ideas

C - Supporting Ideas

A: 1

B: Recognition — The selection, application, and consequences of all *technology* create various types of issues, which may affect individuals, groups and/or society as a whole.

C: A. Historical examples of technological issues help us better understand current and future issues as they arise.

B. Recognizing and addressing technological issues requires a multidisciplinary approach.

C. *Technology* and society affect each other.

D. All *technologies* have alternatives, each with their own benefits and risks.

A: 2.

B: Sources — Technological issues can result from the *technology* itself, how or where it is transferred, or how it interacts with the limitations of the environment or ecosystem.

C: A. Growth of human population and economic systems create technological issues.

B. Transferring *technology* can create cultural as well as technological issues.

C. Engineering design often creates unforeseen failures.

D. The earth has limited energy and material resources as well as a limited ability to recycle wastes.

A: 3.

B: Examining — Examining why and what humans design, including the constraints and limitations, and how the designs interact with society and the environment, helps us create designs and solve problems with fewer technological issues.

C: A. Needs assessment for design include safety and quality of life.

B. Design criteria and constraints should use ergonomic principles.

C. Ethics and product liability are important to reduce technological issues.

D. Environmental assessments and monitoring should be done in advance to limit technological issues.

A: 4.

B: Addressing — Developing solutions to address human needs or wants, requires certain practices, policies, and protections to minimize technological issues.

C: A. Appropriate *technology* is a design methodology that

- incorporates the *technology*, the user, and the location.
  - B. Careful selection of materials and processes, including recycling and green products, limits technological issues.
  - C. Policies and regulations can govern designs and problem solutions to limit technological issues.
  - D. Acquiring, applying, and protecting technical knowledge reduces technological issues.
- A: 5.
- B: Predicting — A variety of tools and processes are available to predict outcomes of designs or problem solutions in advance, thus limiting negative technological issues.
- C: A. Design analysis tools can be used to select a design or solution with the least amount of technological issues.
- B. Modeling, gaming, and simulations can be used to examine systems before they are fully developed.
- C. *Technology* assessment tools are used to research possible negative impacts prior to the selection and use of a variety of *technologies*.
- D. Forecasting and other futurology techniques can be used to minimize possible technological issues in advance.

Figure 3. Curriculum Units and Big Ideas.

Legend for Chart:

A - Lesson Number and Title

B - Corresponding Assignment Number

C - Hours of Instruction

A: Overview of the Course

B: --

C: 2

A: Unit I — Lesson One: Introduction to Technological Issues  
Using an Historical Case Study

B: Lesson 1-1

C: 4

A: Unit I — Lesson Two: Relating Technological Issues to  
Other Subject Areas

B: Lesson 1-2

C: 4

A: Unit I — Lesson Three: Examining a *Technology* and  
its Adoption

B: Lesson 1-3

C: 4

A: Unit I — Lesson Four: *Technology* Alternatives: Benefits and Risks

B: Lesson 1-4

C: 4

A: Unit II — Lesson One: Examining Exponential Growth

B: Lesson 2-1

C: 4

A: Unit II — Lesson Two: Evaluating *Technology* Transfer

B: Lesson 2-2

C: 6

A: Unit II — Lesson Three: Issues From Engineering Design Failures

B: Lesson 2-3

C: 4

A: Unit II — Lesson Four: Examining Earth's Limited Resources

B: Lesson 2-4

C: 6

A: Unit III — Lesson One: Design and *Technology* for Quality of Life

B: Lesson 3-1

C: 6

A: Unit III — Lesson Two: Criteria for Safe and Ergonomic Design

B: Lesson 3-2

C: 4

A: Unit III — Lesson Three: Design Ethics and Product Liability

B: Lesson 3-3

C: 4

A: Unit III — Lesson Four: Modeling Monitoring *Technology*

B: Lesson 3-4

C: 6

A: Unit IV — Lesson One: Appropriate *Technology* Design

B: Lesson 4-1

C: 12

A: Unit IV — Lesson Two: Model City Design Based on Recycling and Green Products

B: Lesson 4-2

C: 12

A: Unit IV — Lesson Three: Debating Current *Technologies*  
and Their Issues

B: Lesson 4-3

C: 6

A: Unit IV — Lesson Four: Protecting *Technology*

B: Lesson 4-4

C: 6

A: Unit V — Lesson One: Weighing and Prioritizing  
Design Trade-Offs

B: Lesson 5-1

C: 4

A: Unit V — Lesson Two: Using Models, Simulations, and Games

B: Lesson 5-2

C: 6

A: Unit V — Lesson Three: Applying *Technology* Assessment Tools

B: Lesson 5-3

C: 4

A: Unit V — Lesson Four: Applying Forecasting/Futurology Tools

B: Lesson 5-4

C: 6

A: Review, Quizzes, Tests

B: --

C: 4

A: School Functions/Make-up Time

B: --

C: 2

A: Total

B: --

C: 120 hours[\*]

\* 120 hours equates to 180 days (full year course) at 40 minutes  
per period

Figure 4. Course Lessons and Corresponding Assignments (Activities)

DIAGRAM: Figure 1. Curriculum Development System

DIAGRAM: Figure 2. Curriculum Development Process

PHOTO (BLACK & WHITE)

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