ADAPTING FOR SPECIAL NEEDS

Universal Design for Learning

Universal Design for Learning (UDL) is a framework that has important implications for technology use in the classroom. UDL means, among other things, proactively valuing academic diversity in ways that enhance access, engagement, and learning outcomes. One of the mantras of UDL is that instructional design that is deliberately created for individuals with disabilities often provides significant benefits to all students. The essence of UDL involves three components:

- Multiple means of representation to give learners various ways of acquiring information and knowledge;
- Multiple means of expression to provide learners with alternatives for demonstrating what they know; and
- Multiple means of engagement to tap into learners' interests, to challenge them appropriately, and to motivate them to learn.

Traditionally, when educators fail to recognize that 25 to 50% of the students in their classroom may not read at grade level, they distribute textbooks that have a readability level *above* grade level. However, using the principle of multiple means of representation, an educator plans instruction to provide access to digital text so that students can manipulate the physical nature of the text (e.g., change the font size, color contrasts), as well as alter the cognitive difficulty by using tools such as text-to-speech (e.g., www.vozme.com) or auto-summarization (e.g., www.textcompactor.com).

Learn more about universal design for learning in order to understand its applications for your own classroom by visiting:

- Teaching Every Student in the Digital Age: http://www.cast.org/teachingeverystudent/ideas/tes
- Teaching Every Student Blog: http://teachingeverystudent.blogspot.com

Contributed by Dave Edyburn

- **Overview of Step 7: Revisions.** Based on findings from Step 6, teachers make any changes that are needed to achieve even better results in terms of student outcomes.

Now we turn to a more detailed look at each of these focuses. The following sections tell how to implement each step in the model.

Phase 1: Analysis of Learning and Teaching Needs

This phase in integrating technology requires analyzing classroom problems and how technology-based strategies could address them. This section will give a detailed description of the Phase 1 analysis steps and an explanation of why each is necessary. Also see Phase 1 of the Technology Integration Example, which shows how to implement this phase of the model.

Step 1: Determining relative advantage. Every teacher has topics—and sometimes whole subject areas—that he or she finds especially challenging to teach. Some concepts are so abstract or foreign to students that they struggle to understand them; some students find some topics so boring, tedious, or irrelevant that they have trouble attending to them. Some learning requires time-consuming tasks that students resist doing. Good teachers spend a lot of time trying to meet these challenges by making concepts more engaging or easier to grasp, or making tasks more efficient to accomplish.

Technology-based strategies offer many unique benefits to teachers as they look for instructional solutions to these problems. Time and effort are required to plan and carry out technology-based methods, however, and sometimes additional expense is involved as well. Teachers have to consider the benefits of such methods compared to their current methods and decide if the benefits are worth the additional effort and cost.

As mentioned earlier, Everett Rogers (2004) refers to this decision as seeing the relative advantage of using a new method. Table 2.7 lists several kinds of learning problems and technology solutions with potential for high relative advantage to teachers. However, these lists are really just guidelines. Being able to recognize specific instances of these problems in a classroom context and knowing how to match them with an appropriate technology solution require knowledge of classroom problems, practice in addressing them, and an in-depth knowledge of the characteristics of each technology. Deciding whether to integrate technology requires answering the following two questions about technology's relative advantage in a given situation:

- **What is the problem?** To make sure a technology application is a good solution, begin with a clear

Table 2.7 Technology Solutions with Potential for High Relative Advantage

Learning Problem	Technology Solutions	Relative Advantage
Concepts are new, foreign (e.g., mathematics, physics principles).	Graphic tools, simulations, video-based problem scenarios	Visual examples clarify concepts and applications.
Concepts are abstract, complex (e.g., physics principles, biology systems).	Math tools (Geometer's *SketchPad*), simulations, problem-solving software, spreadsheet exercises, graphing calculators	Graphics displays make abstract concepts more concrete; students can manipulate systems to see how they work.
Time-consuming manual skills (e.g., handwriting, calculations, data collection) interfere with learning high-level skills.	Tool software (e.g., word processing, spreadsheets) and probeware	Takes low-level labor out of high-level tasks; students can focus on learning high-level concepts and skills.
Students find practice boring (e.g., basic math skills, spelling, vocabulary, test preparation).	Drill-and-practice software, instructional games	Attention-getting displays, immediate feedback, and interaction combine to create motivating practice.
Students cannot see relevance of concepts to their lives (e.g., history, social studies).	Simulations, Internet activities, video-based problem scenarios	Visual, interactive activities help teachers demonstrate relevance.
Skills are "inert," i.e., students can do them but do not see where they apply (e.g., mathematics, physics).	Simulations, problem-solving software, video-based problem scenarios, student development of web pages, multimedia products	Project-based learning using these tools establishes clear links between skills and real-world problems.
Students dislike preparing research reports, presentations.	Student development of desktop-published and web page/multimedia products	Students like products that look polished, professional.
Students need skills in working collaboratively, opportunities to demonstrate learning in alternative ways.	Student development of desktop-published and web pge/multimedia products	Provides format in which group work makes sense; students can work together "virtually"; students make different contributions to one product based on their strengths.
Students need technological competence in preparation for the workplace.	All software and productivity tools; all communications, presentation, and multimedia software	Illustrates and provides practice in skills and tools students will need in work situations.
Teachers have limited time for correcting students' individual practice items.	Drill-and-practice software, handheld computers with assessment software	Feedback to students is immediate; frees teachers for work with students.
No teachers available for advanced courses.	Self-instructional multimedia, distance courses	Provides structured, self-paced learning environments.
Students need individual reviews of missed work.	Tutorial or multimedia software	Provides structured, self-paced environments for individual review of missed concepts.
Schools have insufficient consumable materials (e.g., science labs, workbooks).	Simulations, ebooks	Materials are reusable; saves money on purchasing new copies.
Students need quick access to information and people not locally available.	Internet and email projects; multimedia encyclopedias and atlases	Information is faster to access; people are easier, less expensive to contact.

statement of the teaching and learning problem. This is sometimes difficult to do. It is a natural human tendency to jump to a quick solution rather than to recognize the real problem. Also, everyone may not see a problem the same way. Use the following guidelines when answering the question, "What is the problem?"

- Do not focus on nonuse of technologies—Remember that knowing how to use a technology appropriately is part of a solution, not in itself a problem to solve. Therefore, avoid problem statements like "Students do not know how to use spreadsheets efficiently," or "Teachers are not having their students use the Internet." Not having the skills to use a technology (e.g., a spreadsheet or the Internet) is an instructional problem, but not the kind of teaching/learning problem to be considered here. It is sometimes true that teachers are given a technology and told to implement it. In these situations, they must decide if there is a real teaching or learning problem the new resource can help meet. If teachers have a technology available and choose not to use it, however, it may mean they can see no relative advantage to using it; nonuse of a technology is not in itself a problem to address with the TIP Model.

- Look for evidence—Look for observable indications that there really is a problem. Examples of evidence include the following: students consistently achieve lower grades in a skill area, a formal or informal survey shows that teachers have trouble getting students to attend to learning tasks, or teachers observe that students are refusing to turn in required assignments in a certain area.

» **Do technology-based methods offer a solution with sufficient relative advantage?** Analyze the benefits of the technology-based method in light of the effort and cost to implement it, and then make a final decision. First, use the following guidelines to help determine whether your methods should be primarily directed or constructivist:

- Use directed strategies when students need an efficient way to learn specific skills that must be assessed with traditional tests.

- Use constructivist strategies when students need to develop global skills and insights over time (e.g., cooperative group skills, approaches to solving novel problems, mental models of highly complex topics)

TECHNOLOGY INTEGRATION EXAMPLE 2.1

PHASE 1: ANALYZING LEARNING AND TEACHING NEEDS

Mia wanted to include more meaningful multicultural activities in the social studies curriculum. She and the other social studies teachers in her school focused primarily on studying various holidays and foods from other cultures. They sponsored an annual International Foods smorgasbord event that was very popular with the students, but she doubted it taught them much about the richness of other cultures or why they should respect and appreciate cultures different from their own. She sometimes overheard her students making disparaging comments about people of other nationalities. Mia felt a better approach to multicultural education might help, but she wasn't sure she had enough background knowledge to be able to develop a more meaningful project.

Mia concluded that she could follow a model she heard about while attending a workshop the previous summer. At the workshop, teachers at another school district described an online project with partner schools in countries around the world. One teacher told about her partners in Israel and Spain. She said students exchanged information with designated partners and answered assigned questions to research each other's backgrounds and locales. Then they worked in groups on travel brochures or booklets to email to each other. They even took digital photos of themselves to send. It sounded like a great way for kids to learn about other cultures in a meaningful way while also learning some geography and civics. The teachers in the workshop remarked that it was difficult to demean people who look and talk differently from you when you've worked with them and gotten to know them. Mia was so impressed with the online project they described that she decided to try it out in her own classroom, even though she didn't know anything about digital cameras or the online resources used in the project. She knew some information about some of the cultures they would be studying, but not all she would need to know. However, she felt she could structure a good curriculum around these activities, once she knew about what was needed.

PHASE 1 ANALYSIS QUESTIONS

1. What is the problem Mia wants to address?
2. What evidence does she have that there is a problem?
3. What would be the relative advantage of the method she is proposing?
4. In what ways does she hope this method will be better than previous ones?
5. What deficits does she have in technology, content, and pedagogical knowledge?
6. How could she go about addressing these needs to improve her Tech-PACK?

and when learning may be assessed with alternative measures, such as portfolios or group products.

Then examine the needs and integration strategies described in Tables 2.3 through 2.5, and determine which one(s) apply for the situation. Select one that seems to be a good match to the problem and situation you have identified in your own classroom. Use the following guidelines to answer the question, "Is technology a good solution?"

» **Estimate the impact**—Consider the benefits others have gained from using the technology as a solution. Is it likely you will realize similar benefits?
» **Consider the required effort and expense**—How much time and work will it take to implement the technology solution? Is it likely to be worth it?

Step 2: Tech-PACK assessment. Next, teachers self-assess their ability to carry out the integration strategy they have chosen. They analyze the intersection of the three knowledge domains—content, pedagogy, and technology—by reflecting on the following questions:

» **What is my content knowledge (CK)?** Information in some content areas (especially in sciences and social studies) changes frequently, as do state content standards. As teachers think about topics they are about to teach (or teach again), they reflect on whether they know the latest, most up-to-date information about the content and the standards their students must meet. If the topic is assessed through a state-mandated exam, teachers can review study guides and other prepared materials to make sure they know content at the required depth they will need in order to develop an effective lesson. If they find they do not know the content information as well as they need to, they must go to the required authority (tests, etc.) and acquire the new content knowledge they need.
» **What is my knowledge of pedagogy (PK)?** Every content and skill area has a body of knowledge about how best to teach it. Each field updates its pedagogical knowledge over time by reporting new research and experiences. Some of this accumulated knowledge on best pedagogical practices can be found in teacher manuals that accompany textbooks or other instructional materials, but more recent information may be available in journals or teacher magazines. As teachers consider these new methods, they also reflect on whether they know enough about them to implement them in their classroom. If they feel deficient in this area, they may need to synthesize the newly available best practices and prepare more planning notes than they normally would on how best to engage students, show examples, illustrate concepts, provide practice, and so on.
» **What is my knowledge of technology (TK)?** New technologies, especially those that are computer-based and online, tend to emerge frequently, making it challenging for teachers to keep up with skills and techniques they need to know to take advantage of them. Many of these technologies were not introduced in teachers' preparation programs or have come into use since teachers left their preparation programs. In addition, even "older" technologies that teachers already learned tend to change on a regular basis. For example, the programs in the most recent version of the *Microsoft Office* suite look and act much differently from those in the previous version. As teachers consider various technology integration strategies, they may need to read up on new or updated technology products and consider what they will need to learn about them to employ them efficiently and help students learn how to use them. Some of this new information is available in product manuals, but some requires teachers to obtain professional development or assistance from others teachers who have learned the technologies.

Phase 2: Planning for Integration

This phase in integrating technology requires making decisions about outcomes and how they will be assessed, and about how to arrange and carry out integration strategies. This section will give a detailed description of Phase 2 steps and an explanation of why each is necessary. Also see Phase 2 of the Technology Integration Example , which shows how to implement this phase of the model.

Step 3: Decide on objectives and assessments. Writing objectives is a good way of setting clear expectations for what technology-based methods will accomplish. Usually, teachers expect a new method will improve student behaviors—for example, that it will result in better achievement, more on-task behaviors, or improved attitudes. Sometimes, however, changes in teacher behaviors are important—for example, saving time on a task. In either case, objectives should focus on outcomes that are observable (e.g., demonstrating, writing, completing), rather than on internal results that cannot be seen or measured (e.g., being aware, knowing, understanding, or appreciating).

After stating objectives, teachers create ways to assess how well outcomes have been accomplished. Sometimes,

» Computer schedule—Mia had a classroom workstation consisting of five networked computers, each with an Internet connection, so she set up a schedule for small groups to use the computers. She knew that some students would need to scan pictures, download image files from the digital camera, and process those files for sending to the partner schools, so she scheduled some additional time in the computer lab for this work. She thought that students could do other work in the library/media center after school if they needed still more time.

PHASE 2 ANALYSIS QUESTIONS (SET 3)

1. If Mia wanted to do a demonstration and display of the project website to the whole class at once, what resource(s) would she have to arrange to do this?
2. Mia was concerned about students revealing too much personal information about themselves to people in their partner schools. What guidelines should she give them about information exchanges to protect their privacy and security?
3. If the network or Internet access were interrupted for a day, what could Mia have the students do to make good use of their time during the delay?

Free open source OPTIONS for Assessment Tools for Teachers

ASSESSMENT OPTIONS	FREE SOURCES
Online survey sites (most have a free, limited-feature option, as well as a for-a-fee option)	Advanced Survey: http://www.advancedsurvey.com/surveys Survey Monkey: http://www.surveymonkey.com Zoomerang: http://www.zoomerang.com SurveyMethods: http://www.surveymethods.com
Rubric makers and free prepared rubrics	Kathy Schrock's assessment and rubric sites: http://school.discoveryeducation.com/schrockguide/assess.html
Test-makers and quiz-makers	Quiz Generator: http://www.quizgenerator.org Content Generator: http://www.contentgenerator.net/multiplechoice to practice creating documents that you will use in the classroom Easton's list of quiz-maker sites and other free resources: http://eleaston.com/quizzes.html

they can use existing tests and rubrics. In other cases, they have to create instruments or methods to measure the behaviors. (See the Open Source feature for some free tools to support assessment.)

Here are a few example outcomes, objectives (which are used to state outcomes in a measurable form), and assessment methods matched to the outcomes:

» **Higher achievement outcome**—Overall average performance on an end-of-chapter test will improve by 20%. (Assess achievement with a test.)

» **Cooperative work outcome**—All students will score at least 15 out of 20 on the cooperative group skill rubric. (Use an existing rubric to grade skills.)

» **Attitude outcome**—Students will indicate satisfaction with the simulation lesson by an overall average score of 20 out of 25 points. (Create an attitude survey to assess satisfaction.)

» **Improved motivation**—Teachers will observe better on-task behavior in at least 75% of the students. (Create and use an observation sheet.)

This phase in integrating technology requires answering two questions about outcomes and assessment strategies:

» **Question 1: What outcomes do I expect from using the new methods?** Think about problems you are trying to solve and what would be acceptable indications that the technology solution has succeeded in resolving them. Use the following guidelines:

- *Focus on results, not processes*—Think about the end results you want to achieve, rather than the processes to help you get there. Avoid statements, like "Students will learn cooperative group skills," that focus on a process students use to achieve the outcome (improved cooperative group skills). Instead, state what you want students to be able to do as a result of having participated in the multimedia project—for example, "Ninety percent of students will score 4 out of 5 on a cooperative group skills rubric."
- *Make statements observable and measurable*—Avoid vague statements, like "Students will understand how to work cooperatively," that cannot be measured.

» **Question 2: What are the best ways of assessing these outcomes?** The choice of assessment method depends on the nature of the outcome. Note the following guidelines:

- *Use written tests to assess skill achievement outcomes*—Written cognitive tests (e.g., short answer, multiple choice, true/false, matching) and essay exams remain the most common classroom assessment strategy for many formal knowledge skills.
- *Use evaluation criteria checklists to assess complex tasks or products*—When students must create complex products, such as multimedia presentations, reports, or web pages, teachers may give students a set of criteria that specify the requirements each product must meet. Points are awarded for meeting each criterion.
- *Use rubrics to assess complex tasks or products*—Rubrics fulfill the same role as evaluation criteria checklists and are sometimes used in addition to them. Their added value is giving students descriptions of various levels of quality. Teachers usually associate a letter grade with each level of quality (Level 5 = A, Level 4 = B, etc.).
- *Use Likert scale–type surveys or semantic differentials to assess attitude outcomes*—When the desired outcome is improved attitudes, teachers design a survey in **Likert scale** format or with a **semantic differential**. The teacher sums the item scores to obtain a measure of student perceptions. A **Likert scale** is a series of statements that students use to indicate their degree of agreement or disagreement. For example:

  I like writing more when I use word processing. (Circle one of the following numbers.)

Strongly agree	Agree	No opinion	Disagree	Strongly disagree
1	2	3	4	5

  In a **semantic differential**, students respond to a question by checking a line between each of several sets of bipolar adjectives to indicate their level of feeling about the topic of the question. For example:

  "How do you feel about math?" Check the line closest to the adjective that describes your feeling.

  Warm __ __ __ __ Cold?

  Happy __ __ __ __ Sad?

  Strong __ __ __ __ Weak?

» Use observation instruments to measure frequency of behaviors—For example, if teachers wanted to see an increase in students' use of scientific language, they could create a chart to keep track of this use on a daily basis so they could track baseline performance and improvement over time.

Step 4: Design integration strategies. Teachers make many design decisions as they integrate technologies into teaching, including single-subject vs. interdisciplinary approach, grouping strategies, and sequence of learning activities. What usually drives these design decisions is whether the learning environment will be primarily directed (a teacher or expert source presents information for students to absorb) or primarily inquiry based or constructivist (students do activities to generate their own learning). In light of this decision, which you made in Step 1, consider each of the following implementation decisions:

» **Question 1: What kind of content approach is needed?** Should the approach be single subject or interdisciplinary? Sometimes school or district requirements dictate this decision, and sometimes teachers combine subjects into a single unit of instruction as a way to cover concepts and topics they may not otherwise have time to teach. Most often, however, interdisciplinary approaches are used to model how real-life activities require the use of a combination of skills from several content areas.

» **Question 2: What grouping approach should I use?** Should the students work as individuals, in pairs, in small groups, or as a whole class? This decision is made in light of how many computers or software copies are available, as well as the following guidelines:

- *Whole class:* For demonstrations or to guide whole-class discussion prior to student work
- *Individual:* When students have to demonstrate individual mastery of skills at the end of the lesson or project
- *Pairs:* For peer tutoring; higher ability students work with those of lesser ability
- *Small group:* To model real-world work skills by giving students experience in cooperative group work

» **Question 3: How can I prepare students adequately to use technologies?** When designing a sequence of activities that incorporates technology tools, be sure to leave enough time for demonstrating the tools to students and allowing them to become comfortable using them before they do a graded product.

Step 5: Prepare the instructional environment. If teachers could obtain all of the teaching resources they needed whenever they wanted them, they would make all the planning decisions described here *after* they had decided on the best instructional strategies in Step 1. In practice, however, teachers make many Step 1 and Step 5 decisions at the same time, since most usually decide how they will teach something in light of what is available for teaching it. Effective technology use means making sure that the instructional environment meets all of the following essential conditions required for successful technology integration:

» **Adequate hardware, software, and media**—Enough computers are available, and there are sufficient legal copies of instructional resources.

» **Time to use resources**—Hardware and enough legal copies of software have been obtained or scheduled for the time needed.

» **Special needs of students**—Provisions have been made for access by students with disabilities and for all students' privacy and safety.

» **Planning for technology use**—Teachers are familiar enough with the hardware and software to use it efficiently and do necessary troubleshooting; they have allowed time for testing and backup of files; they have a backup plan in the event technology resources fail to work as planned.

This step requires answering three questions about preparing an instructional environment that will support technology integration:

» **Question 1: What equipment, software, media, and materials will I need to carry out the instructional strategies?** As you create ways to stretch scarce resources, be sure that your strategies are ethical and in keeping with the reasons you chose a technology-based solution in the first place. Some guidelines:

- *Computers*—If there are not enough computers available to support the individual format you wanted, consider organizing the integration plan around student pairs or small groups. Also consider having computer and noncomputer learning stations that individuals or groups cycle through, completing various activities at each one. However, if students must master skills on an individual basis, consider scheduling time in a computer lab when all students in the class can use resources at once.
- *Copies of software and media*—Unless a software or media package specifically allows it, making copies of published software or media is illegal, even if copies are used on a temporary basis. Inquire about education-priced lab packs and site licenses.
- *Access to peripherals*—In addition to computers, remember to plan for adequate access to printers, printer paper, and any other needed peripherals (e.g., probes, handhelds).
- *Handouts and other materials*—Prepare and copy (or post) necessary support materials. Unless learning to use the software without guidance is a goal of the project, consider creating summary sheets to remind students how to do basic operations.

» **Question 2: How should resources be arranged to support instruction and learning?** Guidelines here include:

- *Access by students with disabilities*—For students with visual or hearing deficits, consider software or adaptive devices created especially to address these disabilities.
- *Privacy and safety issues*—School students should never use the Internet (including social networking

sites) without adult supervision and should never participate in unplanned chat sessions. If possible, firewall software should be used to prevent accidental access to inappropriate sites.

» **Question 3: What planning is required to make sure technology resources work well?** Guidelines here include:

- *Troubleshooting*—Computers, like all machines, occasionally break down. Learn simple diagnostic procedures so you can correct some problems without assistance.
- *Test runs and backup plans*—Leave sufficient time to learn and practice using resources before students use them, but also try out the resources again just before class begins. Have a backup plan in case something goes wrong at the last minute.

Phase 3: Post-Instruction Analysis and Revisions

This section will give a detailed description of Phase 3 steps and an explanation of why each is necessary. Also see Phase 3 of the Technology Integration Example, which shows how to implement this phase of the model.

As teachers complete a technology-based project with students, they begin reviewing evidence on how successful the strategies and plans were in solving the problems they identified. They use this evidence to decide what should be changed with respect to objectives, strategies, and implementation tasks to ensure even more success next time.

Step 6. Analyze results. To do a post-instruction analysis, teachers look at the following issues:

» **Were the objectives achieved?** This is the primary criterion of success for the activity. Teachers review achievement, attitude, and observation data they have collected and decide if the technology-based method solved the problem(s) they had in mind. These data help them determine what should be changed to make the activity work better.

» **What do students say?** Some of the best suggestions on needed improvements come from students. Informal discussions with them yield a unique "consumer" focus on the activity.

» **Could improving instructional strategies improve results?** Technologies in themselves do not usually improve results significantly; it is the way teachers use them that is critical. Look at the design of both the technology use and the learning activities surrounding it.

TECHNOLOGY INTEGRATION EXAMPLE 2.3

PHASE 3: EVALUATE AND REVISE INTEGRATION STRATEGIES

Mia was generally pleased with the results of the multicultural project. According to the semantic differential, most students showed a major improvement in how they perceived people from the country they were studying. Students she had spoken with were very enthusiastic about their chats and email exchanges. Some group brochures and booklets were more polished than others, but they all showed good insights into the similarities and differences between cultures, and every group had met the rubric criteria on content. The web searches they had done seemed to have helped a lot. One thing that became clear was that production work on their published products was very time consuming; in the future the schedule would have to be changed to allow more time. Mia also realized she had to stress that the deadlines are firm. Students would search for and take digital photos forever if she let them, and that put them behind on doing their products and left little time to discuss their findings on comparisons of cultures. Results varied on the short-answer test on the government and geography of the country being studied. Only about half the students met the 80% criterion. Mia realized she would have to schedule a review of this information before the test. She decided to make this a final group task after the production work was done.

PHASE 3 ANALYSIS QUESTIONS

1. Although all of Mia's groups did well on context overall, rubric scores revealed that most groups scored lower in one area: spelling, grammar, and punctuation in the products. What steps could Mia add to the production work checklist that might improve this outcome next time?
2. If Mia found that only five of the seven groups in the class were doing well on their final products, what might she do to find out more about why this was happening?
3. One teacher who observed the project told Mia that it might be good to have the school district media/materials production office do the final work on the products for the students. Does this seem like a good idea? Why or why not?

» **Could improving the environment improve results?** Sometimes a small change, such as better scheduling or access to a printer, can make a big difference in a project's success.

» **Have I integrated technology well?** Use the Technology Impact Checklist (see MyEducationLab) to determine if the activity has been "worth it."

This phase in integrating technology requires answering two summary questions about evaluating and revising technology integration strategies:

» **How well has the technology integration strategy worked?** Review the following collected data to answer this question.

- *Achievement data*—If the problem was low student achievement, do data show students are achieving better than they were before? If the goal was improved motivation or attitudes, are students achieving at least as well as they did before? Is higher achievement consistent across the class, or did some students seem to profit more than others?
- *Attitude data*—If the original problem was low motivation or students refusing to do required work, are there indications this behavior has improved? Has it improved for everyone or just for certain students?
- *Students' comments*—Be sure to ask both lower achieving and higher achieving students for their opinions. Even if achievement and motivation seem to have improved, what do students say about the activity? Do they want to do similar activities again?

» **What could be improved to make the technology integration strategy work better?** The first time you do a technology-based activity, you can expect it will take longer and you will encounter more errors than in subsequent uses. The following areas are most often cited as needing improvement:

- *Scheduling*—If students request any change, it is usually for more time. This may or may not be feasible, but you can review the schedule to determine if additional time can be built in for learning software and/or for production work.
- *Technical skills*—It usually takes longer than expected for students to learn the technology tools. How can this learning be expedited or supported better?
- *Efficiency*—From the teacher's point of view, the complaint is usually that the activity took longer than expected to plan and carry out. Review the schedule to see if there is any way the activity can be expedited.

Step 7. Make revisions. Based on the results from Step 6, teachers make adjustments to materials, logistics, and/or strategies. Revision activities are on a continuum ranging from small changes in how materials are used all the way to going back to Step 1 and re-analyzing the problem–solution match. Evidence in the form of student outcomes must drive these decisions.

As a planning tool, the TIP model makes the questions concrete that teachers need to think through when designing instruction that uses technology. Used together, TechPACK and TIP are the theory and practice tools that make technology integration purposeful, effective, and meaningful for teachers and students alike.

WHEN TECHNOLOGY WORKS BEST: ESSENTIAL CONDITIONS FOR TECHNOLOGY INTEGRATION

When ISTE established National Education Technology Standards (NETS) for teachers, students, and administrators, they also described conditions necessary for teachers to exploit the potential power of technology. As ISTE leaders introduced NETS in forums around the country, teachers spoke of barriers they had encountered when they attempted to implement technology in their schools or classrooms. The essential conditions were distilled from these comments. These conditions are summarized in ISTE's *NETS for Teachers* (2008) book, as well as online at **http://www.iste.org**. Once teachers complete an effective preparation program and take positions in schools, their ability to use technology to good advantage is determined in large part by whether the school district and/or school have provided the conditions described here. A summary of the essential conditions for effective technology integration is shown in Figure 2.10.

Essential Condition: A Shared Vision for Technology Integration

Teachers need system-wide support to implement technology. This means that the school, district, local community,