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**Chapter III**

# eTIPs--Educational Technology Integration and Implementation Principles

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## WHY A SET OF PRINCIPLES TO GUIDE TEACHERS ABOUT INTEGRATING AND IMPLEMENTING EDUCATIONAL TECHNOLOGY INTO THE K12 CLASSROOM?

In this section of the chapter, I present a set of educational technology integration and implementation principles, or eTIPs. These principles are offered as an explanation of the conditions that should be present in order for educational technology integration to be effective. The principles are an elaboration of two premises: First, that the teacher must act as an instructional designer, planning the use of the technology so it will support student learning. Second, that the school environment must support teachers in this role by providing adequate technology support. Thinking about these principles while deciding whether or how to integrate technology can help a teacher to take an instructional design perspective while also taking the "technology ecology" of the setting into perspective.

## Objectives for this Section of the Chapter

I will begin by discussing these principles more generally. I then offer a specific explanation of each principle and describe what it would look like in a best practice environment.  At the end of this chapter I offer questions to ask while following these principles when considering technology integration. I also suggest other ways these principles can be adapted and used to help create the conditions that allow effective educational technology integration.

At the end of this section of the chapter, the reader should be able to apply the eTIPS to his or her own teaching context.  The eTIPS questions and examples provide a structure for designing in any K-12 setting.


# EDUCATIONAL TECHNOLOGY INTEGRATION AND IMPLEMENTATION PRINCIPLES

## Two Dimensions

These principles are organized into two dimensions: classroom and school-wide. The classroom principles expand upon the premise that effective technology integration requires the time and attention of teachers in the role of instructional designers. Educational technology does not possess inherent instructional value: a teacher designs into the instruction any value that technology adds to the teaching and learning processes. Thus, the three classroom eTIPS prompt a teacher-designer to consider what they are teaching, what added value the technology might bring to the learning environment, and how technology can help to assess student learning. Together these three principles guide a teacher-designer through the important phases of designing instruction and also in considering technology as a part of that learning environment.

Part of what makes teachers' integration activities feasible or not is the level of technology support at a school. The three school-wide principles focus on technology support features that are present in high-quality technology support programs, the presence of which are correlated to teachers' increased uses of educational technology. These principles describe the implementation environment necessary to support teachers. Together they will help teachers to evaluate the level of access and support available to them in their integration work, which may help to determine whether or not, given their amount of planning time, a particular integration goal is realistic.

## Classroom Level Principles

*Learning outcomes drive the selection of technology.* In order for learning outcomes to drive the selection of technology, teachers must first be clear about their lesson or unit's student learning outcomes. This is an important first step in determining whether or not the educational technology available can be a support to teaching and learning. It will allow teachers to be more efficient as they search for available, appropriate technologies because they will quickly eliminate those that do not support their learning outcomes.

The learning outcomes teachers might plan for their students might focus on acquisition of facts or higher level thinking in a specific curricular area, more general procedural skills, specific technical skills, or some combination of these. While educational technology can support any of these types of outcomes, some educational technologies may be more appropriate for certain outcomes than for others.

For the technology under consideration for use, teachers must also consider the cognitive demands it places on the user. Does it require them to recall facts, like in drill and practice software? Does it require the user to provide content information and represent their understanding, as tool software (such as a database) does? Or does it require the user to represent their knowledge in a symbolic form, as with a programmable calculator? Any one of these technologies requires the user to respond in different ways, thereby supporting very different learner outcomes but perhaps also adding to a learner's outcomes.

When learning outcomes drive the selection of technology in a classroom, the educational technology will be a better fit for teaching and learning, supporting the achievement of the designated outcomes. The conditions for effective technology integration are enhanced further when teachers across a school all work together to enact this principle: Technology use is linked to larger goals and outcomes at the grade level, department, school, district, or state level. Processes for selecting and purchasing technology are linked to these curricular goals. A variety of educational technology, i.e., software titles, web sites, and peripherals, are present, correlated to grade levels, and characterized by the type of outcomes they support.

*Technology use provides added value to teaching and learning.* The phrase "added value" is used to designate that the particular packaging, delivery method or combination of services in a product brings extra benefits than one would otherwise receive. Here, I use the phrase to communicate that the use of technology brings added value to the teaching or learning processes when it makes possible something that otherwise would be impossible or less viable to do.

For teaching, adding value might mean individualizing instruction or making it more responsive to student's questions and interests, or providing additional resources of information so instruction is more real world, authentic, and current. Educational technology can also aid teachers in providing "scaffolds" that support learners as they move from what they already know and can do to what they are learning. For example, by aiding the visualization of or quick reference to information. Educational technology can also help teachers to create social arrangements that support collaborative as well as independent learning by facilitating communication and interaction patterns. This might aid students in carrying out reflection or deliberation themselves, or with others. Teachers can also use educational technology to support additional opportunities for learners to practice, get feedback, or allow for revision or reflection. Thus, it supports knowledge acquisition and practice, so learners become more fluent in their knowledge.

Added value for learning might mean educational technology that supports the accessing of data, processing of information, or communicating of knowledge by making these processes more feasible (see Table 1).

Educational technology can aid students' accessing information or representing it in new ways. It can increase access to people, perspectives, or resources and to more current information. Many times, software's interface design allows learner interaction or presents information in a multi-sensory format. Hyperlinks can allow learners to easily connect to related information. Built-in indexes and key word searching support learners by easing their search through a large amount of information to find what is relevant. These features all add value by increasing access to data or the users' control during that access.

In terms of processing information, added value might mean that the educational technology supports students learning-by-doing or aids them in constructing mental models, or making meaning, by scaffolding their thinking. For example, a database can allow students to compare, contrast, and categorize information through query features. By asking students to create products with tool software, it requires them to think more deeply about the material in order to represent it with that tool (Jonassen, 2000). For example, to create a concept map students would have to analyze, and then categorize information synthesizing from multiple sources. The resulting concept map would show what they understood to be key and subordinate ideas. When students designed the layout of a hypermedia, multimedia document this representation would have required them to think about the best media to represent the content on their topic and then analyze and synthesize this information. When word processing text, students can represent their analysis and categorization of information through its formatting and positioning. For

example, by using multiple levels of headings, tables, or other visual clues to visually represent main and subordinate ideas.

Educational technology can also add value to students' ability to show and articulate to others about what they have learned. For example, the World Wide Web is a medium through which it is relatively easy for students to communicate with others around the world. Whether to their peers or outside experts, with educational technology students are able to create more authentic and professional communication, and in the style and format appropriate for the topic (see Table 1).

Using educational technology in a classroom to add value to teaching and learning, by adding, extending, or changing what teachers or students do, inherently increases the effectiveness of technology. When teachers work together on this principle in a department, grade level, or school it will ensure that students will learn to use technology to help them find information, organize or analyze it, and then tell others about what they've learned. Software and hardware being considered for purchase would be evaluated according to the value that it adds to teaching and learning, ensuring that only the most effective materials are selected for purchase.

*Table 1: Added value summary for accessing data, processing information, and communicating knowledge*

| Task | Added Value |
|---|---|
| Accessing Data | Multi-sensory<br>Greater amounts of data<br>Searching and "mining" capabilities<br>Timeliness of the information<br>Relevance of the information |
| Processing Information | ▪ Self-paced<br>▪ Individual attention<br>▪ Remediation<br>▪ Practice to the point of fluency<br>▪ Visualizing information<br>▪ Develop process or skill capabilities<br>▪ Organize and categorize information |
| Communicating Knowledge | ▪ Publish information to an audience<br>▪ Communicate in authentic format, style<br>▪ Communicate findings and understanding to others |

Technology assists in the assessment of the learning outcomes. Planning for the assessment of students' learning outcomes is a key component of designing instruction. At times, teachers will want to collect and return to students formative data, to let them know about their learning progress. Almost always, teachers will want to collect summative information about students' achievement of the learning outcomes. Technology can assist teachers in collecting both formative and summative data that will help them understand how students are meeting or have met the learning outcomes for that lesson or unit.

Some software or hardware actually collects formative data during its use, and some technologies also provide help in the analysis of the information. Generally, these are software programs designed to assess student learning, such as tutorial or drill and practice software. Some of these programs, through screens or printouts of information, or other feedback mechanisms, support student's self-assessment of their learning. When students are working on learning procedural knowledge, they need opportunities to practice and develop their skills. Their progress as they work toward a product can easily be captured through software features such as tracking changes, or by asking students to use the "Save As" feature to freeze earlier versions of their work. These in-process products could help teachers to provide feedback to students for their revision and reflection, thereby aiding teachers' formative assessment practices.

In addition, educational technology is an aid to summative assessment, especially performance assessments where students are to produce products that allow them to show what they know and can do. Products students produce through software, whether a database, "mind map," multimedia or word-processed report, or a Web site, demonstrate what they have learned about both the content of their product, the procedural knowledge required to produce it, and their ability to communicate. The capabilities a product might demonstrate include the skills of editing, analysis, group collaboration, or the operation of the software itself.

When teachers use educational technology to assist them in the assessment of students' progress toward or obtainment of learning outcomes it makes technology an even more effective instructional tool. It will help students to prepare for their future to be asked to create computer-produced products, become accustomed to showing their progress through such products, and describing how these products demonstrate what they know. If this principle were employed consistently within a grade level, department, or a school, teachers would become more skillful at determining what can be learned about students' process skills, his or her progress, and learning through their technology products.

## School Level Principles

I now turn to the principles of technology implementation that are associated with the overall school technology environment, which is shared by all the teachers at the same school. While this means that these principles are usually beyond the control of any one teacher, as a group the teachers at a school can, and do, influence the decisions and priority-setting that would put these principles into place. These school level principles are conclusions from the findings of Dexter, Anderson and Ronnkvist (in press), who describe the quality technology support conditions that are associated with increased teacher and classroom uses of technology.

Ronnkvist, Dexter, and Anderson (2000) report that technology support encompasses both technical and instructional domains. In both of these domains, teachers need facilities, staff support, incentives, and opportunities to provide feedback (see Table 2).

In the school-level educational technology implementation principles we have simplified and collapsed these domains and resource types to the following three eTIPs.

Ready access to supported technology is provided. Teachers must have convenient and flexible access to and technical support for appropriate educational technology in order for them to utilize it in their classrooms. Perhaps of all the principles, this one is the most self-evident. Without available and working educational technology, it can hardly be utilized in a classroom. But, the two key words in this principle are ready and supported. Ready access means the technology should be close to where teachers need to use it and that it is scheduled flexibly, so that teachers have an opportunity to sign up for it when it is relevant for classroom work. Here, support specifically refers to the technical domain, like troubleshooting help and scheduled maintenance.

The idea of ready access should raise for the teacher questions about whether or not the students could be grouped together to work with the educational technology, if it could be a station through which students rotated, or if all students need to have simultaneous access to the educational technology. Ultimately, the access has to be practical. It must be ready enough that working through the logistics of providing students access to the technology does not outweigh the added value it provides.

Dockterman (1991) describes several possibilities for how to effectively use one computer in a classroom. The instructional uses he describes include using the computer as a presentation tool, as a discussion generator, and as a station to which cooperative groups circulate. Other sources for one-computer classroom ideas are found in most educational technology magazines for practitioners.

*Table 2: Technology support content by resource type used to deliver technology services to teachers*

| Resource Type | Technical Domain |
|---|---|
| Facilities | ▪ Network and Internet access, hardware, software |
| Staff assistance and necessary services | ▪ Technical support, help desk, network services |
| One-on-one personal guidance, help | ▪ Computer experts for trouble-shooting |
| Professional development | ▪ Operating equipment, general software, etc. |
| Incentives | ▪ Release time; free hardware, software and network access; anticipation of expert status |

| Resource Type | Instructional Domain |
|---|---|
| Facilities | ▪ Content-area specific software, communications access to pedagogical expertise |
| Staff assistance and necessary services | ▪ Instructional expertise and background of people providing support |
| One-on-one personal guidance, help | ▪ Guided practice, consultation for curriculum integration |
| Professional development | ▪ Pedagogy, models implementation strategies |
| Incentives | ▪ Release time, support focusing on instructional content |

Means, Olson, and Singh (1995) describe the advantages and disadvantages of a variety of computer placement configurations: Computer labs usually provide enough machines for one student to one computer access. However, scheduling their use and having to move to the lab's location can hamper the integration of the computer with the content under study. Where labs are staffed, scheduling and support of its users contributes to a positive experience; however, this can be a negative experience if relying on the lab staff results in less engagement by the teacher. An advantage of equipment distributed throughout regular classrooms is that it gets the equipment to the where the teachers and students do their work. But because of budget constraints, it might be difficult for the school to provide enough equipment to make student groups feasible in size, or to use them as stations through which students would rotate. More mobile computers, such as laptops or

desktop computers on carts can aid in bringing a critical mass of computers to the classroom. However, it does require scheduling and coordination of equipment between staff members. Additional time must be allowed to move and set-up the equipment.

The other key idea in this principle is that there is technical support. Many teachers are able to provide simple troubleshooting on their own. Those who cannot, or when the problem is more complex, must have access to technical support. Most schools have some level of technical support available, although the frequency and level of expertise varies widely (Ronnkvist, Dexter, & Anderson, 2000). Teachers must individually assess whether or not the level of support available to them serves as an adequate safety net. For example, if technical support is through a staff member who comes to the school only once a week, a teacher would have to determine if s/he could wait that long to continue the activity should a problem arise that s/he could not fix. Of course, no matter what the level of access, a back-up plan is essential for all technology-integrated activities.

Ready and supported access at a school obviously adds to the effectiveness of technology, making possible teachers' basic, working access to technology. When a school makes it a priority to provide ready, supported access, the distribution of hardware and software resources is based on instructional priorities; if instructional priorities change, the hardware and software resource distribution is re-visited. For example, computer labs might be dismantled if teachers decide they would benefit from classroom-based access to computers. Schools that work toward this principle also provide trained, reliable technical support at the most frequent level of access it can afford.

*Professional development is targeted at successful technology integration*. Technology professional development is key to teachers' learning to integrate technology effectively into the classroom (CEO Forum, 1999). The learning needs can be thought of as, one, about learning to operate the software and, two, about learning to use software as an integrated, instructional tool. Too often, teachers' learning opportunities are limited to the operation of the software. Teachers must have frequent opportunities to simply learn how to operate the educational technology but also have learning opportunities that address more than these basic skills; this eTIP emphasizes the entire instructional domain shown in Table 2. Possible formats for learning include access to shared resources, training modules, mentoring, face-to-face classes, or online, asynchronous professional development courses or net-seminars. Whatever the format, the target of professional development for technology must be an opportunity for classroom teachers to examine their goals of

instruction and related educational technology resources so they may construct an understanding of educational technology as an instructional tool.

Specifically, these extended learning opportunities should guide teachers in the instructional design we have laid out in the three classroom educational technology integration principles. By having sufficient time to explore educational technology and have their technological imagination sparked by examples of it in use, teachers can identify which materials match their learning outcomes (eTIP #1). Professional development sessions should also provide frameworks or criteria that can aid a teacher in determining whether or not an educational technology resource brings any added value to teaching or learning (eTIP #2). Likewise, through examples and discussion teachers should have opportunity to consider how might educational technology aid the formative or summative assessment of students' learning (eTIP #3).

Professional development targeted at successful technology integration at a school increases the effectiveness of technology by ensuring that teachers' learning needs are met with both "how to operate" and "how to integrate" sessions. Because technology integration should be in support of specific outcomes and add value to and assist in the assessment of those outcomes, the professional development sessions would ideally be specific for grade levels and customized to match the outcomes they teach. This means that overall, curriculum connections should often be the central focus of technology professional development sessions and facilitate sharing or instructional planning time.

*Teachers reflect on, discuss, and provide feedback about the role of and support for educational technology.* This principle describes a professional collaborative environment for integrating and implementing technology. In such an environment technology use would be more effective because the school organization would recognize the contribution individual make to the collective knowledge of the school (Marks & Louis, 1999). And the entire staff would work toward consensus about the school's performance, in this case with technology, and how they could improve it (Marks & Louis, 1997). A collaborative professional community would serve as the vehicle for school-wide knowledge processing about technology integration and implementation, increasing the likelihood of reflective dialogue, sharing of instructional practices, and generally increasing collaboration on new practices.

When a school staff has habits of discussing the ways technology is used and supported, they will identify ways to make the technology environment at the school more conducive to effective use. Such collaboration might come from a number of sources; for example, if teachers from

all grade levels or subjects were represented on a school's technology committee. When school leaders systematically seek input from teachers and these ideas are used to guide future goals for and decisions about educational technology, this feedback can assist in planning for future educational technology purchases and be used to improve the quality of technology support. When technology integration is regularly discussed among colleagues, they are likely to develop shared goals for technology use. When teachers are asked to reflect on the role of technology in their classroom, it is likely that they will recognize ways to become more effective integrators. Teachers can self-assess their use against shared school-wide goals, as well as set personal goals for their technology uses.

When technology integration is underway at a school where teachers' interactions are characterized by professional collaboration, it increases the likelihood of all the other eTIPs being in place, and thus the effective use of technology. In a collaborative environment teachers share their successes, or failures, at matching technology to outcomes. They can talk about their hopes, or fears, for whether technology will add value to their classroom, and what was revealed, or obscured, about student performance. A school that works to learn from all its members uses input from technology novices and experts alike to create high quality technology support.

# QUESTIONS FOR FURTHER CONSIDERATION

In the following section, I present questions to prompt teachers' awareness of and work towards each of the educational technology integration and implementation principles (eTIPs). I designed them to be used by teachers while planning instruction in order to guide their thinking through the additional issues and questions that are raised when integrating and implementing technology.

After determining the lesson or unit objections, consider the following additional issues and questions about the appropriateness of integrating technology into the instruction.

## Questions for eTIP 1: Learning Outcomes Drive the Selection of Technology

- Which objectives or standards does the technology complement and support? Are these mainly content area objectives or process skills?
- What is the cognitive demand on the learner as they use the technology?
  After determining your lesson or unit objections, the following questions guide teachers' thinking through adding value by integrating technology.

## Questions for eTIP 2: Technology Use Provides Added Value to Teaching and Learning

- How does using the technology add to what the teacher or students can do? Compared to other resources, what added value does the technology bring to the teacher or students' work?
- What are the costs and benefits? Do students have sufficient skills with the computer's operating system to use the technology? What menu items or operational skills do students' need to use the technology? Will developing the necessary prerequisite skills require extensive instructional time? Would all students need these prerequisites or could students be grouped with an "expert"? How does the time required for the integration of the technology balance with the instructional goals and objectives?
- Would using the technology require the teacher to overcome inordinately difficult logistics? (i.e. to secure sufficient electrical outlets, tables, or chairs and space for the computers)

After determining the lesson or unit outcomes and that educational technology would add value to students' work towards those outcomes, these next questions can guide teachers' thinking through how integrating technology could help assess student learning.

## Questions for eTIP 3: Technology Assists in the Assessment of the Learning Outcomes

- What criteria will be used to evaluate student work?
- In the assessment, will students' capability with the software also be assessed?
- How can the students' technology-supported work help you learn what they know and can do?
- How does a technology-supported performance demonstrate progress toward specific content standards?

These next questions can help teachers to determine whether or not the access to educational technology is ready enough that the added value provided by the capabilities of the educational technology outweighs the effort required to work through any logistics.

## Questions for eTIP 4: Ready Access to Supported Technology is Provided

- What technology will the students or teacher need to complete the task?
- Are enough of the technology resources available during the timeframe you will need them?

- Are the resources available in locations and configurations that fit your time and space needs?
- Does the level of availability of the technology resources suggest that students will work individually or in groups for the different tasks or components of the lesson?
- Who is available to assist with the setup and troubleshooting of the technology resources? How quickly can they respond if you need assistance?

The following questions can guide teachers as they determine any learning needs they have for the technologies they are considering using.

## Questions for eTIP 5: Professional Development is Targeted at Successful Technology Integration

- What professional development or instructional support might you need to implement this technology integration?
- Are there online resources, classes, or individuals that could show you how to operate the technology?

The questions below could be used to guide teachers' thinking through the additional issues and questions that are raised by integrating and implementing technology in a collaborative professional community.

## Questions for eTIP 6: Teachers Reflect, Discuss, and Provide Feedback About the Role of and Support for Educational Technology

- With whom can you talk or share to gather insight about your integration experiences?
- How can you capture your integration experiences to share them with others?
- How will you make your integration experiences more public, so others can learn from you?

# CONCLUSION

In addition to helping teachers recognize and plan for the effective technology use, the educational technology integration principles (eTIPs) can be adapted for other purposes. For example, job candidates might use them as a framework to organize questions to ask during an interview, and to determine whether or not they might like the technology environment at the school site, if offered a job. Generating indicators for the presence of each principle could be used as a checklist by a school technology team to conduct

a needs assessment. Teachers could use them to determine the kinds of input and guidance to provide during technology planning or evaluation efforts.

Overall, these educational technology integration and implementation principles point out the two key aspects of teachers designing effective integrated instruction: The technology use must match and support teaching and learning and the larger school environment must provide support for the logistical and learning demands technology integration puts on teachers.

# ACKNOWLEDGEMENTS

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