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Grounded Tech Integration: Science

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Grounded Tech Integration: Science

This is the sixth article in a series on grounded technology integration. See Resources on page 34 for the full list of previous articles.

Technologies such as microscopes, Bunsen burners, and balances have long been associated with learning and teaching in the science classroom. Digital technologies, such as simulations, interactive whiteboards, probeware, and Flip cameras, offer additional opportunities for science teachers to put students in charge of data generation, collection, analysis, and presentation. Yet the widespread use of even traditional technologies in science classrooms, much less newer tools, remains limited. Science teachers must choose among several technologies—for example, mercury thermometers, handheld digital thermometers, and digital temperature probes—that accomplish the same or similar tasks to assist students' science learning. How can we best choose and integrate these tools into the science classroom?

Learning Activity Types

One way to help teachers integrate technology effectively is to focus on instructional planning. Research tells us that teachers plan instruction primarily according to students' curriculum-based learning needs. They typically organize lessons, projects, and units around content-based learning activities. That's why we recommend matching technology-integration strategies to planning, rather than designing instruction around a particular educational technology.

To assist teachers with technology integration, we offer a comprehensive set of learning activity types for each

curriculum area and suggest specific educational technologies that best support the types of learning done within each activity. We have organized them into subcategories, so that each content-based collection of learning activity types forms an informal taxonomy.

Once teachers have determined the learning goals for a lesson, project, or unit, they review the activity types in the taxonomy for that content area, selecting and combining the learning activities that will best help students achieve the learning goals. We've suggested educational technologies for each learning activity type to help teachers select technologies to support the plan in sensible, practical, and usable ways. We think of this as grounded technology integration because it is based in content, pedagogy, and how teachers plan instruction.

Science Learning Activity Types

We have identified 38 science learning activity types for building and expressing science conceptual and procedural knowledge. The complete taxonomy is available on the Activity Types Wiki.

Teachers who have new educational "toys," such as interactive whiteboards, may find themselves trying to figure out how to add the new technology to their instruction, rather than planning based on instructional objectives. This conundrum faced teachers in Margaret Blanchard's SMART Project last year. Thirty science teachers from two school districts in eastern North Carolina learned how to use probeware with graphing calculators to detect relative humidity, conductivity, temperature, heart rate, light, UVA, UVB, magnetism, pH, motion, gas pressure,



and force. They also learned how to use Flip cameras, document cameras, portable interactive whiteboards, tablets, projectors, and data analysis software programs.

Judi Harris led a session at Blanchard's June 2009 SMART for Teachers workshop to help teachers use the science learning activity types in planning their lessons for the fall. To avoid the "technology first" pitfall, Harris asked teachers to form grade-level collaborative groups, then choose the curriculum objectives they planned to address, decide which types of activities best addressed those objectives, and consider which technologies best supported these activities.

A More Engaging Lesson

Three sixth grade science teachers from Bertie Middle School in Windsor, North Carolina, were concerned about how "dry" their solar system unit has been. Wanda Ruffin, Carolyn Outlaw, and Floria Smith wanted to plan a week-long unit that would be more engaging than their previous curriculum. They selected two state curriculum objectives: one that addressed students analyzing the components and cycles of the solar system

By Margaret Blanchard, Judi Harris, and Mark Hofer

Knowledge-Building Activity Types

Seventeen of the thirty-eight science activity types emphasize conceptual knowledge building.

Sample Activity Type	Brief Description	Possible Technologies
View presentation/demonstration	Students gain information from teachers, guest speakers, and peers synchronously/asynchronously, face to face, or via multimedia	Presentation software, document cameras, videos/DVDs, videoconferencing, class websites, Flip cameras
Take notes	Students record information from lectures, presentations, or group work	Word processors, handheld computers, wikis, interactive tablets
Observe phenomena	Students observe phenomena that raises scientific questions from physical objects, organisms, or digital media	Video, digital microscopes, document cameras

Ten knowledge-building activity types involve procedural knowledge employed in science learning.

Sample Activity Type	Brief Description	Possible Technologies
Learn procedures	Students learn how to safely and appropriately handle equipment	Video/DVDs, document cameras, online videos
Generate data	Students generate data (e.g., heart rate, cooling water temperatures) by manipulating equipment or animations	Graphing calculators, probeware, digital balances
Record data	Students record observational and recorded data in tables, graphs, images, or lab notes	Spreadsheets, word processors, databases, handheld or tablet computers

Knowledge-Expression Activity Types

Eleven of the learning activity types describe activities that support students in expressing their knowledge.

Sample Activity Type	Brief Description	Possible Technologies
Write a report	Students write a laboratory or research report	Word processors, presentation software, videos, wikis, podcasts
Develop or build a model	Students manually or digitally create models to demonstrate content knowledge, conduct experiments, etc. (e.g., solar system model, human body organs/systems)	Modeling software, drawing tools, Inspiration, Lego robots
Create/perform	Students create and/or perform a script, rap, song, poem, collection, invention, exhibit, etc.	Video/audio recorders, word processors, wikis, Web authoring software, presentation software

Once teachers have determined the learning goals for a lesson, project, or unit, they review the activity types in the taxonomy for that content area, selecting and combining the learning activities that will best help students achieve the learning goals.

and another that involved comparing and contrasting Earth to other planets.

To determine how much prior knowledge the students had about the planets, the teachers planned to ask students to draw or create images of the solar system using the portable interactive whiteboards or traditional paper-and-pencil drawings. Students

would then volunteer to do a presentation of their initial models to the class, either by projecting from their tablets or by using a document camera.

Once teachers could gauge students' prior knowledge, they would have them watch a presentation on the planets in the solar system, using websites viewed on a whiteboard. The teachers

would then ask students to work with partners to conduct online research on a particular planet. Students would be expected to take notes on the information they discovered and to organize and classify the data using spreadsheets or LoggerPro software.

Students would present their research findings using Flip cameras and/or podcasting. All the information that students collected would be posted on the classroom website so students could review the information before the test. Teachers also

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planned to play an exam review game with their classes using the interactive whiteboard.

Ruffin, Outlaw, and Smith are convinced that their students will be much more interested in this re-designed solar system unit that uses interactive technologies and student-centered instructional methods instead of a lecture. They found that the activity-types taxonomy helped them think of more activities and technologies to integrate into their lessons.

Invitation for Collaboration

Given continual changes in curricula and resources, the range of science learning activity types as well as the technologies that can support each will change over time. We invite you to help us expand, refine, and revise

the science activity types taxonomy by visiting the Activity Types Wiki and sharing your ideas via the online survey posted there.

Resources

- “Grounded Tech Integration,” *L&L*, September/October, 2009, pp. 22–25
- “Grounded Tech Integration: English Language Arts,” *L&L*, February 2009, pp. 28–30
- “Grounded Tech Integration: Languages,” *L&L*, December/January 2009, pp. 26–28
- “Grounded Tech Integration: Math,” *L&L*, November, 2009, pp. 24–26
- Learning Activity Types Wiki: <http://activitytypes.wmwikis.net/World+Languages>
- “Tech Integration in Social Studies,” *L&L*, September/October, 2009, pp. 26–28

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—Judi Harris is the Pavey Family Chair in educational technology at the College of William & Mary. Her teaching and research focus on K–12 curriculum-based technology integration, tele-mentoring, and teacher professional development.

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