Technology Infusion and the Student-Centered Classroom

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In this paper, I will discuss my vision for technology infusion in a student centered classroom and offer a model for what a technology-infused classroom might look like, relating my experiences in both observing and teaching technology-infused lessons as examples.

I have identified three criteria that technology infusion should fulfill. To be effective and support a student-centered approach, technology use should **enable**, be **pedagogically appropriate**, and **be elegant**.

1. Technology use should **enable** students and teachers to more than they could without its use. Marc Prensky (2005) uses the phrases "dabbling" and "doing old things in old ways" to refer to a base-level of technology integration, in which similar results are attained through the use of technology as would be attained without its use. While this can be an appropriate way to begin technology integration, it is worth aiming for "doing new things in new ways" as a goal (Prensky, 2005) in order to truly take advantage of the new opportunities offered by technology.

2. Technology use should be **pedagogically appropriate**. Understanding the impact on student learning due to the use of technology can be difficult, but it is worth considering before implementing a lesson driven by technology. For example, do we always need technology to hold a class discussion? When would the use of technology benefit this (perhaps allowing students to write about uncomfortable topics versus being embarrassed to discuss them in person) and when would they simply get in the way (being able to have real, intimate, face-to-face conversations)?

3. Technology used should be **elegant**. The technology used should meet the students' needs while being as free from unnecessary hindrances as possible. This is, I believe, an under-appreciated facet of technology usage. All of us have had the experience of being excited to try a new tool (whether it be a physical object, software program, or some combination of these domains) but been frustrated by poor design and usability. Donald Norman, a renowned expert on design and usability, writes in the preface to his seminal work *The Design of Everyday Things*, "Humans do not always err. But they do when the things they use are badly conceived and designed" (Norman, 1989). If the technology itself requires a learning process that is greater than the benefit using it offers, can it truly be said to be an effective tool?

The Technology Acceptance Model proposed by Davis, Bagozzi & Warshaw (1989) speaks to this issue of usefulness and usability:

"TAM posits that two particular beliefs, perceived usefulness and perceived ease of use, are of primary relevance for computer acceptance behaviors (Figure 2). Perceived usefulness (U) is defined as the prospective user's subjective probability that using a specific application system will increase his or her job performance within an organizational context. Perceived ease of use (EOU) refers to the degree to which the prospective user expects the target system to be free of effort." (p. 985)

Put more simply, in order for technology to be accepted and adopted, people must see that it will be useful and easy to use. Dan Meyer, a high school algebra teacher and doctoral student at Stanford University, elaborates on this idea in the context of new teaching practices:

"If [x] is going to change teaching practice at scale, then [x] needs to be easy, fun, and free for both the teacher and her students. [x] needs to be all three of those things at the same time."

Meyer goes on to write, "Learning isn't always easy but learning tools should be. Just for instance, last week, I saw groups of students clicking the same download link over and over again in Safari not realizing that they had already downloaded the attachment. The download window was open but obscured by the browser... Many of you have vastly overrated the ease of educational computing." (Meyer, 2010)

After understanding these three facets, it is interesting to consider how much of the pedagogical approach in a high-functioning classroom is due as a result of the technology infusion, and how much would be sound teaching practice regardless of the amount or quality of technology used. It would certainly be possible to have a classroom that emphasizes active learning, constructivist practices, intentional work, authentic problems, and collaboration without necessarily using technology.

It is also possible to have high student achievement without the use of technology, and it can be hard to measure the effect of technology usage on student achievement. Chandra and Lloyd (2008) put it this way:

"We would cautiously contend that there is no common field of research, no shared universe of discourse when it comes to e-learning environments. There are simply too many variables for truths, convenient or otherwise, to emerge. What we have instead, like a Foucauldian history of disparate, discontinuous and asynchronous events, is a series of instances where different students use different technologies to achieve different

outcomes measured in different ways. The 'truth' lies within and across collective instances rather than there being a seamless metanarrative."

A question, then, becomes "how does appropriate technology infusion inform and shape the goals of a constructivist classroom"? With both the three guiding criteria of technology infusion I described and the above considerations in mind, allow me to describe some aspects of what a model classroom that follows these principles might look like.

The Model Classroom

The three guiding criteria I identified for technology infusion (to enable, be pedagogically appropriate, and be elegant) should be in full evidence in the model classroom. Some exploration of what this looks like in practice is provided below.

Students should have 1:1 access to a mobile computing device in the model classroom, whether it be a laptop, tablet, or handheld. This enables and empowers students and teachers in several ways. First, there is no hesitation about being able to conduct an activity or not based on the availability of the technology; it's simply present all the time. Secondly, it allows teachers to easily take advantage of teachable moments. For example, if a class discussion about history wanders into a time period with which the students are not familiar, they can look it up and find out information during the discussion in order to allow it to continue without pause. Finally, 1:1 access opens up a whole extra dimension or layer of possible teacher-student interactions. "Backchannel" discussions during an activity (held using an online chat or forum) allow all students to share ideas and ask questions, when doing so in the physical setting might be time prohibitive or raise difficult issue. Students can submit work to an online course management

system and teachers can comment on their work, returning it for revision, providing feedback, or moving students on to the next unit of study.

Most work done by students in the model classroom is active, reflective, and emphasizes a project based approach. Students are required to use and demonstrate what they learn because learning activities are situated in the context of a project. An integral part of these projects is a reflective component, whether this be a written reflection, oral report, video interview, or other artifact.

At its best, technology infusion enables students to work and learn at their own pace in a project-based context as described. It can do this in several ways. For example, the use of a "flipped" or "hybrid" classroom model, in which direct instruction is accomplished via video tutorials, online learning activities, or other time-shifted media, allows students to go through material as quickly or slowly as needed, and as many times as needed. This allows students to gather new information outside of class time, and use their class time instead to get the help of teachers through practice, application, and project work. Technology enables this approach by providing a central hub for these resources, whether it be a course management system, a course webpage, or a set of digital materials loaded on student devices.

Technology Infused Learning Activities

For purposes of clarifying how these ideas would be implemented in the model classroom, a collection of technology infused learning activities, in the form of an example project, is included below. This collection of activities is based around a project-based integrated curriculum unit for the middle school age level. In this unit, benchmarks and standards from the

science, social studies, technology, and engineering curriculum all contribute to the project. The design brief for this project is to design a house that takes into consideration sustainability practices, climate and ecosystem concerns, occupant requirements, and the personal interests of the students. During this process, they experience a range of different learning activities, including those listed below. I facilitated a version of this project working in the role of technology and engineering educator; most of the activities listed are actual activities used and developed for purposes of this analysis. A brief evaluation of each activity that was used accompanies the description; activities that were developed but not actually used in the field are noted as such.

The learning activities listed below are in roughly chronological order based on when they would be used in the unit.

For this project, it is assumed that students have continuous 1:1 access to a computing device; specific hardware required is listed in the table below, with more details in each learning activity. A laptop cart, tablet cart, set of classroom devices, or computer lab would all be acceptable for purposes of this project, assuming continuous 1:1 access. Additional hardware, such as digital cameras and probeware, are used in specific learning activities, and are noted as such.

Learning Activity	Hardware Category	Software Category
Project Assignments & Online Discussions	Computer, Mobile Device	Communication
Intended Occupants & Location	Computer	Problem Solving

Learning Activity	Hardware Category	Software Category
Floor Plan	Mobile Device	Problem Solving
Build Process	Mobile Device	Productivity
Building Materials WebQuest	Mobile Device	Research
Survey of Interest	Computer	Communication
Insulation "R" Value Simulation and Experiments	Computer, Peripherals	Educational Software
Advertising with Media	Computer, Peripherals, External Storage	Multimedia Production

Project Assignments

This project will be facilitated using online course management software. In this case, Moodle was used as the course management software. Using Moodle, students are empowered to work at their own pace, communicate with instructors, and receive feedback on components of their work. As students complete one assignment, they can submit it electronically, and move on to the next assignment at their own pace.

Students can also participate in online discussions, in which they describe various problems that they face with their design, and offer suggestions, feedback, and critique of their classmates. One strength of the online course management system is that it is accessible from any computing device (desktop, laptop, tablet, or mobile device).

For this learning activity, students will need to be familiar with using a Web browser, logging in to the course management system, and uploading files.

Intended Occupants & Location

The first step in this project is deciding for whom the house will be designed, and deciding where will it be located. Students are required to decide on the following information about the occupants of the house:

- How many occupants are you designing for (how many people will live in the house)?

- Who are the intended occupants? Make sure you describe their name, age, occupation, marital status, etc.

- What do they like to do (interests, hobbies, etc)?

- Pick four words to describe the house your occupants would like to have.

This information will be used to understand the needs and wants of the intended occupants. In this way, the design problem is made more personally relevant: they are not simply designing a house for "someone", they are designing a house for an individual, group, or family with specific needs and wants.

In addition to knowing who will live there, students are also required to decide on a location for this house. They must look up climate information about where house will be located, as this will also have an effect on their eventual house design. Students must look up:

- In what area of the country will your house be located (climate zone, state, and city)?

- What is the highest average monthly temperature (in degrees Fahrenheit) your intended location gets in the summer?

- What is the coldest average monthly temperature (in degrees Fahrenheit) your intended location gets in the winter?

- What is the average yearly rainfall in your region in inches?

- What are the average house prices in your region?

For this learning activity, students will need to be familiar with using a Web browser, searching the Web, and using word processing software.

Floor Plan

Another problem-solving learning activity will be to design the house's layout or floor plan, using sketchpad software. For this activity, the iPad and the Autodesk SketchBook Mobile Express will be used. Students are required to draw three rough versions of the floor plan of the house they are designing, with each version emphasizing different possible features and potential layouts. In the past, students would have done this with pencil and paper, but for this project they will use the software environment to do their drawings.

The use of Sketchbook Mobile Express is, in some ways, "doing old things in new ways", but it also moves toward "new things in new ways". For example, students can copy drawings directly into their project documentation (although paper drawings could be scanned, this was a faster and easier process). The software approach allows for multi-floor drawings more easily, as students can overlay one floor plan on top of another. Using the software approach allows for files to easily be emailed and shared. There are a few drawbacks to using software instead of pencil and paper - some students may not like drawing with their fingers, and there is less precision than if students used pencil and paper. The lack of precision could be addressed with the use of drawing styluses; also, the lack of precision is acceptable for rough drawings.

For this learning activity, students will need to be familiar with navigating and launching apps with a mobile device, using the drawing tools provided, and saving/emailing files from the mobile device.

Build Process

After completing a final floor plan, students build a model of their house using physical materials (cardboard and foamcore board). Along the way, students will use productivity software to document the process of building the house, using the iPad tablet's built-in camera and Pages software. Students are required to take a picture at the end of each work session to document their work, and after their model is completed they will take a number of photos from different vantage points, displaying the completed house model.

For this learning activity, students will need to be familiar with using a mobile device's camera, embedding photographs in a document, and saving/uploading files.

Building Materials WebQuest

In this activity, students conduct a WebQuest to find out about different types of building materials that they could choose to build their house from. Students are broken into small groups, using a jigsaw approach in which the small group researches and then reports their findings back to the entire class in the form of short presentations. Groups are directed to focus on these three things:

- What are the material choices? (What is the material made from? How is it made? What does it look like? How much does it cost?)

- What are the advantages to each material? (Why would a homebuilder choose to build with this material? What's good about it?)

- What are the disadvantages to each material? (Why would a homebuilder NOT choose to build with this material? What's bad about it?)

After retrieving the relevant information, students will assemble brief presentations using presentation software such as Keynote or Powerpoint to prepare a presentation to their classmates sharing the information they have gathered. For this type of activity, it is particularly important that the teacher creating the WebQuest remember the third criteria described ("be elegant"), as too many Web sites and online simulations are badly organized and make it difficult to accomplish the task for learners at the given age level. Tools like the Lexile level should be used to determine appropriate materials based on reading ability and content.

For this learning activity, students will need to be familiar with using a Web browser, using a search engine, and using presentation software.

Survey of Interest

In this activity, students use online forms (Google Forms, for example) to gather survey information from classmates regarding their perceptions about the relative value of choosing sustainable building materials and using sustainable building practices. After the data has been collected, students should analyze the data by compiling a spreadsheet, creating graphs to represent the data, and writing up their conclusions. This activity was not conducted during this project, but was designed to accompany it for the model classroom's purposes.

For this learning activity, students will need to be familiar with using a Web browser, creating form, and analyzing data using a spreadsheet.

Insulation "R" Value Simulation and Experiments

Part of designing the house involves students learning about how the climate their house is in will affect its energy usage. The insulation of a house plays a large role in this. Students will use simulation software to experiment with different building materials, observing how the different choices affect the "R" value of the house's insulation. Students also will use probeware, such as temperature sensors and energy meters, to conduct experimental tests of different materials and their heat-transfer properties. These activities were not conducted during this project, but are designed to accompany it for the model classroom's purposes.

For this learning activity, students will need to be familiar with using a Web browser, as well as using data collection software and probeware. This activity requires the use of additional hardware resources in the form of probeware, interfaces, and energy meters such as the Kill-a-watt energy meter.

Advertising with Media

After completing the house model and design specifications, students are tasked with creating a piece of promotional media, advertising the house as being for sale. This promotional media could take a number of different shapes, such as a flyer or promotional video. This activity was not conducted during this project, but was designed to accompany it for the model classroom's purposes.

For this learning activity, students may need to be familiar with several different pieces of technology depending on the approach they take, including video editing software, page layout software, image manipulation and editing packages, and digital cameras/video recorders. This activity requires the use of additional hardware, in the form of digital cameras and/or digital video recording devices.

Conclusion

Creating a model classroom that is student-centered and oriented toward relevant and meaningful learning experiences can be enabled by the thoughtful, intentional use of technology, as discussed above. Technology by itself cannot create meaningful content, improve pedagogy, or increase student performance. It can, however, empower both students and teachers to work in new ways, expand the opportunities that students and teachers have to explore their world, offer meaningful experiences that would otherwise be impractical, and in many other ways support dedicated, thoughtful teaching practices.

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