

slide 1 – Title **Characteristics of appropriate use of technology in teaching and assessment**

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slide 2 -Moore's Law: The number of transistors on a chip doubles about every two years. Gordon Moore, co-founder of Intel, (1965).

Early on in the development of computers, Gordon Moore, the co-founder of the integrated chip company we now know as Intel, prophesized that technological power will double about every two years.¹ Prophesizing growth is quite common in business, but rarely so accurate. What does this law mean to us college and university administrators and educators?

Moore's law suggests that training for one particular type of technology may not have the wonderfully planned effect we had in mind when we chose that technology. Technology is simply increasing faster than the ability of many teachers to cope and adapt. New technologies may be creating a digital divide between classrooms and between institutions. (Corbeil and Brown, 2004; Oldknow, 1997; Monaghan, 2002). Many teachers lack formal training in the use of technology, few have an extended breadth or depth of the theory of teaching with technology. Support for innovation is not systematic, nor practical in most of our institutions. Thus, it is not surprising to witness inappropriate use of technology in some classrooms. It is possible that we might be misunderstanding technology use in the classroom.

¹ As quoted in "Technology and Society: Opposing Viewpoints" and also at <http://www.intel.com/technology/silicon/mooreslaw/index.htm>

I will present some significant characteristics of the appropriate use of technology and through them I will discuss some of the major issues involved in bringing technology into the classroom.

Should we teach with technology?

slide 3 – Ron Paige US Secretary of Education (2005)

Education is the only business still debating the **usefulness of technology.**

This is a fairly sweeping indictment of educators, don't you think? It is true that some countries are lagging far behind in adopting new technology into the classroom (Oldknow, 1997; Monaghan, 2002). But in 2005, a survey by Quality Education Data Inc. found that 28 percent of U.S. school districts offered handhelds for student and teacher use. One of every four computers purchased by schools was a laptop. Most countries are placing cutting edge technology in the hands of students faster than businesses place the same technology in the hands of their employees (AP, 2005). Does this sound like educators are debating the usefulness of technology?

slide 4 ... Simply using instructional technology does not guarantee successful student learning or better educational outcomes

Educators still ask this question because we know that “Simply using instructional technology does not guarantee successful student learning or better educational outcomes.” This should be seen as a maturity of thought rather than being seen as a flaw. For some, asking such a question is foolishness and demonstrates how out of touch education is with the realworld. Indeed, Paige followed up his first statement with the statement that “Schools remain unchanged for the most part, despite numerous reforms and increased investments in computers and networks.”

Why do teachers continue to mess with technology when our experience and instinct says this is going to be a complicated and frustrating event? And in the end,

people like Paige are just going to point the finger at us and say, “Look them, aren’t they quaint and out of touch?” Teachers use technology because it represents a potential to do things differently, tools to help learners. Business is also full of technologies of various sorts and we owe it to our students to train them in the technology they will face in the workplace. We also chose technology because we think it helps us reach a particular learning goal better or faster. In the coinage of popular language, we seek technology as an alternative learning style or a tool to provide alternative learning opportunities.

In general, teachers use technology to better achieve particular instructional goals. This represents the first major characteristic of the appropriate use of technology: technology as a tool to achieve a particular goal or process.

slide 5 First characteristic of appropriate use of technology: technology as a tool to achieve a particular goal or process.

At our colleges and universities we regularly identify students who are unprepared for our programs. Irrespective of where the deficiencies originate, lower level schools, programs or a student’s own personal set of issues, technology may be the tool to tackle the deficiency. We might also see technology in the role of assisting students over a learning barrier and to make learning more interesting. It might be used to assist with understanding complicated processes in an engineering class or for organizing the students study habits using a planner program. It even might be used to bring a connection to the world as suggest earlier by Michal Aston.

slide 6 Why should we use technology?

- ✍ **Business tools**
- ✍ **Blended ore -learning**
- ✍ **Representation and communication**
- ✍ **Alternate learning style**
- ✍ **Alternative memory mapping**
- ✍ **Flash bulb memory**

James Kaput states that technology generally provides at least two major affordances: representation and communication (2004). Currently you are viewing my use of technology because of the advantage power point has in representing and visualizing ideas ... using visual components in a lecture or encouraging tactile/kinesthetic experiences with hands on computer based programs or modeling may enhance the development of representation and communication. This is a direct application of what David Kolb calls “experiential learning” or what Martin Gardener described as creating a potential for different and mixed learning styles.

The classroom certainly contains the potential for different learning styles : the visual, auditory and tactile/kinesthetic (Gardener, 1993). Teachers should provide opportunities for learning via alternative learning styles. Even if the majority of students were auditory, the learning style corresponding to the traditional classroom, teaching only in one style remains insufficient and perhaps is boring to the point of distraction. Over reliance on one particular learning style may results in learning barriers.

Traditional lecture classrooms, for example, may result in auditory overloading, especially in second or foreign language situations. We jabber away at the front of the classroom hoping the students are taking it all in. The students are hearing and processing both language and academics at the same time. If this single learning style is continuous and nonstop, it is certain to overwork and then overload the auditory memory pathways (Owensby and Kolodner, 2002). Technology represents an opportunity to provide other alternatives, opportunities necessary for student success (Kolb, 2001).

Occasionally popping up picture and sound may help to open alternative pathways for memory mapping and perhaps might strengthen newly linked memory

pathways. Flash bulb memory, linked memory related to particular sights, sounds or smells is a well documented phenomenon (Gottfried, 2003; Engen, 1973). Chosen well, you might possibly be able to induce an instance of flashbulb memory (Brown and Kulik, 1977 and 1982) by carefully choosing a visual cue related to an important learning goal.

Flashbulb example: OJ Chase and link to Truck image “Is this how you use technology?”

At the very least, the lecture will be slightly more interesting and keep the student’s attention longer. There is a saying that ‘Good mechanical engineers are those who know what the material feels like.’ In education, what is really important often goes well beyond what we think is purely academic and makes the differences that create not just good students, but people of excellence.

Thus,

slide 8 The second characteristic of appropriate use of technology: using technology to enhance representation and/or communication, providing alternative learning styles and possible improvement of memory mapping.

How should we use technology?

In the last ten or so years, new technology such as Graphics Display Calculators (GDCs) or Computer Algebra System enabled (CAsE) devices have posed some serious problems with assessment. These devices have been evolving faster than computers and they require specific training. That the technology may become obsolete in a short period makes this kind of training difficult to justify. Technology changes are so rapid that (slide 8) newly trained teachers will face some kind of new technology in his/her very first year of teaching (Corbeil and Brown, 2004, Monaghan, 2002).

Added to all this, is the heightened set of expectations coming from administrators, parents and the community at large. Hey you, teacher! You better be making use of technology in the classroom, and let's see those outcomes come up this semester! Given the limitations and costs, is this a fair set of expectations? How do we make better training decisions for teachers?

slide 9 Is this how you use technology?

Does this image remind you of anything? I hope it does. Since I have made two visual links, one perhaps critically mapped in your memory already, you may find that you will make the connection from now on: and you will remember the warning. Irrespective of the specific technology training, the most important feature of training should be some kind of grounding in the theory of using technology. The critical skill that a teacher needs is the skill in evaluating the way technology makes their teaching better. When learning a new technology, is the teacher encouraged to ask, "What possible alternative learning style might this new technology introduce?" "What improvements to the enhancement of representations and communication are now possible in my classroom?"

This requires grounding in the understanding of the process involved in learning generally, and learning with technology specifically. Not just stand alone training in one software or product but the theory of using technology in teaching in general. Cutting edge technology training or in-service courses should always be packaged around educational theory related to teaching with technology, *skills that can be transferred to the next evolution of technology.*

slide 10 *The third characteristic of the appropriate use of technology: training in the theory of using and evaluating technology*

How do we assess the learning goal?

We know that technology is creating some major difficulties in assessment, and we know that unbalanced or inappropriate use of technology can seriously disadvantage some students (Corbeil and Brown, 2004). When assessing mathematics and science, we have traditionally expected students "to show enough of their work for readers to follow their line of reasoning" (College Board, 2004). But technology results in both student and teachers falling well short of what we traditionally have thought of as "answers." Consider the following example:

slide 11 Andrew has Dh 200.00. He buys five energy drinks (Dh 20 each) and one shirt (Dh 22 each). How much change does he get?

slide 12 Teacher answer: $5 \times 20 = 100$, $1 \times 22 = 22$, $100 + 22 = 122$, $200 - 122 = 78$. He gets Dh 78 in change.

Student answer: Dh 78.00. (i.e. no work)

A number of teachers have a hard time giving full marks to a solution that "appears" to lack "work". There is this nagging feeling that the student must have cheated or that something fundamental is missing. In short, we are judging this student's answer as a **product outcome**. But, the lack of work on examinations in today's computer/calculator world does NOT imply that work did not occur. Indeed, a very advanced level of thinking is likely to have occurred via a handheld device. In one line on the calculator, (click slide 12) Calculator: $200 - (5 \times 20 + 22) =$ and voila, 78. Students often understand and use technology far better than we do and it should not come as a surprise when they out-tech us. Should we penalize for a "lack of work" when the student answered the question in a sophisticated technological manner?

It is true that students can become over reliant on technology to do what some of us might think of as mental mathematics. But, the history of science and mathematics is full of funny little examples of “critical basic skills” that disappear later on. For instance, the following type of problem was once commonly found in algebra examinations. No calculators.

slide 12 Extract the cube root of 113 to four decimal places. Show your work.

The solution would require 10 iterations of the modified Babylonian Algorithm, with about 30-35 calculations. Or perhaps you might prefer to use Newton’s Method? slide 13 Newton’s method solution.

Using technology changes the nature of the beast. Kaput calls this the computational medium and he suggests that changes in technology results in

Slide 14 Kaput’s “computational medium

- ? Changes in mathematical content
- ? Changes which content is important and for whom
- ? Changes the means by which it can be known, taught or learned
- ? Changes the socio-cultural milieu (Kaput, 1998).

If true, does it make sense to maintain subject matter that is trivialized by technology or to award grades for machine answers? It seems obvious that teachers need to be very familiar with technology and identify when, where and how students might use it in the subject. But it now seems important to us that we reconsider the changes resulting in the curriculum, the subject matter, the teaching model and the assessment.

slide 15 *The fourth characteristic of appropriate use of technology: always follow the introduction of technology in teaching by modifications of the curriculum, the subject matter, the teaching model and the assessment.*

High Stake Assessment: Product versus process

If asked, “What is the goal of teaching mathematics?”, many mathematics teachers might claim that they are teaching a process called “thinking”. The reality is that we have an infatuation with learning as a **product outcome**, answers. We often do not seem to construct assessment in terms of **process outcome**, e.g thinking. Maybe we hope or believe that right answers imply good thinking. But the trap is set for answers, and that's what we measure. Rogers claims that especially for adult learners, teaching only using product outcomes may be a serious barrier to the appropriate use of technology (2003).

Recently, many educators have given some thought to alternative assessment models including project-based teaching. It is not surprising to find that teachers who are attempting to use technology in the classroom for the first time, find themselves with the same sort of problems as those trying alternative assessment models: time constraints and the issues related to product outcome based assessment. Alternatives bring down product outcome results, and make those involved in these alternative programs very uncomfortable. The use of technology often does not result in measurable improvement of outcome, or may even have a negative result, especially when using a pre-technology assessment model.

For example, studies measuring the success or failure of introducing tablet PCs, are largely inconclusive in demonstrating particular product outcomes. Can the use of the Personal Digital Assistant [PDA], laptops or Tablet PCs be fairly evaluated within the paradigm of a product outcome only structure?

If we wish to adopt new technologies and new ways of doing mathematics in schools then we first must recognize that (slide 15) high stakes assessment is one of the most significant influences on what and how we teach (Barnes, Clarke, &

Stephens, 2000; Corbeil and Brown, 2004). This is part because of the time limitations and that “final exam.” These are THE realities of the game, we know it and we act accordingly. To ignore a high stakes assessment for the sake of process outcomes or an alternative teaching model would be irresponsible.

A shift towards process outcomes can help alleviate some of the stress of using project or technology based teaching and the result is an honest paradigm for the evaluation of a new model. Perhaps we should take the hint given by Blenkin and Kelly (1981) who suggest that we evaluate intellectual development and cognitive functioning rather than the quantities of knowledge absorbed or changed.

Performance tasks that assess “processes rather than products,” “approached and planned by reference to the kinds of activities and experiences that constitute” the process of learning.

The main reaction to the introduction of GDCs and CASe devices in high stakes examinations have been mostly to neutralize technology in examinations by using calculator free portions of the assessment (Corbeil and Brown, 2004) or by banning the technology in exams altogether. Good assessment practices would instead use open ended questions that can result in impressive demonstrations of subject material or one would use device active questions that allow a demonstration of both technological and mathematical sophistication. But these rarely see the light in examinations. Science subjects seem to take the turtle approach to technology. slide 18 Turtle image. Since assessment a reflection of institutional leadership, the current status of assessment world wide represents very poor leadership indeed.

We should want students to demonstrate that they can use technology to get answers to really novel and hard questions. The College Board, the body responsible for the US based Advanced Placement examinations, state that assessment must move

away from a basis in the testing of rote manipulation and towards problems or instruments that probe an understanding of the fundamental concepts (College Board, 2003). We have plenty of practice with drill and answer, but sparse experience in determining actual subject understanding of a particular student. Perhaps concentrating on the process of learning may result in a better understanding and better schemata to improve the understanding.

slide 19 Defining goals as process outcomes – making them the major feature of the assessment model is the fifth characteristic of the appropriate use of technology.

slide 20 Leadership ?

It is not surprising to witness inappropriate use of technology in some classrooms. The command from administrators is “use technology.” “Here it is, here is some stuff, there is the training, now GO and get better results!” Ask yourself, “Where does one find the expertise for technology use my school?”. Does technology developed come from an institution’s IT department? The purpose of IT in an institution is to support current and past technology. IT’s job is rarely defined as the development of cutting edge technology since today’s problems are from yesterdays hardware and software. Teachers are busy teaching and administrators are nervous about tools that may have negative effects on results (again product outcomes). Exam boards are unlikely to point out any deficiencies in their examinations schemes and we know that high stakes exams drive the curriculum. - skip if time low -

So who takes the lead? The risk takers seem to be the so called “early adopters.” These are teachers who tend to be technologically savvy (techno nerds) but they are rarely trained in the theory of teaching with technology. They often lack adequate preparation time and have very limited resources and so end up using technology inconsistently. These teachers are very willing to take risks in teaching but

may tend to try unproved alternatives and may get caught up in band wagon programs. The current over the top embracing of e-learning seems just might be an example of a good idea gone too far, over emphasizing what might not be appropriate in a direct student - teacher relationship. When the teacher in the same classroom is using technology to communicate with a student at the ode end of the classroom, we know there is a problem. Have you ever gotten an email from a colleague two desks down saying “ready for lunch?”. Same idea. Vocalization still works.

Early adopters can also easily lose sight of the learning goal as they must devote time to developing resources and this takes away time from developing the curriculum. They will have little or no time to close the circle of appropriate use of technology by making appropriate changes in curriculum and assessment that develop as a result of the use of technology. In short, early adopters, for no fault of their own, tend not to have most of the characteristics of appropriate use of technology.

But we can turn this around and take advantage of the promising leadership we have already in our institutions in the form of these early adopters by fusing some or all of these characteristics of the appropriate use of technology. **slide 22 (recap of 5 characteristics so far)** Leaders (trainers?) need to be trained or experienced in the theory behind the use of technology so they can transfer these skills , as well as specific ones related to the technology at hand. Identifying, supporting and repositioning these kind of early adopters is necessary to improve the systematic relationships between users and to move towards the learning goal. The learning goals need to be reflected in the adoption of technology. In addition, the learning goals must be adapted to the technology introduced.

All this while keeping in the mind the **process** of learning and the importance of opportunities to learn in more than one learning style. This relationship then needs

to be borne out in the assessment instruments and general institutional goals, either by involving the leaders into the process of assessment directly, or by making demands that examination bodies themselves adjust assessment to take account of appropriate (perhaps cutting edge) technology being used in the subject. This means providing support outside the normal academic structure or creating specialist positions across departments/schools.

Thus, slide 23 the final characteristic of the appropriate use of technology: an institution's systematic attempt to fuse the basic characteristics into the general instructional principles/policy, but especially assessment.

So, who do we start? We start with the view of technology as a means to achieve a particular process outcome based learning goal, work towards (slide 24) having teachers focus on using technology to enhance representation and learning alternatives towards a process outcome based learning goal AND we give these teachers the transferable skills through a minimal grounding in theory of teaching with technology. The institution should demonstrate systematic accounting of the inter-relationship between use of technology, assessment and subject content using subject, assessment and instructional goals defined both as process outcomes and product outcomes.

slide 25 Thank you.

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