Assessing Technology Integration:
The RAT – Replacement, Amplification, and Transformation - Framework

Dr. Joan Hughes
Department of Curriculum and Instruction
University of Minnesota
USA
joanh@umn.edu

Dr. Ruth Thomas
Department of Curriculum and Instruction
University of Minnesota
USA
thoma006@umn.edu

Cassie Scharber
Department of Curriculum and Instruction
University of Minnesota
USA
scha0809@umn.edu

Abstract: This brief paper will introduce an assessment framework, called *RAT – Replacement, Amplification, and Transformation*, that can be used with preservice and inservice teachers to increase critical decision-making concerning integration of technology into the K-12 classroom. The framework is currently being refined through (a) expanding our literature review to refine conceptual and theoretical categories, (b) subsequently applying the framework to videotaped technology-supported classroom lessons, and (c) working with practicing teachers interested in learning self-assessment techniques to improve their technology integration decision-making.

Theoretical Orientation

We view technology use as a means to some pedagogical and curricular end – that acknowledges the specific and unique motivation (Bruce, 1996; Mitra, 1998) underlying a teacher's choice to use technology. Looking deeper to what end technology serves rather than simply focusing on the variety and number of software programs teachers use will yield representations of teachers' technology use more accurately than in past research. Simply identifying the technological applications in use does not help the field think about the role(s) of technology in education.

Teachers are in great need of evaluative frameworks for assessing and guiding their own accomplishments with technology integration. Research has shown that preservice teachers have difficulty developing new technology-integrated lessons after completing their licensure programs (Doering, Hughes, & Huffman, 2003), and inservice teachers are provided a plethora of example lessons but no strategies for determining if the lessons are worthwhile for adoption. Our theoretical framework described below is aimed to assist both preservice and inservice teachers in making technology integration adoption decisions.

The RAT Framework

The initial conceptualization of this framework was developed in consultation with past research (e.g., Wood, 1998), theories about technology in education (Pea, 1985; Reinking, 1997), and analysis of classroom observations and teacher interviews to identify technology's enacted use in teachers' classrooms (Hughes, 2000). Three use categories were theoretically defined: (a) Technology as Replacement; (b) Technology as Amplification; and (c) Technology as Transformation. To determine if a particular technology use replaced, amplified, or

transformed practice, each instance of technology use is assessed in a very systematic manner. To ensure attention to all aspects of the instructional event in which the technology use is embedded, specific dimensions of three broad themes, (a) instructional method, (b) student learning processes, and (c) curriculum goals, are considered (see Table 1). All dimensions listed under each theme in Table 1 are considered, and the degree to which any dimensions within each theme were replaced, amplified, or transformed are noted.

Instructional Methods	*Student Learning Processes*	*Curriculum Goals*
	…include…	
Teacher's role	Activity task	"Knowledge" to be gained, learned, or applied
Interaction with students	Thinking process – mental process	"Experience" to be gained, learned, or applied
Assessment of students	Task milieu (individual, small group, whole-class, others)	
Professional development	Motivation	
Preparation	Student attitude	
Administrative tasks		

Table 1: Dimensions (within Themes) for Guiding Analysis of Technology Use

Technology as Replacement

Theoretical Basis

The *Technology as Replacement* category involves technology used to replace and, in no way change established instructional practices, student learning processes, or content goals. The technology serves merely as a different means to the same instructional end. Technology as Replacement does not include technology uses that are a "time-filler," a reward, or a supplement for completing other work (e.g., playing games after completing seatwork) as described by Ertmer et al. (1999). These uses are not included in the framework because they do not usually involve explicit subject matter connections.

Application

The distinguishing feature in categorizing a technology use into the Technology as Replacement category rests on it replicating an already functioning instructional method, learning process, or content goal in the classroom; in essence all that changes is the medium used to achieve a well-established purpose. For example, an English teacher had students recognize parts of speech by highlighting or underlining examples within text typed into a word processing file. This activity resembled circling the correct word with a pencil on a worksheet. In this case, the technology use functioned exactly as a worksheet. The teacher's instructional method (introducing the parts of speech and assigning an activity to practice identifying them) remained identical (R)[1]. The student's learning processes were unchanged (R); they still selected the correct answer and worked individually. And, the content goals within the curriculum (the ability to identify parts of speech in sentences) were steadfast (R).

Technology as Amplification

Theoretical Basis

The *Technology as Amplification* category focuses on technology use that amplified current instructional practices, student learning, or content goals. Increased efficiency and productivity are major effects. Pea (1985), who has been instrumental in conceptualizing the nature of technology amplification, described how technology may amplify what we already do, "Computers are commonly believed to change how effectively we do traditional

[1] "R," "A," and "T" are notations used to identify replacement (R), amplification (A), or transformation (T).

tasks, amplifying or extending our capabilities, with the assumption that these tasks stay fundamentally the same" (p. 168). Pea notes how:

> …the term "amplify" means to make more powerful, and to amplify in the scientific sense "refers rather specifically to the intensification of a signal (acoustic, electronic), *which does not undergo change in its basic structure*" (Cole and Griffin, 1980, p. 349). As such, "amplify" leads one to unidimensional, quantitative theorizing about the effects of cognitive technologies. (p. 170)

The focus is effectiveness or streamlining rather than change. As in the Technology as Replacement category, there is no fundamental change in any of the themes — instructional methods, student learning processes, or curriculum goals. Cuban (1988) might call Technology as Amplification a "first-order change" whereby technology is used to "try to make what exists more efficient and effective without disturbing the basic organizational features…" (p. 93). Reinking (1997), describing amplified uses of technology in the field of literacy, identified that technology "help[s] us do what we've always done (but doing it better)" (p. 636). Accordingly, research in this tradition sought to compare computer-based activities against traditional approaches in terms of their ability to meet or advance traditional curricular goals. Instances of technology used as amplification are responsible for increasing the efficiency or productivity of instruction, student learning or the curriculum.

Application

Instances of technology used as amplification were responsible for increasing the efficiency or productivity of instruction, student learning or the curriculum. For example, a high school English teacher used the word processor to amplify her instructional preparation (A). She produced handouts, tests, and other student materials for her English classes using a word processor. This use may seem, at first glance, like replacement but the difference lies in the teacher's evaluation of its usefulness. She explained that creating these materials on the computer served as an archive, in which she could easily change the materials for future activities. It was more efficient than using written or typed materials that, if used again with slight alterations, would require a complete reproduction. Since her use of technology was so focused on instructional preparation, this particular technology use did not impact the students' learning processes (R) and the content goals (R), leaving them unchanged and identical.

Technology as Transformation

Theoretical Basis

The *Technology as Transformation* category involves technology use that transforms the instructional method, the students' learning processes, and/or the actual subject matter. Pea (1985) conceptualizes potential transformation in terms of the students' learning routines. He wonders, "How might information technology redefine the very possibilities of education?" (p. 167) and theorizes that "both the content and flow of the cognitive processes engaged in human problem solving" (p. 170) will be restructured or reorganized. Such reorganization involves the following changes:

1. The actual mental work changed or expanded.
2. The number of variables involved in the mental processing expanded.
3. The tool changed the organization in which it had been used.
4. New players became involved with the tool's use (or expanded use of the tool).
5. New opportunities for different forms and types of learning through problem solving, unavailable in traditional approaches, developed.

These changes describe reorganization in the student learning process. Theoretically, instructional methods can transform as well. For example, the teacher may be responsible for shaping "new opportunities for different forms and types of learning through problem solving…" where her role in the classroom fundamentally changes. Technology:

> …improve[s] the process of bringing thought into communicable expressions in such significant ways that, once the tool is understood and used regularly, the user feels wanting if it is not available *because it has opened up new possibilities of thought and action* without which one comes to feel at a disadvantage. *It becomes an indispensable instrument of mentality*, and not merely a tool. (Pea, 1985, p. 175; emphasis added)

Pea argues that technologies used in work and education restructure the manner in which tasks occur and the way the user's thought processes are enacted. Because technologies were new machines and tools when he wrote on this

topic, such reorganization in mental processing was theorized. Analyzing technology solely as amplification or replacement may obscure or hide the discovery of technology's potential transformative effects. Pea summarizes, "there are emergent properties of computer-aided thought that are unrecognized when one subscribes solely to the amplifier metaphor" (p. 175).

Computer technology also has the potential to transform more than student mental processes. Modern technologies may spur a transformation in teachers' instructional practices within the language arts curriculum, according to Reinking (1997). He observed how the use of multimedia book reviews changed classroom social interaction – reducing teacher direction, increasing peer interaction and collaboration, and altering student roles. Reinking also acknowledges that we must open our imaginations in order to conceptualize and recognize how technology might transform:

> … we will be best served by setting our imaginations free from seeing a computer as a machine that lacks the warmth and security of a book, seeing it instead as a technological alternative providing almost unlimited potential to operationalize the humanistic values that fuel our noblest conceptions of literacy. (p. 642)

In essence, transformation is akin to Cuban's (1988) notion of "second-order changes" that produce "new goals, structures, and roles that transform familiar ways of doing things into novel solutions to persistent problems" (p. 94).

Garner and Gillingham's (1996) work describes changes in content that occurred with the use of computer technology, specifically Internet communications. Six teachers in their study sought "alternatives to their current practice" (p. 135). For some, that involved changing instruction that, in turn, altered student learning processes. Others used technology in ways that altered the literacy practices in their classrooms. For example, two teachers sought "new ways for their L2 students to practice speaking and writing in English," and another teacher wanted "ways to encourage open, but respectful, conversation in her classroom" (p. 136). It is more, Garner and Gillingham conclude, than changing materials and methods; these teachers' literacy content goals were transformed.

Application

Technology use that leads to or supports transformed instruction, learning, or content distinguished uses into this category. Unlike Technology as Replacement, the technology in this case certainly does *not* reiterate established educational patterns and goals. The technology may, as in Technology as Amplification, increase productivity but toward a different end. The key in this case is something — the instruction, the learning process, and/or the content — is fundamentally different, thus, transformed, and the technology played a central role in developing such a transformation.

For example, a middle school English teacher had her students use StorySpace software to write hypertext narratives. In this case, the curriculum content goals were completely different (T) than traditional 8th grade English language arts. After learning about and writing hypertext herself, Nell expanded her English goals to include the teaching of hypertext writing. When she took on this goal, she truly stepped out onto the cutting edge of the field. At that time, hypertext was not an explicit goal even in one of the most forward-looking documents available to Nell—her state's English Language Arts content standards. Technology enabled Nell to "transform" her goals for student learning. Instead of writing what Nell called "straight" stories (linear), students wrote intertextually. Nell first attempted to teach hypertext using string and paper. Later, using a software program, her students better understood and grasped the concepts than with other non-computer-based approaches. The student learning processes were amplified with a technological approach (A). Though Nell believed the most effective way to communicate notions of text, writing and reading to her students required the technology, she was able to use a non-computer based approach. Nell's instructional methods were also amplified (A) with technology. StorySpace, the computer program she used, allowed simpler and clearer illustrations of the concepts. With the string and paper approach, textual passages were connected intertextually, denoted with string connectors. Representing more lengthy writing, as one can imagine, was a mess of string. StorySpace provided several ways to view text and the intertextual links.

Work-in-Progress

Teachers who have used this framework report that moving from amplification to transformation is a big leap. Therefore, we are engaging in a revision of the original RAT framework to more fully consider the literature to inform our categories. To that end, our current investigation of the literature examines the categories of and keywords related to "educational change," "educational innovation," "technology innovation," "technological frameworks and models," and theoretical literature related to educational technology in ERIC, Education Full Text,

and PsycINFO databases from 1983 - current. Subsequently, the revised framework will be applied to videotaped technology-supported classroom lessons, and piloted with practicing teachers interested in learning self-assessment techniques to improve their technology integration decision-making.

References

Bruce, B. C. (1996). Foreward. In R. Garner & M. G. Gillingham, *Internet communication in six classrooms: Conversations across time, space, and culture*, (pp. ix-xii). Mahwah, N. J.: Lawrence Erlbaum.

Cole, M., & Griffin, P. (1980). Cultural amplifiers reconsidered. In D. Olson (Ed.), *Social foundations of language and thought.* New York: W.W. Norton.

Cuban, L. (1988). Constancy and change in schools (1880s to the present). In P. W. Jackson (Ed.), *Contributing to educational change: Perspectives on research and practice*, (pp. 85-105). Berkeley, CA: McCutchan.

Doering, A., Hughes, J. & Huffman, D. (2003). Preservice teachers: Are we thinking with technology? *Journal of Research on Technology in Education, 35*(3), 342-36

Ertmer, P. A., Addison, P., Lane, M., Ross, E., & Woods, D. (1999). Examining teachers' beliefs about the role of technology in the classroom. *Journal of Research on Computing in Education, 32*(1), 54-72.

Garner, R., & Gillingham, M. G. (1996). *Internet communication in six classrooms: Conversations across time, space, and culture.* Mahwah, N. J.: Lawrence Erlbaum.

Hughes, J. (2000). *Teaching English with technology: Exploring teacher learning and practice.* Unpublished Doctoral Dissertation, [blind] University.

Mitra, A. (1998). Categories of computer use and their relationships with attitudes toward computers. *Journal of Research on Computing in Education, 30*(3), 281-295.

Pea, R. D. (1985). Beyond amplification: Using the computer to reorganize mental functioning. *Educational Psychologist, 20*(4), 167-182.

Reinking, D. (1997). Me and my hypertext:) A multiple digression analysis of technology and literacy (sic). *The Reading Teacher, 50*(8), 626-643.

Wood, J. M. (1998, December). *Redefining literacy instruction in the digital age: Profiles of 3 exemplary teachers.* Paper presented at the National Reading Conference, Austin, TX.