SUMMARY. Cognizant of the difficulty teachers face in attempting to integrate computers into instructional settings, the authors propose a new technology integration assessment strategy that can guide individual development or be used to track programmatic change. The Technology Integration Assessment Instrument (TIAI) explores seven dimensions of planning with specific attention to levels of technology integration. Repeated use of the TIAI is anticipated to promote individuals’ abilities to track their own growth, as well as provide a standard method for documenting the application of Type II uses of educational computing. This paper presents the TIAI, identifying the method of analyzing lesson plans employed in this system, as well as addressing likely uses of the instrument by teachers, administrators, and program evaluators.
UNDERSTANDING TECHNOLOGY USE IN INSTRUCTIONAL PLANNING OF CLASSROOM TEACHERS

Although technology in the classroom is typically deemed to be a positive shift in the betterment of students’ post-school skills, simply placing technology in the classroom is not enough (Burke, 2000). As argued by Cuban (2001), access to technology does not translate into the use of that technology by classroom teachers. Therefore, to effectively measure technology integration, evaluators need to focus on how the technology is implemented in the classroom, not merely document available materials (Dockstader, 1999). Another problem in assessing technology integration has been the common problem of poor operational definitions for “technology” (Moersch, 1995). With respect to this paper we identify technology as computers, regardless of standard contextual setting (i.e., lab versus classroom use).

The International Society for Technology in Education (ISTE) technology standards provide a foundation for goal setting and the longitudinal tracking of technology use by classroom teachers. Central to the technology standards for teachers (NETS-T) is attention to the use of technology for the purpose of improving instructional design and outcomes (NETS Project, 2003). The presence of these standards in P-12 settings is just now becoming an embedded part of school-reform efforts. However, as the implementation of these standards is in its infancy, one of the lessons learned with regard to implementing curriculum standards in the P-12 setting is that standards must be aligned with professional evaluation, and natural responsibilities of classroom teachers (Turnbaugh Lockwood, 1999). Thus, we assert that it is critical to the successful infusion of technology standards that there be a means by which classroom teachers can identify the connections among standards, best practices in teaching, and uses of technology.

Effective use of technology to support learning is distinctly related to classroom teachers’ understandings for different modes of technology use, basic understanding of technology, beliefs about instruction, and ability to motivate students to use the technology (Maddux & Cummings, 1986; MacArthur, 2001). However, determining efficacy is
difficult because it is often unclear in what ways teachers’ use of technology supports instructional goals (see Cuban, 2001). Thus, attempts to classify instructional uses for technology need to be framed within the standard language and context of P-12 educational settings.

As defined by Maddux (1986), classification of technology use can be summarized into two critical types. Type I applications of technology are defined as being passive or teacher-centered. Maddux defined Type II applications of technology as more learner-centered, and those that hold the potential to alter the effectiveness of teaching and ultimately the success of learning. While this dichotomy provides a basic framework, we argue that there is a need for an instrument by which teachers can assess their use and make data-driven decisions specific to their application of technology in the classroom.

ASSESSING THE ARTICULATION OF TECHNOLOGY INTEGRATION IN LESSON PLANS

The need in the field for lesson plan rating systems specific to technology integration is expected to increase in upcoming years (Brooks-Young, 2002). Administratively, such a rating system can provide a point of dialogue during evaluation conferences specific to technology application by classroom teachers (Brooks-Young, 2002; Darling-Hammond, Wise, & Pease, 1983). Given that technology is of growing importance to schools and that sizable portions of operating budgets are focused on technology purchases, it is imperative that administrators establish a better understanding of how teachers are using technology to support instruction and enhance student learning (Department of Education, 1999). However, many school administrators are in need of sound evaluative tools to make this internal assessment process reliable.

Another reason for the need for a systematic scoring rubric for lesson plans is based on the need in program evaluation to establish program success through triangulation. To effectively measure success of many educational technology initiatives, it is required that the evaluators demonstrate change in teacher behaviors. This has traditionally been accomplished through classroom observation, survey data, loose estimations of teacher lesson plans, or more holistic organizational analyses (Bober, 2002; Yepes-Baraya, 2002). Although several strategies have been employed to examine the level of integration of technology in the classroom, no measure examining teachers’ use of technology through
archived lesson plans that are aligned with NETS-T has been established.

Through our own work with evaluating technology innovation projects, we have seen the wealth of extant data available in the form of lesson plans. Using existing lesson plans that have been constructed within a framework of progressive change toward improved use of technology in education has several advantages. First, there is little logistical strain to the evaluation. School administrators or program evaluators can examine progress of several teachers in one “session,” without having to schedule school-hour observation time. Second, the lesson plans maintain a higher degree of validity in response than self-report instruments. Third, the use of lesson plans as an evaluative data set provides a greater level of contextual validity in the analyses. Attention to the contextual factors in the given educational environment is a necessity for meaningful use of the TIAI as well as for the generalization of results.

The Technology Integration Assessment Instrument was designed to enable teachers, administrators, and evaluators to systematically examine the level and style of technology integration in a standard classroom application.

**USING THE TECHNOLOGY INTEGRATION ASSESSMENT INSTRUMENT**

The Technology Integration Assessment Instrument (TIAI), as seen in the Appendix, provides for ratings across seven dimensions of a lesson plan, with four levels of classification within each dimension. The classifications represent a continuum of technology integration; the labels are (a) Technology Not Present, (b) Non-Essential Technology Component, (c) Supportive Technology Component, and (d) Essential Technology Component. A brief description of each dimension follows, with a small set of examples to illustrate the types of activities within each level of classification. Note that the rubric itself (Appendix) encompasses these definitions; however, the descriptions to follow do not repeat that content.

We created the TIAI in an attempt to evaluate the progress teachers made over the course of one project that used the school classroom as a central point of intervention for overcoming the digital divide in a diverse community. An initial attempt at classifying lesson plans made use of a simple holistic rating driven by the school district’s existing
guidelines. That original rating system proved to be unreliable due to the holistic approach to rating. Subsequent to configuring the TIAI to provide specific evaluative data on the seven specific dimensions, the ratings generated through evaluating teachers’ lesson plans met a higher standard of psychometric qualifications. In a random selection of teachers’ lesson plans extending across all academic disciplines, inter-rater reliability estimates exceeded .70 across each dimension. In addition to demonstrating a high degree of 1:1 correspondence in ratings provided by the two independently trained raters, our examination of the ratings revealed that, in those cases where the ratings did not agree, the two responses were typically adjacent to each other on the rubric. As a second test of the utility of the TIAI, we compared teachers’ selected lesson plans from within the same semester of instruction, also generating a high level of concordance in the dimension-specific technology integration estimations. In addition to these estimations of consistency in response across raters and across lessons, the trained raters were interviewed regarding the usability of the TIAI. One rater was a graduate student in education with experience in teaching and developing lesson plans. The second rater was a graduate student in school psychology with expertise in standardized testing and assessment. Both found the rubric easy to learn and free from ambiguity.

Planning

The planning dimension focused on the teachers’ use of technology to locate, evaluate, select, and organize lesson activities. That is, the lesson itself does not depend upon the technology, and it would be possible to create or locate lesson-planning processes in the absence of the technology tools (Type I application). Technology is supportive in conditions when it is clear that not only was the computer used for planning, but that the lesson plan itself identified technology tools (i.e., hardware and/or software) that would be necessary to implement the lesson. Such a lesson that makes use of technology as a supportive component may be one that mentions using a pre-packaged PowerPoint presentation for the day’s lecture. Although the technology provides support to the learning situation, it is not essential to meet the learning objectives, because the PowerPoint slides could merely be run off on a transparency, or the instructor could work without the visual aids (Type I application). Finally, those lessons that offer technology as an essential component demonstrate the development of a lesson that cannot be prepared without using technology tools (Type II application). Thus, these lessons of-
ten result in using technology as either a content-delivery mechanism (e.g., use of an Integrated Learning System) or an essential resource that makes the learning event possible (e.g., data probes connected to a statistical package for biology laboratory experiments).

**Standards Relation (Content and NETS-Students)**

The attention to standards is a common focus in recent years given pressure from federal and state mandates to demonstrate and promote effective planning related to core objectives and goals. For content standards, the focus of the rubric is on the level of technology integration into the targeted standards for the lesson. That is, rather than merely identifying that the instructor has linked the lesson to content standards or demonstrated that technology is evident in the lesson, our tool examines the level to which the standards are addressed as a consequence of the presence of the technology tools or materials. The most common example of non-essential uses of technology are word-processing programs used to complete written work that does not involve a write-and-rewrite process (e.g., typing spelling word lists). Supportive technology may include using Web-based search engines, or word-processing tools (Type I application). Essential uses of technology may include lessons requiring using a technology program for analyzing data (provided the standard was targeting data analyses) or using a computer assisted drawing program (CAD) for completing a project (Type II application).

NETS for Students (NETS-S; NETS Project, 2000) are becoming more commonly addressed as school districts recognize the importance of lifelong learning and employability associated with technology skills. Essentially, this dimension examines the level to which teachers have explicitly identified and incorporated NETS-S into the activity or lesson itself, with attention to developmental appropriateness.

**Student Needs**

Essentially, most proponents of educational technology applications promote the notion that individualized learning experiences or differentiated learning is improved in technology-rich classrooms. Although this is a common promise of educational technology, it is clearly not a realized vision in many educational settings. Non-essential uses of technology in this dimension include having all students complete an online or CD-ROM tutorial that does not adjust for individual learners (Type I
application). Supportive technology may involve delivering lesson plans that can be preset to provide content at varied degrees of difficulty, either established by the user or in advance by the teacher (Type II application). Such “difficulty level” adjustments are common in skills-development software or games, but should not be confused with individualized instruction attempts afforded with programs that fall into the category of Integrated Learning Systems. Finally, essential technology focuses on providing differentiated instructional opportunities to children that could not be accomplished without technology tools (Type II application). In this way, the technology should be viewed as a tool that may provide remediation as well as enrichment for students, as the need may exist. Such programs generally have a control process through which the teacher can determine the order or presentation of learning materials, or allow the user to self-select content that is appropriate to her/his interests and skill level.

**Implementation: Learning and Teaching**

The implementation dimensions focus on using technology for both teaching and learning, recognizing the unique differences between these two processes. Implementation for learning focuses on using technology in the classroom as a means to boost students’ understanding of the content, or to engage students in the core activity through the assistance of technology (Type II application). The implementation of technology for teaching dimension examines the level to which the teacher relies upon the technology during an instructional session to deliver the content (Type I or Type II application). This dimension is intended to discriminate among the lessons that make use of technology at rudimentary levels (Type I application) and those that make the technology an integral part of the instructional process (Type II application).

A helpful distinction identified in the rubric itself focuses on technology that is used in a process-oriented versus product-oriented activity. Product orientations typically make use of the technology tool as a useful but not necessary feature (Type I application). There is a common experience in observing lessons where teachers use technology, but the implementation really provides no additional gains to the learning environment and generally could be considered a wasteful use of resources. For example, one application suggested in a reviewed lesson was to provide all students with wireless devices so they could follow the class lecture PowerPoint slides from their own desks. The students in this setting would have no additional access to material; the teacher planned to
still display the PowerPoint slides on the front board to keep everyone on the same topic, and there was no intention to expand the level of interaction among students using the wireless units.

Using technology in a supportive fashion generally can be seen in situations where the teacher is able to call up additional resources in a quick manner, or deliver divergent content to students with differential needs with ease (Type II application). The essential distinction between this rating and the “essential” category rests on identifying of the possibility to deliver content in the absence of the specified technology (Type II application). If the learning goals of the lesson could still be met without the technology tools, then they are merely supportive to those tasks. Generally, this distinction is tied to the presence of attention to technology skills as a meaningful focus of at least part of the curriculum (i.e., NETS-S focus).

Implementing technology for student learning examines the lesson from the perspective of the student as technology user. From a learning perspective, we define non-essential technology as those technical tools or procedures that clearly provide opportunities for students to use technology, but the use of technology itself is not anticipated to support or promote learning. Examples include word processing for spelling words, e-mail access for “penpals,” and using a digital paint program to design a cover for the student’s self-authored book. Supportive technology tools promote the learning environment, but only through efficiency or access to additional resources that would not be possible otherwise. Examples of these include using word-processing programs in the editing process, accessing content experts through discussion boards, or viewing online photos of historical documents or materials. Finally, essential technology components provide an undeniable and irreplaceable learning benefit for students, by exposing the learner to content that is not available in any other format, or by providing the learner with a method of interacting that is enabled only through digital media.

Assessment

One often-overlooked area of lesson development when examining lesson plans is the connection to assessment. Once again, the varied levels of classification for this dimension are primarily influenced by the ability to assess the learner in the absence of technology. Non-essential uses of technology are characterized by lessons that make use of technology, but in which no assessment of the outcome product or developed skills related to the learning process is undertaken (Type I
application). Supportive technology makes use of technology to deliver assessment or focuses on the product of a technology-driven activity in determining mastery (Type II application). Finally, essential technology builds upon the expectations for supportive technology by requiring that the assessment be impossible in the absence of technology, such as through a demonstrated procedural skill involving technology application (Type II). There is also the expectation that the lesson will include assessment of mastery of NETS-S (or an alternate technology standards system) by the learners.

USE OF RATINGS

Once the ratings in each dimension have been recorded, the process of categorizing the level of technology integration exhibited in the lesson begins. As mentioned earlier, it is not reasonable to generate holistic ratings in most cases due to the threats to validity and internal reliability inherent when condensing multiple distinct categories. For example, a teacher who clearly makes use of essential technologies in the classroom but fails to identify a method of assessment or list standards for the lesson would receive an overall rating that was equivalent to a teacher with primarily non-essential uses of technology but who had made mention of the content standards and assessment practices.

Consequently, the Technology Integration Assessment Instrument rating is best used as a measure of strengths and weaknesses across the seven dimensions of lesson planning. As alluded to earlier, we see two primary contributions this instrument can make to the process of integrating technology into educational environments. First, the rubric can be used as an evaluative measure for projects with a focus on teacher integration of educational technology. The lesson plan analyses afforded with this tool exceed most pre-existing measures, and allow for triangulation of data in typical educational technology evaluation plans. As an evaluation instrument, the rubric can track change over time, diagnose patterns of strengths and weaknesses, and allow for comparisons among control and experimental conditions.

The second anticipated use of this Technology Integration Assessment Instrument is within the P-12 school itself, either as a personal reflection or an action research tool. Teachers or administrators who are consciously attempting to increase the level of technology integration (i.e., from Type I to Type II) in the daily education of their students will benefit from periodic, or representative, use of this rubric. Teachers
may find it useful as a before-and-after picture of their technology integration following technology-focused professional growth activities, or as a means of documenting proficiency in technology for performance-based reviews or application to tenure status. As a tool employed for action research, the teacher may simultaneously ask students about their interest or satisfaction in the specific lesson plans, and compare student responses based on the overall level of technology integration in the seven dimensions. Similarly, comparisons on student achievement could be tracked in relation to level of technology integration, identifying the level of impact of each dimension on these important outcome measures.

CONCLUSIONS

While we acknowledge that using an instrument to rate the level of technology integration in teacher-created lesson plans could be observed as somewhat controversial, it is important to note that in this era of accountability there must be efforts made to accomplish goals and mandates of accountability within the natural work of classroom teachers. In addition, while assessment specific to technology use by teachers has been explored (NETS Project, 2003), we have observed a trend where the assessment of technology use has been disassociated with the assessment of other critical instructional factors. This rubric is intended to provide teachers, administrators, or program evaluators with a consistent framework for articulating how technology is used and, more importantly, how that technology is integrally tied to critical pedagogical features such as assessment, individualized attention to student needs, and addressing educational standards.

In efforts to increase the Type II application of technology in the classroom, it is important to continue searching for a valid instrument to assess use, but it is also critical to have a data-driven decision-making context for providing technology-focused professional development. The only way to reasonably expect technology to positively impact the learning of P-12 students is through the expectation of teachers to meaningfully apply those technologies in an instructional setting (Cradler, 1992). We believe that the TIAI can help teachers and program implementers more effectively assess the development of these skills and practices in classroom settings. The TIAI is a flexible tool that enables the user to explore individual growth in select dimensions as well as provides the opportunity to examine an entire district perspective in overall technology integration across the seven dimensions.
REFERENCES


## APPENDIX
### Technology Integration Assessment Instrument

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Technology not present</th>
<th>Non-essential technology component</th>
<th>Supportive technology component</th>
<th>Essential technology component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning (materials, equipment, etc.)</td>
<td>No mention of technology.</td>
<td>Uses technology in lesson not related to the addressed standards.</td>
<td>Uses computer to plan for lesson. Makes mention of necessary equipment and technologies for replication purposes.</td>
<td>Computer is essential to planning of lesson (e.g., WebQuest). Equipment and technologies are built into lesson design and objectives, and are discussed within the context of the lesson and not as an external component.</td>
</tr>
<tr>
<td>Standards (content standards per grade level and content area)</td>
<td>No mention of technology. OR No mention of content standards.</td>
<td>Uses computer to plan for lesson.</td>
<td>Uses technology supports or promotes the acquisition of standards in the lesson, but is not directly tied to the standard itself.</td>
<td>Technology use in the lesson is directly linked to one or more standards, making acquisition of that standard possible.</td>
</tr>
<tr>
<td>Standards (NETS-S)</td>
<td>No mention of technology. OR No mention of NETS.</td>
<td>NETS are present but not identified or embedded into lesson as a learning goal. NETS addressed are not up to expected grade level.</td>
<td>NETS are present but not identified or embedded into lesson as a learning goal.</td>
<td>NETS are present and integrated into grade-level appropriate learning goals.</td>
</tr>
<tr>
<td>Attention to student needs</td>
<td>No mention of technology.</td>
<td>Technology is not used in an adaptable fashion. All students use same technology tool or complete same technology-based activity.</td>
<td>Technology can be modified by the teacher or student to meet the needs of students from diverse backgrounds.</td>
<td>Technology is the only means by which this lesson can be adapted to meet the needs of students from diverse backgrounds; that is, the technology tool or activity is designed to be adaptive.</td>
</tr>
<tr>
<td>Implementation (use of technology in learning)</td>
<td>No mention of technology.</td>
<td>Technology is not expected to directly impact learning.</td>
<td>Learning is impacted in time, quality, or wealth of resources by the use of technology.</td>
<td>Technology impacts learning by presentation, product, or process.</td>
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<tr>
<td>Implementation (use of technology in teaching)</td>
<td>No mention of technology.</td>
<td>Lesson uses technology but does not impact implementation (product-oriented technology).</td>
<td>Lesson is facilitated with technology, but learning goals could be achieved without technology in place (process-oriented and/or product-oriented technology).</td>
<td>Equipment and technologies are built into lesson design and objectives and are discussed within the context of the lesson and not as an external component. Lesson requires the use of technology (process and product are dependent upon technology).</td>
</tr>
<tr>
<td>Assessment</td>
<td>No mention of assessment. OR No mention of technology.</td>
<td>Technology is not used in the assessment component (neither the use of technology nor a product of technology).</td>
<td>Technology-based product is assessed, or technology application is used to deliver and/or score the assessment instrument. However, similar assessment could be replicated without technology.</td>
<td>Technology products and/or processes are directly assessed, or assessment relies upon the use of technology for delivery or collection. Identified assessment could not be conducted without technology. NETS are identified as part of assessment.</td>
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</table>