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The Effects of NCLB-funded Instructional Technology Training on Teachers' Classroom Practice

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Abstract

In order to establish higher levels of instructional technology use in public schools, the Enhancing Education through Technology (EETT) program under the No Child Left Behind Act (NCLB) provided competitive grants to help teachers integrate technology into their curricula. This study investigated the effects of a teacher professional development institute funded by the NCLB-EETT grant on the participants' classroom technology integration. Both quantitative and qualitative data were collected through classroom observations. The results showed that the program had positive impacts on the participants' effective and efficient use of instructional technology: most participants successfully transferred the program content to their classroom practice. This study also explored the barriers that K-12 teachers were likely to encounter in their technology implementation endeavors.

Continual efforts to place necessary and adequate technology in public school classrooms has finally succeeded with over 90% of schools providing access to computers with broadband connections at a student/computer ratio of 3.8 to 1 (Parsad & Jones, 2005; Wells & Lewis, 2006). The presence of, and access to technology is, however, no guarantee that teachers and students are using the technology to enhance learning; in fact, the United States Department of Education reported that technology is used primarily for low-level productivity such as email, basic internet searches, word processing, and electronic presentations (Lanahan, 2002). That is not to say that basic productivity tools cannot be used for higher-level thinking and problem-solving—they can, and they should be. Well known examples include Jonassen's (1996, 2000) notion of computer applications as Mindtools and Dodge's (1995) popular Webquests. In addition, the use of productivity tools for higher-level learning makes sense financially as many applications such as word processors, presentation software, spreadsheets, web browsers, and email clients are found on nearly every computer. Many schools also provide additional "open" software tools such as graphic organizers (e.g., *Kidspiration/Inspiration*), Smartboards, and access to multimedia databases such as United Streaming (graphics, video clips, and lesson plans).

To establish higher levels of instructional technology use, teacher professional development is critical. The *No Child Left Behind Act (NCLB)*, signed into law by President Bush in 2002, is a five-year initiative funded by the federal government. One of the components of the initiative— the *Enhancing Education through Technology (EETT)* program, also known as *EdTech* or Title II, part D, provided competitive grants to improve student academic achievement through the use of technology in elementary and secondary schools (U.S. Department of Education, 2002). The act was also designed to enable every student to become technologically literate by the end of the eighth grade and to encourage the effective integration of technology resources and systems with teacher training and professional development to establish research-based instructional models (Massachusetts Department of Education, 2006).

As one of the recipients of the *NCLB- EETT* regional competitive grants, the *Four Rivers Technology in Education Consortium* in mid-eastern Virginia designed and implemented a series of technology-enhanced and curriculum-based instructional institutes to help K-12 teachers, administrators, and instructional technology resource teachers (ITRTs) effectively integrate technology into their curricula. This study attempted to explore the effectiveness of the institutes in this endeavor. The research questions addressed are:

1. What impact did the *NCLB- EETT* institutes, offered by the Four Rivers Consortium, have on technology integration in K-12 classrooms?
2. What barriers have K-12 teachers met in their technology application efforts?

Methods

Sample

The sample of this study was K-12 in-service teachers in mid-eastern Virginia who volunteered to participate in the 2006 math, reading, and special needs education institutes offered by the Four Rivers Consortium (referred to as “participants” in the remainder of the article). Although no pre-institute assessment was conducted, the voluntary nature of the professional development opportunity can be interpreted as participants’ self-determined area in need of improvement. A total of 55 participants enrolled in the institutes, and our data were collected from 53 (one participant moved out of the region; one changed his job).

Instrument

The *Classroom Observation Form* (see Appendix), developed by the authors specifically for this program, was used to record how teachers actually implemented the specific technologies and teaching/learning strategies they learned from the institutes in their classroom instruction. Both quantitative and qualitative data were gathered via this instrument. The quantitative data sought information in four domains: 1) Location where technology is used, 2) Transfer of institute content to classroom instruction, 3) Frequency of technology used by the institute participants, and 4) Levels of student cognitive engagement in class. Qualitative data explored the barriers that influence the use of technology as well as the levels of institute content implementation according to the observers' judgment.

Procedure

The institute instructors (referred to as "observers" in the remainder of the article) conducted the classroom observations with all the teachers who participated in the Four Rivers *NCLB-EETT* 2006 summer institutes during the fall semester of 2006 in an effort to verify whether and how well these grant-funded institutes helped the participants incorporate the technology applications, and related teaching and learning strategies into their instruction. All participants were contacted by the observers via email or phone to arrange the class visit. Each class observation lasted one class period (45-60 minutes). The observers recorded on the *Classroom Observation Form* (a) what was observed during the class, (b) answers to specific questions posed to the teachers, and (c) their own reflections on the classroom instruction.

Data Analysis

The quantitative data from the *Classroom Observation Form* were analyzed descriptively to identify the conditions of technology application. A content analysis approach was used for the qualitative data recorded on the *Classroom Observation Form* to help better understand the technology implementation environment in K-12 classrooms.

Results and Discussion

Quantitative results

The descriptive statistics from the quantitative data showed that technology-enhanced activities took place mostly in classrooms or a combination of classrooms and computer labs (Table 1 & Figure 1). This is desirable because the most convenient, practical, and efficient use of technology should be in classrooms where teachers and students can access technology any time based on their teaching and learning needs.

In terms of the frequency of technology application reported by participants, the results varied from less than once per week to daily. Interestingly, two peaks occurred at the two ends of a frequency continuum—either once a week or daily (Table 1 & Figure 2). One possible explanation for this phenomenon might be the relationship between the location of technology use and frequency of technology use: if teachers had easy access to adequate and appropriate technology in their own classroom, they may tend to use it on a daily basis; if they could only access technology in a lab or library, they may only use it occasionally. This makes sense when comparing the statistics presented in Table 1 (the total number of “twice, three times, four times, and five times” is close to the total number of “Classroom Only + Classroom & Lab”; the total of “Less than once + Once” is close to the total of “Lab Only + Library). The implication is that if technology should be used on a daily basis, classrooms need to be equipped with the necessary technology resources.

Regarding the transferability of the institute content to classroom practice, more than half the participants successfully transferred both technology skills and related teaching & learning strategies into their classroom practice. Nearly one third of the participants transferred technology skills but failed to transfer teaching & learning strategies and five transferred teaching & learning strategies without utilizing any of the related technologies. Only three participants used neither the technology nor teaching & learning strategies for reasons both objective (resources not available) and subjective (not prepared) (Table 1 & Figure 3). This result implies that the institutes were more successful in helping participants with technology-related knowledge, skills, and techniques than with teaching & learning strategies.

Level of student cognitive engagement in the learning process refers to the assessment of cognitive complexity as described by a hierarchy such as the well-known Bloom’s Taxonomy (Anderson & Krathwohl, 2001), which includes six levels with “remembering” at the bottom, indicating the lowest level of learning and “creating” at the highest level. It is important to engage student thinking and learning at higher cognitive levels which is a characteristic of problem/project-based and cooperative/collaborative pedagogy (Jonassen, 1996, 2000), reflecting a shift in instructional focus from product to process (Hanney, 2005) and strengthened further by real-world problems for which no specific “right” answers or paths to resolution exist (Savin-Baden, 2003). The observers were required to check the highest level of student cognitive engagement observed during the lesson. The reason for identifying the highest cognitive level is that an activity at any specific level must include cognitive engagement at the levels below. For example, a concept at the Apply level requires students to know the supporting Facts, and Understand the concept before he/she can Apply the concept. Therefore, even if the majority of a lesson is conducted at the lower level, the overarching learning goal will be to reach the highest level. The data analysis showed that instances of the use of instructional technology and strategies were most prevalent at the levels of “Understanding” and “Applying”. The instances of “Analyzing” and “Creating” were few, with “Remembering” in between. No “Evaluation” instances were observed. Given the fact that most observed classes were elementary, this result is satisfactory (Table 1 & Figures 4).

Table 1
Descriptive Statistics of the Quantitative Results from Classroom Observations.

Location of Technology Use (N = 53)

Category	Classroom Only	Classroom & Lab	Lab Only	Library
Frequency	23	17	8	5

Frequency of Technology Used Every Week (N = 53)

Category	< Once	Once	Twice	3 Times	4 Times	≥ 5 times
Frequency	3	12	3	8	2	19

Transferability of the Institute Content to Classroom Instruction (N = 53)

Category	w/oTech & w/oStr	w/Tech but w/oStr	w/Str but w/oTech	w/Tech & w/Str
Frequency	3	16	5	29

Levels of Student Cognitive Engagement (N = 53)

Category	Remember	Understand	Apply	Analyze	Evaluate	Create
Frequency	10	22	15	3	0	2

Figure 1. The Place Where Technology Takes Place.

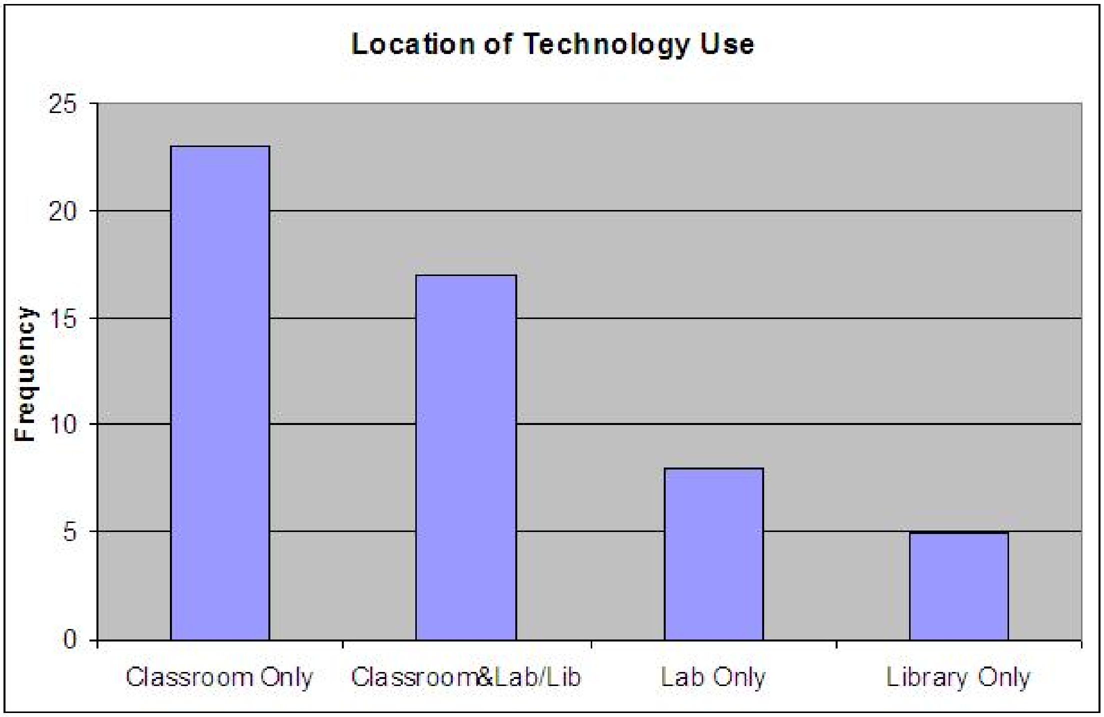


Figure 2. The Frequency of Technology Usage.

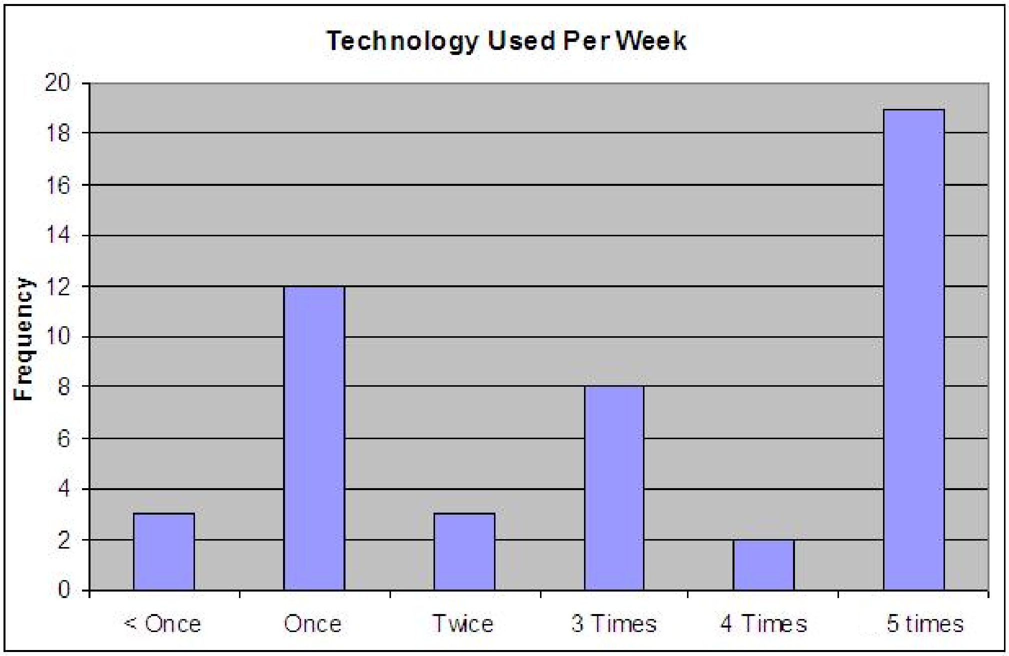


Figure 3. Transferability of the Institute Content to Classroom Instruction.

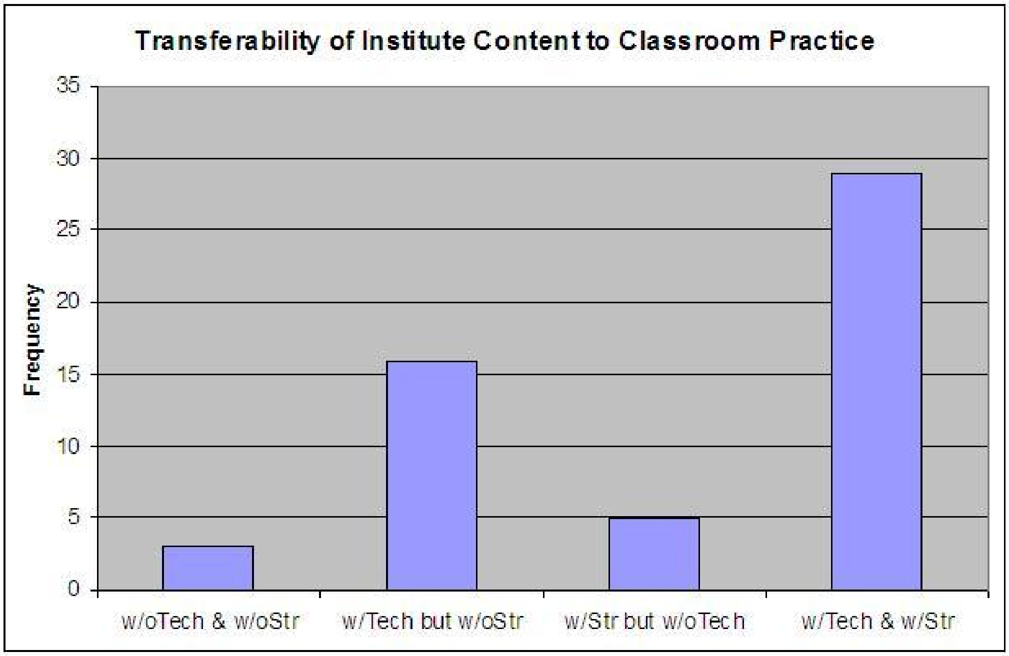
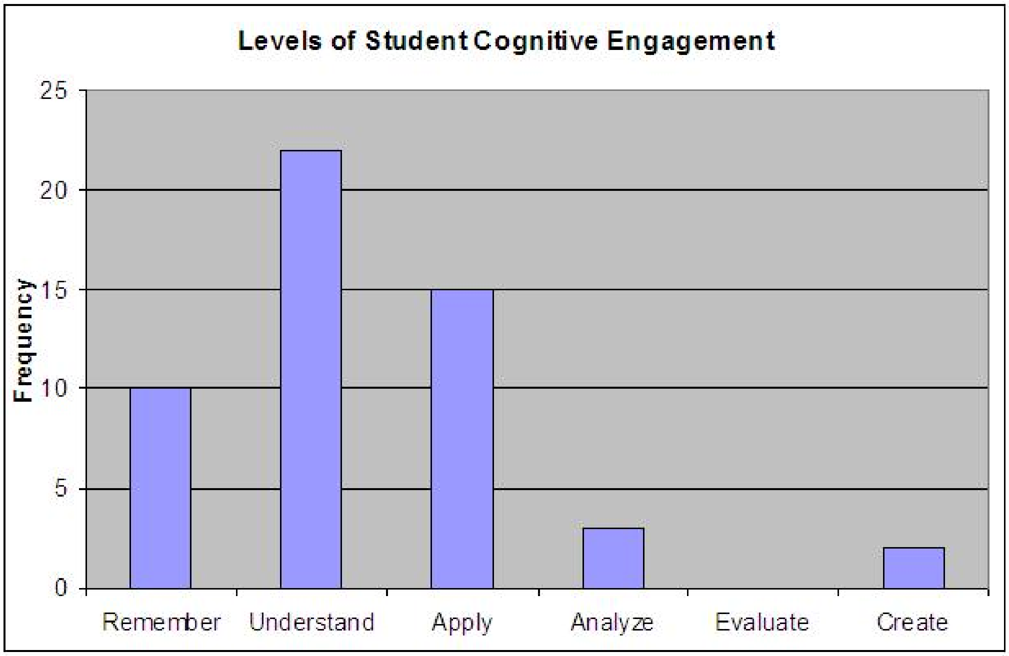


Figure 4. Levels of Student Cognitive Engagement in the Learning Process.



Qualitative Results

The *Classroom Observation Form* was also used to gather data about barriers teachers met in their efforts to implement instructional technology tools and strategies. Eight categories emerged from repeated data processing (Table 2). The top categories centered on inadequate technology resources, time, and technical support personnel, followed by teacher technology training. In addition, it was found that class size (too big to organize hands-on activities with technology) and classroom size (too small to set up equipment, e.g. Smartboard) also contributed to difficulties in using technology efficiently and effectively.

Table 2
Barriers Preventing Teachers from Successful Technology Implementation

Category	# Responses	Category	# Responses
No/Limited access to hardware	24	Lack of technology support staff	12
Lack of time to prepare & implement technology-enhanced instruction	19	Lack of technology training	6
Outdated/nonworking hardware	14	Class size (too big)	4
No/Limited access to software	12	Classroom size (too small)	3

The *Classroom Observation Form* also gathered the observers' perception of the overall quality of classroom technology integration in each classroom, which revealed both positive and negative comments (Table 3). In nearly half of the observed classrooms, technology was used by both teachers and students. In almost one third of the cases, technology was successfully incorporated into the curriculum, and students showed high levels of engagement, involvement, and interest in the learning process. Student collaboration and interaction were observed in many classrooms, and teaching/learning strategies from the institute were incorporated in instructional activities. Typical comments were:

> "Students worked through problems using a template and *wikisticks* from the *LoTTIE Kit* [Low Tech Tools for Inclusive Education Kit—a collection of over 50 low and mid tech tools that can help students with special needs be as independent and successful as possible] ... All students benefited from elements learned at the institute;"
>
> "The teaching/learning strategies of student-centered lessons and incorporation of prior knowledge were used throughout, and small group collaboration was utilized in the second half of the lesson;"
>
> "That the teacher was fluent with *SMART Notebook and Sympodium* [a SMART Board interactive pen display/tool] suggested regular usage;"
>
> "Students were able to use *LoTTIE Kit* supports throughout the lesson, and they were very comfortable with the Kit elements;"
>
> "The lesson was set up for students to work collaboratively to learn the information;"
>
> "Students knew how to operate the SMART Board and they interacted with it throughout the lesson, which was evidence of prior usage."

It should be noted that budgetary constraints prevented multiple, unannounced observations which would have been ideal. However, observer training on the use of the *Classroom Observation Form* emphasized assessing the comfort level of the teachers and students as a way to counteract the effect that planned observations might have.

In spite of all these positive comments, there were some less desirable observations. In nearly one fifth of the observed classrooms, only the teachers were using technology and some were still employing teacher-centered and directed lessons. In a few classrooms, there was no or very limited use of technology and related teaching/learning strategies. One observer wrote: "I could NOT check anything above (referring to the technology & strategy elements listed on the Classroom Observation Form)…No technology used, minimal transfer of either technology or strategy, whole group oriented, not about differentiation or kids' own thinking." Another observer, after talking with the teacher after the observation, explained the situation in a more informed way: "Before this summer, she (the teacher) didn't use any manipulatives [a kinesthetic math teaching strategy] to teach and build concepts; she didn't know much about computers, either; now she is thinking about ways that she can get children engaged in the math learning...This lesson did not center around kids' activities, BUT she talked as if some of her other lessons this semester had…I think so much of this was new, and she is taking baby steps in both areas—math and technology."

Table 3
Observers' Comments on K-12 Classroom Technology Application

Positive Comments		Negative Comments	
Category	# Responses	Category	# Responses
Both teacher & students using technology	23	Teacher using technology only	10
Successful technology integration	15	Teacher-centered/directed lesson	7
Student engaged/involved/interested in learning process	15	No/Minimum use of instructional strategies	6
Student collaboration/interaction observed	11	No/Minimum use of technology	3
Curriculum instructional strategies used	10		
Student-centered lesson	9		

It is worthwhile to note that some observers were not only observing, but also serving as consultants and assistants. They did not simply sit in the classroom listening, observing, and filling out the *Classroom Observation Form*. Instead, they tried to provide guidance and help to assist the teachers to solve on-site problems and move onto the right track. Such observers were assets to the consortium. Below is a quote from one observer:

> I don't believe she has been using the video streaming very much as she could not get her password to work. I did help her access United Streaming by using my password. We found the perfect video that was on the letter "O" and showed lots of footage of the ostrich as well as the on and off switch which was on the student worksheet too. She was so excited to discover the video that went with her lesson so perfectly and said she would definitely contact her tech person to get her password straight. Students watched attentively in small groups (due to no LCD because the librarian was absent that week) around the computer. One of the questions heard from a student was, "Why is its neck so long?" Additional follow-up would be beneficial with this teacher if possible.

From the standpoint of a research design, observers operating in the additional role of an instructional resource person might be considered problematic. However, the observers were trained to assess the situation according to the *Classroom Observation Form*. That some were able to offer help and follow-up to the institute participants was added value which, we believe, extended the function of the institute instruction and did not have any significant influence on the objectivity of data collection.

Conclusion

This study was undertaken, as part of a larger program assessment effort, to assess the effects of the 2006 summer institutes provided by the Federally-funded Four Rivers NCLB-EETT Consortium on the classroom practice of the institute participants. Clearly, the participants returned to their classrooms with new, research-based teaching/learning strategies enhanced by technology, which they subsequently began to successfully implement. The degree to which these technologies and strategies were implemented appeared to be directly related to the ease-of-access to and quality of the technology available to the participants and, to perhaps a lesser degree, the level of technology use participants had before the institute. Those who faced inadequate technology infrastructure were constricted. Those who had little or no experience with instructional technology before the institutes were (mostly) satisfied with having had their awareness levels raised, which should lead to further development. Finally, Virginia is in the process of providing schools with Instructional Technology Resource Teachers (ITRT) specifically to provide assistance in integrating technology-based/enhanced instruction, while technical support will remain the province of Information Technology specialists. This effort will provide teachers with extended opportunities to implement and expand upon new skills learned in the summer institutes.

One limitation of this investigation was that all the classroom observations were scheduled ahead of time at the mutual convenience of the observers and participants. It was likely that the participants would purposefully design a technology integration lesson for the sake of observation, which might “exaggerate” the effects of the institutes. However, given the fact that the familiarity of technology use suggested regular usage of technology by both students and teachers, the findings of the study were still informative. Still, the study would have been improved if it had included some unannounced observations, which warrants another direction for future investigation in this area.

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4TEC Classroom Observation

Teacher:___________________________________ Observer: _________________________________
Content Area: ______________________________ Grade Level:________________________________
School:_____________________________________ School Division:____________________________
Date: _____________________________________ Number of Students: _______________________

I. Questions to be asked of classroom teachers by the observer (Whenever convenient during your class visit)

1. What is keeping/preventing you from doing what you want to do with technology in your teaching?

2. When you use technology with your students, *where* does that normally happen? (e.g., classroom, computer lab, library, etc.)

3. How many times have you been able to use technology since the beginning of the school year? #___

4. (Then, if appropriate) On average, how often each week? #___

5. (Probing further if appropriate) What kinds of things, or range of things do you use technology for?

II. Core of observation based on Bloom's taxonomy with teaching strategy, technology(ies) identified and the role of technology

6. What is the observed level of cognitive engagement from the students? Check only the highest level:

   Bloom's Taxonomy:

   Create: generating, planning, producing
   Evaluate: checking, critiquing
   Analyze: Differentiating, organizing, attributing
   Apply: Executing, implementing
   Understand: Interpreting, exemplifying, classifying, summarizing, inferring, comparing, explaining
   Remember: Recognizing, Recalling

7. State the observed activity(ies) as a learning objective(s) including an appropriate teaching/learning verb in Bloom's taxonomy.

8. Identify technology tools and teaching/learning strategies used in the classroom. Listed below are the tools and strategies covered in each summer institute.

Appendix

Technology use in Classrooms

	X	Math	X	Special Needs	X	Reading
Teacher Use of Technology		United Streaming Clips		United Streaming Clips		United Streaming Clips
		Smartboard		Smartboard		Smartboard
		Inspiration/Kidspiration		Inspiration/Kidspiration		Inspiration/Kidspiration
		PowerPoint		Use of materials from TTAC website		PowerPoint
		Universal Design for Learning (UDL) elements evident		Universal Design for Learning (UDL) elements evident		
		Math illustrations created in Word		Use of LoTTIE kit elements		
Teaching/ learning Strategies		Student-centered lesson		Student-centered lesson		Student-centered lesson
		Problem-based learning tasks		Problem-based learning tasks		Problem-based learning tasks
		Incorporation of student interest and/or prior knowledge		Incorporation of student interest and/or prior knowledge		Incorporation of student interest and/or prior knowledge
		Small group collaboration		Small group collaboration		Small group collaboration
		Learning community evident		Learning community evident		Cubing
		Student choice of learning strategy		Equitable access evident		Semantic Features Analysis
				Teacher modeling		Magic Squares
						Interactive Cloze (including Bloom's taxonomy)
						PAR-Preparation
						PAR- Assistance
						PAR- Reflection
						DR-TA (Directed Reading-Thinking Activity)
						Graphic organizers
Student use of technology		Smartboard (Instructional use)		Smartboard (Instructional use)		Smartboard (Instructional use)
		United Streaming clips		United Streaming clips		United Streaming clips
		Inspiration/Kidspiration		Inspiration/Kidspiration		Inspiration/Kidspiration
		Word Drawing tools to represent math knowledge		Use of language tools in Microsoft Word for students with learning or physical disabilities		PowerPoint
		Online manipulatives		Use of LoTTIE Kit elements		
				Podcast, wiki or blog		

Technology use in Classrooms

9. There are four possible workshop effects; choose the one that best fits the classroom you are observing.

- ❑ No transfer of technology skills or teaching strategies from institute to classroom
- ❑ Transfer of technology w/o teaching & Learning strategies from institute to classroom
- ❑ Transfer of Teaching & Learning strategies w/o technology from institute to classroom
- ❑ Transfer of Teaching & Learning strategies AND technology from institute to classroom

10. Elaborate on why you made the above choice based on your classroom observation. (For example, what technologies enhanced/enabled or are superfluous/negatively impact the teaching/learning process.)

11. (Optional) Use the space below for any other notable situations that you observed with the teacher, school or students that might influence the use of the skills/strategies learned in the institute?

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