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AUTHOR	Abate, Ronald J.; Bagaka's, Joshua Gisemba
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ABSTRACT

This paper reports on the relationships among classroom teaching, learning activities and technology integration in the middle school classroom. The results are based on a comparison of three studies conducted across diverse middle school settings. The studies considered three primary questions: (1) Are specific learning activities identifiable across middle school classrooms? (2) Are the technologies available to the schools supportive of the classroom goals of teachers and students? and (3) What reasons influence the use of current technology in classroom learning activities? A learning activity-oriented viewpoint guided the research focus. Documented within the study are the typical learning activities and potential role for technology within the classroom learning environment of middle schools. Includes four tables and two figures. (Contains 12 references.) (Author)

Middle School Technology Use—Design Impediments Versus Classroom Needs

Ronald J. Abate
Cleveland State University, USA
r.abate@csuohio.edu

Joshua Gisemba Bagaka's
Cleveland State University, USA
j.bagagkas@csuohio.edu

Abstract: This paper reports on the relationships among classroom teaching, learning activities and technology integration in the middle school classroom. The results are based on a comparison of three studies conducted across diverse middle school settings. The studies considered three primary questions; 1) Are specific learning activities identifiable across middle school classrooms? 2) Are the technologies available to the schools supportive of the classroom goals of teachers and students? and 3) What reasons influence the use of current technology in classroom learning activities? A learning activity-oriented viewpoint guided the research focus. Documented within the study are the typical learning activities and potential role for technology within the classroom learning environment of middle schools.

After two decades of educational computing in schools it is easy to overlook that many teachers' experiences with technology fall short of the successful and exciting experiences reported by researchers (Ambron and Hooper,1990). What is reported; the individual instances of success, innovative technologies, and grant funded development projects provide a stimulating look at what can occur when circumstances are optimal. Unfortunately teachers work in less than optimal conditions. The occupational world of classroom teachers is different from that of an educational technology researcher. Classroom teachers do not design the software, hardware or technologies they use. They have minimal control over instructional time, preparation time, or the content mandated by their district. In addition, classroom teachers have minimal daily assistance with technology.

For the average teacher the use of technology has not been an empowering experience. Consequently, the level of technology use in the classroom has remained relatively low. There is documented concern that the level of technology use needs to increase (Morrison, Lowther, and DeMeulle, 1999). From the standpoint of the students, the end users of the technology, or the teachers, the facilitators of learning, the focus on level of technology is misplaced The critical variable of interest in the classroom is student learning. Technology offers one tool for accomplishing this learning. Using technology as the primary variable ignores the goals of the teachers and the needs of the students. Quantity alone disregards the context of learning activities and discounts whether technology supports classroom instruction. Agreement with the position that the quantity of technology in schools needs to increase is dependent in part on assumptions regarding the design of the technologies provided teachers. A key assumption is that educational technologies were designed for use by teachers and students. This is not the case for most technology available in schools.

Two questions merit considerations; 1. Are the technologies available in schools supportive of the classroom goals of teachers and students? and 2. What reasons influence the use of technologies in classroom learning activities? These are complex questions but they may be considered in light of studies of how people work in technology intensive workplaces. Holtzblatt and Jones, (1993) have pointed out that well designed technologies that take into account the reality of what people do on the job can boost productivity, enhance job satisfaction, and give workers a clear sense of what needs to be accomplished in their workplace. The essential point is that technological tools that are

insensitive to the work being performed lead to the negative consequence of reduced productivity. The argument for teacher and student use of technology hinges in part on how well available technology represents and supports what teachers and students do. Software developed for the classroom includes tutorials, simulations, drill and practice software, and educational games. These applications deliver instruction by complementing or replacing teacher directed instruction. Underrepresented in the software designed for school use are software tools for increasing productivity. Existing tool/productivity software such as the word processors databases, spreadsheets, and graphics were designed for an industrial or business audience. Both the context and the content of classroom teaching are markedly different from that of industry.

Those of us who work in the field of educational technology recognize technology as an outstanding resource. It provides opportunities for learning, tools for productivity, and a medium for creativity. However, many teachers still perceive technology to be confusing, complex and cumbersome. Despite advances in usability, teachers report that productivity software is not intuitive and that the software fails to address the needs of their classroom situation. In the eyes of teachers, productivity software is essentially re-purposed for classroom use. Consequently, teachers are hesitant to implement technology that does not address their immediate goals. As an example, elementary teachers participating in an in-service technology workshop indicated a preference for using *The Writing Center*, a simple writing and publishing tool designed for classroom use over Microsoft Word despite the expanded feature set offered in Word and pressure by their

administrators to use the more powerful software (P. Comstock, personal communication, June 16, 1998).

Purpose of Study

This study is based on three pilot studies. The goal of the three pilot studies was to establish a baseline on what technologies are most useful for students, and what technologies fit appropriately and effortlessly into classroom learning. The studies considered the questions; 1) Are the technologies available in schools supportive of the classroom goals of teachers and students? and 2) What reasons influence the use of technologies in their learning activities? This study examined technology use from an activity-oriented view. This viewpoint guided the research focus through an examination of the following research questions:

(1) What technology tools do students frequently use in their classrooms?
(2) What technological tools do teachers model for students' use in the K-12 classrooms?
(3) What learning activities do students do in the classroom?
(4) Is there a statistically significant relationship between teachers' modeling of technological tools and the level their students' use of these tools?
(5) Do students' usage of the technological tools significantly vary by teachers characteristics such as merit rating, level of teaching experience, and technology skills?

Methods

Within the field of software design there exists an organizing structure for initiating an analysis of user needs (Kuhn, 1996). The structure is a design approach that employs an activity-oriented view assessed from the perspective of the user audience. This study

initiated an examination of technology use from an activity-oriented view. Middle school teachers and students were targeted as the user audience. Central to the goal of identifying learning activities was to understand the middle school teachers and the tasks they wish to achieve with their students. A secondary goal was to identify existing technology based tools that might serve the teachers and students with these learning activities. The process of determining typical learning activities and enhancing some of those activities with technology began by surveying teachers.

Survey 1. The phenomena of learning in a middle school setting occur across a wide range of conditions. Agreed upon descriptions of classroom activities are elusive. A survey was developed to obtain a baseline of learning activities that span the curriculum. The first survey was distributed to ten middle school principals representing urban and suburban school districts in Northeast Ohio. The principals were instructed to select two teachers to participate in the pilot study. Criteria were provided to the principals for teacher selection. The teacher was to have at least three years of teaching experience, the students of this teacher should consistently perform at or above expectation, and the teacher should also have a history that included parental requests to have students placed in his or her class. Expertise in technology was absent from the selection criteria. The selected teacher completed an anonymous survey composed of three sections and returned it to their principal.

The first section consisted of six questions that contributed background information on the respondent. Included in this section were questions on teaching experience, grade

level, subjects taught, technology expertise, student expertise in technology, and the type of technology available to the teacher.

The second section provided a list of nineteen possible learning activities along with a four-point scale indicating the anticipated frequency of the learning activity. Traditional and technology based methods for implementing the activity were included below each learning activity. The teachers were directed to rate all items that applied. The nineteen activities represented a range of learning activities including; writing, collecting data, organizing data, analyzing data, presenting information, discussions, reviewing instruction, and developing projects. Ideas for the learning activities were based on sample activities included in assignments submitted by teachers enrolled in an instructional development course during the past ten years.

The third section of the survey included eight questions pertaining to students' use of computer based tools. These statements were also scored using the four-point scale. In addition, the teachers were asked to select the reason(s) for the score. Twenty-four reasons were provided. The teachers were encouraged to select all reasons that applied or to choose "Other" and explain this choice. The respondents were informed that this was a pilot survey and that comments were welcomed.

Survey 2. The second survey included the three sections in Survey 1 plus a forth section on teacher modeling of technology. This survey was completed by twenty-nine teachers from a suburban middle school. Teachers who taught one or more of four content areas;

Language Arts, Social Studies, Mathematics, and Science completed a four-part forty-seven item survey. Field notes and follow-up interviews were conducted to expand on the preliminary understanding of classroom / technology interactions.

Survey 3. Thirty-one self-selected middle school teachers from urban, suburban, and rural school districts were recruited to complete a four-part forty-seven item survey and complete a post-survey interview.

Results

Dimensions of modeling, activities, and technology use. A list of learning activities presented to teachers as a sample to establish everyday instructional activities are presented in Table 1.

Factor analysis revealed two parallel dimensions of technological modeling and use. The first dimension was *productivity tools,* which included database, spreadsheets, graphics, and presentations. The second was the *common tools,* which consisted of word processing, internet, and e-mail. Similarly, learning activities were conceptualized into three dimensions based on the tools they utilized. The first dimension was the *traditional tools* which utilized tools such as paper and pencil, worksheets, photographic slides, index cards, etc. The second was *common tools* which utilized popular technological tools such as word processing, internet, and e-mail.

Table 1: List of learning activities

	Learning Tools		
Learning Activities	Traditional	Common	Productivity
Writing drafts of reports	Paper & pencil	Word processing	
Editing written materials	Paper & pencil	Word processing	
Presentation of final written products	Posted in class or school hallway		
Writing correspondence	Letters	e-mails	
Note taking and recording observations	Paper & pencil	Word processing	Database, Spreadsheet
Creating tables or charts	Paper & pencil	Word processing	Database, Spreadsheet
Drawing graphs or diagrams	Paper & pencil		Database, Spreadsheet
Drawing maps	Paper & pencil		Graphic programs
Collecting data	Books, magazines,Surveys, interviews, Lab experiments, etc		Internet
Creating materials for presentation	Paper & pencil – printed materials, Makers & transparencies, slides		Computer presentation programs
Delivering presentations	Oral presentations		Computer-based multimedia
Discussing topics/assignments	Face-to-face/class discussions		e-mail discussions, list server/newsgroup discussions
Organizing data on forms	Worksheet, index cards		Databases, spreadsheets
Analyzing data	Manual computation, calculators		Auto calculating/spreadsheets
Reporting data	Verbal explanation, written reports	Word processing	
Checking learning progress	Print-based tests & quizzes, papers & projects		
Practicing/reviewing instruction	Notebooks, worksheets		
Developing projects	Paper, pencil & art materials	Word Processing	Computer Presentation Programs
Reading	Textbooks, trade books, magazines, newspapers, handouts		
Taking tests & practice tests	Handwritten, open book		

The following are the Crombach alpha reliability coefficients for each of these dimensions associated with modeling, learning activities, and technology use:

Crombach alpha Reliability coefficients

Dimension	Modeling	Use	Activity
Productivity Tools	0.79	0.78	0.90
Common Tools	0.69	0.60	0.81
Traditional Tools	-	-	0.90

The frequency of learning activity implementation was based on a four point response scale: 1 Never, 2 Rarely, 3 Occasionally, and 4 Frequently. Average implementation of learning activities with traditional tools was 2.87. Average implementation of the common tools was 1.74 and productivity tools was 1.37.

The Pearson correlation analysis was used to assess the relationship between students' usage of computer technology and teachers' modeling of technological tools and students' participation in various learning activities. The results are presented in Table 2.

Table 2
Pearson correlation results for the relationship between students' usage of technological tools and teachers modeling of tools and students' learning activities.

		Students' technological usage	
		Common tools	Productivity tools
Teachers' modeling	Common tools	0.599**	0.422**
	Productivity tools	0.454**	0.635**
Students learning activities	Traditional tools	0.385**	0.240*
	Common tools	0.764**	0.526**
	Productivity tools	0.519**	0.730**

* $p < 0.05$ ** $p < 0.01$

The Pearson correlation analysis revealed significant positive relationships between teachers modeling common and productivity tools and their students' use of such tools. The strongest correlation was observed between teachers modeling productivity tools and their students' usage of the same productivity tools ($r = 0.635$, $p < 0.01$). Similarly, a strong positive correlation was revealed between students participation in learning

activities utilizing common tools and their usage of the same common tools ($r = 0.764$, $p < 0.01$) and between students participation in activities utilizing productivity tools and their usage of the same productivity tools ($r = 0.730$, $p < 0.01$). These findings suggests that, teachers modeling as well as students participation in learning activities using productivity and common tools translates to increased students using the same tools. A moderate but positive relationship was also observed between students' participation in traditional learning activities and their use of common tools ($r = 0.385$, $p < 0.01$) and productivity tools ($r = 0.240$, $p < 0.05$). This finding also suggests that, students' participation in the proposed learning activities that utilize traditional tools does relate positively with students' usage of both common and productive technology tools.

The question of whether the level of classroom learning activities, teacher modeling, and student usage of technology tools varied by teacher rating, years of experience, and level of technological skills was assessed using analysis of variance. Analysis of variance results for the differences in level of classroom learning activities, teacher modeling, and student usage of technology tools between rated and non-rated teachers is presented in Table 3.

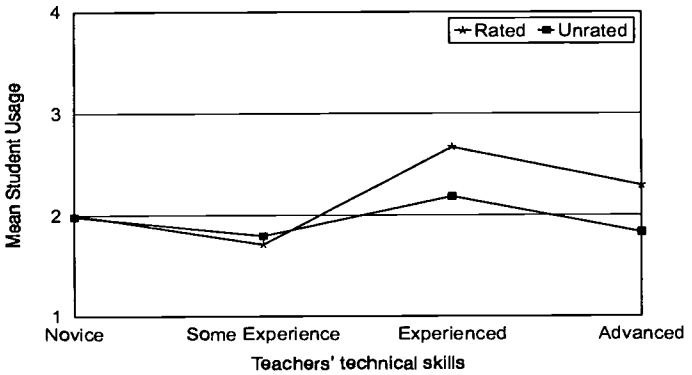
Analysis of variance revealed statistically significant difference between *rated* and *non-rated* teachers in the students' use of productivity tools ($F = 9.88$, $p < 0.01$). Table 3 also presents analysis of variance results for the differences in level of students' usage of technology tools, teachers' modeling technology tools, students' level of participation in classroom activities utilizing technology tools by teacher's level of experience with technology.

Table 3
Analysis of variance results for the differences in students' technology usage and participation in classroom learning activities between rated and non-rated teachers

	Rated		Non-rated			
Outcome	Mean	SD	Mean	SD	F-value	P-value
Students Technology usage						
Common tools	2.04	0.76	1.91	0.65	0.50	0.480
Productivity tools	1.93	1.05	1.41	0.46	9.88	0.002
Students' learning activities						
Traditional tools	2.94	0.48	2.85	0.64	0.34	0.560
Common tools	1.78	0.58	1.72	0.50	0.19	0.668
Productivity tools	1.49	0.53	1.34	0.42	1.50	0.224

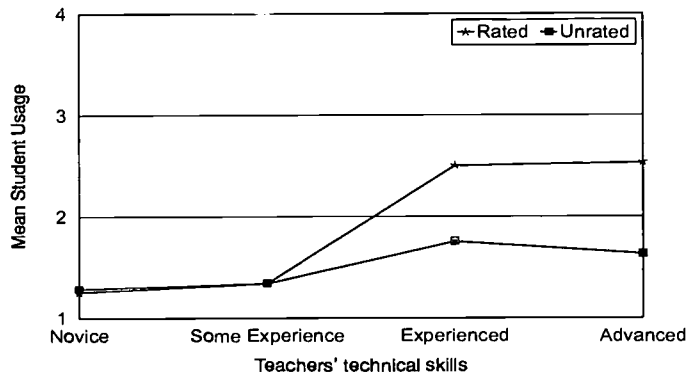
Teachers' perceived level of technological skills was a significant factor on students' technology usage of productivity tools ($F = 9.55$, $p < 0.001$), teachers' modeling of common ($F = 4.93$, $p < 0.01$) and productivity tools ($F = 4.44$, $p < 0.01$). In all these cases, the data seems to suggest that, the level of students' technology usage and teachers' level of modeling tends to increases with teachers' perceived level of technology skills (see also Figures 1 & 2). Teachers' perceived level of technological skills was a significant factor on students' participation on classroom learning activities when utilizing productivity tools ($F = 6.98$, $p < 0.001$) but not when utilizing either common tools ($F = 1.47$, $p > 0.05$) or traditional tools ($F = 0.84$, $p > 0.05$).

Figure 1: Student use of common tools



Participation in classroom learning activities utilizing productivity tools tended to be greater among teachers with more technology skills than those with less skills. However, teachers' years of teaching experience was not a significant factor on students' technology usage, teachers' modeling tools, or students' participation in classroom learning activities (see Table 4).

Figure 2: Student use of Productivity tools



Participation in classroom learning activities utilizing productivity tools tended to be greater among teachers with more technology skills than those with less skills. However,

teachers' years of teaching experience was not a significant factor on students' technology usage, teachers' modeling tools, or students' participation in classroom learning activities (see Table 4).

Conclusions

Eight categories of learning activities were considered in the study. The categories included 1) communication activities including written and multimedia forms of reporting, 2) data collection, 3) data organization, 4) data analysis, 5) practice and review, 6) discussion, 7) reading, and 8) evaluation. The individual items in the survey were not mutually exclusive. The frequency of traditional implementation for the nineteen items across all subjects was 2.87 suggesting occasional implementation of the activities. Level of implementation of individual items varied on the basis of content area. For example, writing drafts of papers was more prevalent in English Language Arts than Mathematics.

Table 4
Analysis of variance results for the differences in students' technology usage, teachers' modeling and student participation in classroom learning activities by teachers' technological skills

	Novice		Some Experience		Experienced		Advanced			
Outcome	Mean	SD	Mean	SD	Mean	SD	Mean	SD	F-value	P-value
Students Technology Usage										
Common tools	1.98	0.55	1.78	0.59	2.22	0.81	2.14	0.86	1.98	0.124
Productivity tools	1.28	0.33	1.34	0.43	1.81	0.59	2.23	1.12	9.55	0.000
Teachers' Modeling Tools										
Common tools	2.00	0.64	1.95	0.73	2.89	0.94	1.72	0.75	4.93	0.004
Productivity tools	1.29	0.48	1.39	0.48	2.02	0.85	1.33	0.58	4.44	0.007

Students' Learning Activities										
Traditional tools	2.87	0.69	2.84	0.58	3.11	0.37	2.75	0.72	0.84	0.475
Common tools	1.68	0.42	1.66	0.43	1.97	0.74	1.86	0.64	1.47	0.230
Productivity tools	1.20	0.29	1.31	0.35	1.59	0.61	1.65	0.57	4.18	0.008

The "occasional" score suggests that the sample learning activities represent a subset of baseline learning activities conducted in middle school classrooms. As such, one may conclude that the activities are useful for relating the level of technology use in middle school classrooms to the teaching and learning conducted in those classrooms. Specifically, the individual items may serve as point of reference for comparing levels of technology use within existing teaching practice. Participation in traditional learning activities correlated with an increase in student use of both common and productivity tools. The correlation hints at a connection between the identified learning activities and the potential application of technological tools to fulfill the learning goals of the activities.

Teachers in this study were more likely to engage their students in traditional (non-technology based) activities than in technology-based activities. This result was consistent with expectations and prior findings. More importantly teachers were more likely to engage students in common types of technology such as word processing, Internet, and email than in productivity tools. This result was true for all teachers regardless of their perceived technology acumen or teacher rating. The significant differences in tool selection suggest that teachers sense a distinction between common

and productivity tools. The nature of this distinction was not conclusively resolvable from the survey results. However, teachers in all three studies indicated 1) lack of teacher training, 2) too difficult, and 3) students lack skills as important reasons for students' non-use of computer based instructional tools in the classroom. Technology tools that most closely reflected the goals of the learning activity such as word processing and writing assignments or calculators for computation were cited as frequently used by students. The simpler the use and the more closely a technological tool mirrored the learning activity the more likely it was that students used the tools. Nevertheless, the results indicated that despite the fit of a tool to an activity, technological tools (common 1.94 and productivity 1.52) were used seldom at best in the classrooms. Individual activities might encourage frequent use of a specific tool but generalized technological tool use by students was lacking.

Teacher modeling of technological tool use was a strong predictor of student tool use. The positive correlation was intuitive. Teachers were more likely to model technological tools that their students need to complete learning activities. As expected, teachers modeled the use of common tools more often than productivity tools. This finding, coupled with the "lack of training" response commonly cited as a reason why students did not use computer tools in class suggests that teachers model the technological tools they are most comfortable using themselves.

The primary difference between rated and non-rated teachers related to the use of productivity tools. Students in the classes of rated teachers were more likely to use

productivity tools than students in the classes of non-rated teachers. This finding is intriguing. The criteria used to select the rated teachers lacked any reference to expertise in technology. The surveys were presented to school principals as surveys on learning activities not technology activities. Principals received copies of the surveys after the rated teachers were selected. It was not apparent from the data collected why rated teachers recognized a role for productivity tools in the learning activities listed. The number of years of teaching experience was not significant. This finding is somewhat counter intuitive as many educational technology practitioners assume that new graduates are more likely to implement technology than teachers who completed their teacher preparation programs less recently. Teachers' perception of their technology, however, was a positive factor in student use of technology and teacher modeling. The more knowledgeable a teacher was a tool the more likely they were to adopt it.

The current study avoided the limitation of level of technology use by tying specific learning activities to the use of technology. However the correlation results only hint at the reasons for use and non-use of the technologies listed in the study. The initial two questions remain unanswered. The data suggests that common and productivity technologies may be supportive of the classroom goals of teachers and students. However, the factors influencing the use of the technologies are not clear. Commonly recognized impediments such as lack of training, lack of student skills, difficulty of technology, and accessibility to technology were cited by study participants. Additional data is required to determine the factors that assist or impede technology use by middle school teachers. Further investigation is underway.

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