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Does computer-supported Math instruction makes students perceive them to be task-oriented and well-behaved? An experimental study

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Abstract

This study investigated the effectiveness of computer-supported Math instruction on ninth graders' task orientation and disruptive behaviors. Subjects were 40 students enrolled in two classes, each of which was randomly selected as the experimental and control group. The former was given instructions including animations, games, interactive drill-and-practice programs, and video documentaries while the latter was given with traditional media. The same questionnaire was administered before and after the intervention as pretest and posttest. Although both groups received better scores on the posttests, ANCOVA analyses failed to produce significant differences between adjusted posttest scores for both task orientation and disruptive behaviors.

Keywords: Computer-supported instruction; classroom management; task orientation; disruptive behavior; experimental research

1. Technology and classroom management

Classroom management has been regarded as the most challenging concern for teachers especially those who are novice in the profession (Evertson & Weinstein, 2006). This is also an important issue for society at large. Public opinion surveys have consistently indicated that the lack of discipline among the students have been seen the most serious problem of public schools (Rose & Gallup, 2006). Teachers facing with problems in managing behaviors in the classrooms have been demonstrated to experience high levels of stress and burnout (Browers & Tomic, 2000). In fact, issues related to maintaining student discipline have been reported as the primary reason for leaving the teaching profession (Ingersoll, 2001). Prior research on teacher effectiveness revealed that having effective classroom management skills was one of the predictors of instructional achievement (Brophy, 2006; Celep, 2000). Teachers' management styles effect students' not only academic success, but also social, emotional, and moral developments.

The concept of classroom management can be defined as performing academic and administrative tasks in order to establish and sustain an orderly and positive learning environment. Hence, it is a multi-faceted process that requires teachers to organize the physical dimension of the classroom, plan and implement effective instructions, manage the time, establish caring relationships with the students, develop and enforce classroom rules, and deal with

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students' disruptive behaviors (Başar, 2006; Evertson & Weinstein, 2006). Perhaps, reducing the incidence of misbehavior and having students focus on classroom tasks are prevailing tasks in this process.

The related literature has some research exploring common problem behaviors and effective strategies to prevent from or modify such behaviors. However, the recent integration of technology into the classroom has clearly transformed the traditional conception and contextualization of the classroom, and thus, warranted the consideration of new research agenda. Bolick and Cooper (2006) underlined the paucity of research on how technology impacts classroom management and delineated several research topics including a number of new management issues encountered in a technology-infused classroom, the association between teachers' technology adoption and managerial skills, the ways of keeping students actively organized around learning tasks when using technology, effective ways of transition to and from computer activities, and teacher training about the nexus of classroom management and technology. In a number of research studies, technology integration has been demonstrated to improve student motivation (Sivin-Kachala & Bialo, 2000). It can therefore be assumed that students' off-task behaviors and discipline issues may decrease as their motivation enhances. On the other hand, the inclusion of technology may also introduce a new realm of discipline issues that can further complicate the already-complex nature of the classroom especially for those teachers facing with management problems (Selinger, 1999; Bolick & Cooper, 2006). These paradoxical assumptions obviously call for further research. Within this scope, the primary purpose of the present study was to investigate the effectiveness of computer-supported Math instruction on ninth graders' task orientation and disruptive behaviors in Math classes.

2. The experiment

This study was designed as a pretest-posttest control group quasi-experimental research because it explored the possible effect of computer-supported Mathematics instruction (independent variable) on both task-orientation and disruptive behaviors (dependent variables) in Math classes. The experiment took place in the city of Isparta, Turkey, during the spring semester of 2009 academic year.

Participants were 40 ninth grade students in a private high school in the city center. They were 14-15 years old and enrolled in two classes of basic Mathematics course given in the weekends. Students were selected for these classes by the school management based on their scores on the Student Selection Exam for Secondary Schools (OKS). Both classes were made up of students with scores under 300, and thus, were homogenous in terms of their academic level. One class was randomly selected as the experimental group (ten boys, ten girls) and the remaining was used as the control group (eleven boys, nine girls).

A paper-based questionnaire form was employed as a main data collection tool. The form had two scales measuring the dependent variables used in this study. The first one was taken from the "What is happening in this class (WIHIC)" classroom environment instrument (Fraser, 1998). The WIHIC was developed with 56 items to assess seven dimensions of classroom psychosocial environment in high schools and was cross-nationally validated (Dorman, 2003). Eight items in the "task orientation" dimension were adapted for this study. They were statements germane to interest in the completion of classroom tasks and staying on the subject matter (e.g., I pay attention in Math classes). Students were asked to rate each item by using a five-point Likert-type scale (1=Strongly Disagree, 5=Strongly Agree). A composite variable was calculated by summing up the scores of eight items for each participant. Thus, the total score could range from 8 to 40. Higher scores indicated higher level of task orientation. The Croanbach alpha internal consistency coefficient was calculated as .87 for both pretest and posttest, indicating that the scale was reliable.

The second scale comprised of 12 items adapted from the literature related to student misbehaviors in the classrooms (Sadık, 2006). Each item was about a disruptive behavior (e.g., I make noise in Math classes) and asked students to report how often they exhibit the behavior on a five-point Likert-type scale (1=Never, 5=Always). An exploratory factor analysis with varimax rotation was conducted to determine whether these items all together establish underlying factors. The best model presented a one-factor solution accounting for 56% of the total variance. Four items were removed because of their factor loadings under .40. A composite variable was established by summing up the scores of the remaining eight items and used as the second dependent variable, perceived level of disruptive behavior. Hence, the possible scores could range from 8 to 40 with higher scores indicating more misbehavior conducted in the Math classes. The Croanbach alpha coefficient was .88 for pretest and .85 for posttest, indicating that the scale was reliable.

The research procedure followed pretest, intervention, and posttest schedule. Prior to experiment, the questionnaire form explained above was administered to both groups as a pretest. The second author began teaching both groups basic Math courses during eight weeks. Each weekly lesson took about two hours and was given in the weekends. The subjects covered throughout the experiment included whole numbers, rational numbers, decimal numbers, four operations with these numbers, and simple linear equations. Both groups were given the same amount of time and learning objectives. The control group was given instructions with traditional tools and materials (e.g., blackboard, worksheets, paper tests etc.). The experimental group received computer-supported instructions in the classroom equipped with a computer, an electronic board, and a video projector. Each instruction was supported with some computer applications including game-based animations, video documentaries, and interactive drill-and-practice programs. For example, the animation named "Magic Ball" was used to help students grasp the relationships between numbers by asking them to do four equations. Another one, The Archimedes' Bathroom, was used to have students form patterns among the numbers and use variables. The game "One word, One Operation" was employed to have students practice in four operations and solving equations. "The Question Bank" including repetitive question-answer type interactions was frequently integrated into the instructions to reinforce previously learned concepts and skills (e.g., addition, subtraction). Students also watched some interesting video clips taken from Math documentaries. It is important to highlight that the instructions of the experimental group took place at a one-computer classroom. Thus, computer was mainly used by the instructor and students followed the content on the electronic board. Most of the computer activities did not require students' direct access to the computer. After the instructions were completed, the same questionnaire form was reapplied for both groups as a posttest.

The collected data were entered into the SPSS package program for statistical analysis. At first, descriptive statistics especially mean and standard deviations were calculated to describe the dependent variables before and after the intervention. Next, an analysis of covariance (ANCOVA) was conducted for each variable to test whether the groups' posttest scores differed after controlling for the pretest scores.

3. Research findings

Table 1, below presents means and standard deviations for pretest scores, posttest scores, and adjusted posttest scores after removing the effect of pretest scores. As shown, the actual differences in the groups' pretest scores for both dependent variables were quite small. In fact, independent samples t-tests for task orientation ($t=-.15$, $p>.05$) and disruptive behavior ($t=.75$, $p>.05$) indicated that these differences were not significant at all. This demonstrated that control and experimental groups were homogenous in terms of both variables. As far as the posttest scores were concerned, both groups increased their task orientation and decreased their disruptive behavior scores after the treatment.

Table 1. Descriptive statistics for the dependent variables

		Pretest		Posttest		Adjusted Posttest	
Variables	**Groups**	**M**	**SD**	**M**	**SD**	**M**	**SE**
Task orientation	Experimental	27.95	6.57	33.30	5.28	33.23	.97
	Control	27.65	5.87	31.75	4.92	31.82	.97
Disruptive behavior	Experimental	18.75	7.77	15.40	4.28	15.57	1.01
	Control	20.40	5.98	16.20	5.03	16.03	1.01

A one-way between-groups ANCOVA analysis was conducted to compare the effectiveness of instructional designs (computer-supported vs. traditional) on each of the dependent variable (posttest scores). Participants' pretest scores were used as the covariate in these analyses. Preliminary checks were initially conducted to test the specific assumptions of the ANCOVA test. The scatterplots between the dependent variables and their covariates for both groups ensured that the relationships could be defined as linear. The assumption of homogeneity of regression slopes was met for both dependent variables because neither the interaction between task orientation pretest scores and the treatment ($F=.89$, $p>.05$) nor the one between disruptive behavior pretest scores and the treatment ($F=.01$, $p>.05$) was significant. The insignificant Levene's statistics for task orientation ($F=.01$, $p>.05$) and disruptive behavior posttest scores ($F=.07$, $p>.05$) ensured the assumption of homogeneity of variances. Therefore, it was decided that the data set was appropriate for the ANCOVA analyses.

Table 2. ANCOVA results for the dependent variables

Variables	Source	Sum of Squares	df	Mean Squares	F	p	η^2
Task orientation	Pretest (covariate)	299.31	1	299.31	16.04	.00	.30
	Group	20.01	1	20.01	1.07	.31	.03
	Error	690.64	37	18.67			
	Corrected total	1013.98	39				
Disruptive behavior	Pretest (covariate)	75.93	1	75.93	3.73	.06	.09
	Group	2.12	1	2.12	.10	.75	.00
	Error	754.07	37	20.38			
	Corrected total	836.40	39				

As can be seen from Table 2, there was no significant difference between experimental and control groups on posttest scores both on the task orientation ($F=1.07$, $p>.05$, $\eta^2=.03$) and disruptive behavior scales ($F=.10$, $p>.05$, $\eta^2=.00$) after controlling for the respective pretest scores. These findings suggested that computer-supported Math instruction compared to traditional one did not produce significant effect on task orientation and disruptive behavior. Similarly, the very small effect sizes indicated that instructional type accounted for negligible amount of variance (3% and almost 1%) in the dependent variables. Upon examining the mean scores on pretests and adjusted mean scores on the posttests, it can be concluded that both instructions resulted in similar improvements on the dependent variables.

4. Discussion and conclusion

This study was one of the first attempts to investigate the potential effects of technology enhanced instruction on classroom management issues and practices because the available research was mostly descriptive and exploratory in nature. It was carried out as an experimental design with control and treatment conditions and pretest and posttest measures. The treatment was eight-week of computer-supported Math instruction and the dependent variables were task orientation and disruptive behaviors. The results indicated no significant effect of computer-supported instruction on both variables.

One possible explanation of this result could be related to the lack of reducing effect on disruptive behaviors. Students could already be highly motivated for Math classes and thus the implementation of computer-supported instruction may not have produced significant change on their engagement level. The pretest mean scores for both task orientation and disruptive behavior for both groups support this argument as students seem to be well-behaved and focused on the learning tasks. Thus, it can be concluded that computer-supported instruction may not result in significant effect on students with low level of behavior problems and high level of task orientation. Future research should repeat the intervention on a sample of students with high level of misbehavior.

One another explanation of the result may be due to the fact that computer-supported instructions conducted in a one-computer classroom setting. The instructor operated the computer to present key concepts, multimedia products, and interactive practices. Students mostly stayed on their desks, observed the screen, and work on the tasks. Therefore, such an interaction might not have generated extra discipline problems. This raise the question, what would have happened if each student or small groups had worked on a computer station? There has been a shared assumption among the teachers that integrating computers may shift the control from teachers to students and therefore disrupt the classroom management. There were also research studies indicating that teachers actually had a fear of this situation (Burns, 2002). The lack of increase in the level of student misbehavior in this study suggests that there may be no need to stress for such a fear at least in a one-computer setting. Future research should explore whether the results are consistent in multicomputer classrooms or computer rooms where students work individually or collaboratively on the computers.

Finally, it is important to acknowledge the limitations of the study. It employed participants' self-report to measure the level of task orientation and disruptive behavior in Math classes due to the restricted resources. The generalizability of the results is therefore limited. Future studies should develop and employ observational-based measures to operationalize these variables.

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