MAP Communication Arts Scores for Voice Recognition and Speech-to-Text Pilot Implementation in Primary General Education Technology-Rich eMINTS Classrooms

Prepared in partial requirement for the Missouri Department of Elementary and Secondary Education, Special Education, Effective Practices grant

Speech-to-Text Pilot Software

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Abstract

Text-to-speech (TtS) and voice recognition (VR) software has been in use as both an accommodation and an intervention for over a decade. This study sought to determine the effectiveness of these two computer-based applications in general education technology-rich classrooms. The software was implemented for all students to use following universal design for learning (UDL) principles. This quantitative study examines the Missouri Assessment Program (MAP) scores for participating classrooms.

Introduction

With funding from the Missouri Department of Elementary and Secondary Education (MO DESE), Division of Special Education, the eMINTS National Center (eMINTS) was selected to pilot TtS and VR software in technology-rich classrooms during FY 07. eMINTS classrooms are equipped with a minimum of one computer for every two students, an interactive whiteboard (SMART Board™) and projector, teacher laptop, digital scanner, digital camera, and color printer ("eMINTS classroom equipment," 2007). Three elementary buildings, from three different St. Louis suburban districts, participated in the study. Teachers who had completed the eMINTS two-year comprehensive professional development training prior to the start of the study were selected. This study presents an analysis of the MAP scores for participating classrooms. For more description of the participant selection process, successes and effective teaching strategies reported by teachers see the previous report, “Voice Recognition and Speech-to-Text Pilot Implementation in Primary General Education Technology-Rich eMINTS Classrooms,” submitted to MO DESE in October 2007.

Related Work

Research is extant about the advantages of TtS and VR supporting students with special needs. However, the literature focuses on implementation with IEP students and very limited numbers of participants. The time frame is often during summer months with one-on-one experiments with researcher and participant (Beacham & Alty, 2006; Boon, Fore, & Ayres,

2005; Englert, Zhao, & Dunsmore, 2007; Forgrave, 2002; Fuchs, Fuchs, & Hamlet, 2006; Hetzroni & Shrieber, 2004; Higgins & Raskind, 2004; Jerome & Barbetta, 2005; Lancaster, Lancaster, & Schumaker, 2006; Montgomery & Marks, 2006; Quenneville, 2001; Whittaker, 2003). Research indicates implementation of TtS and VR software in general education classrooms would benefit all students at the elementary level. The pilot project completed by eMINTS during the 2006-2007 school year was implemented in the general education classroom using guidelines appropriate for universal design for learning (UDL) as previous studies suggested (Abell, 2005; Downing, 2006; Hitchcock, Meyer, & Rose, 2002; Howard, 2004).

After selection of schools and teachers in spring 2006, the participating teachers, principals, and school technologists met to select the software for use in the classrooms. Several software packages were demonstrated and made available for the group to explore. Discussion centered on networking, total cost of implementation, prior experience with software, site licensing options, scanning options, integration into Microsoft® Office®, utilities other than TtS and VR, and possible application in eMINTS classrooms. Read and Write Gold® (R&WG®) was selected by the participants. Participants noted that the number of functions offered by R&WG® was not matched by other selections. Technologists were mindful of R&WG® offering server-based installation for student use.

Typically, many elementary classrooms in the third through sixth grades have students struggling with basic skills (Fink, Graham, & Harris, 2005; Helsel & Greenberg, 2007; Reid & Lienemann, 2006; Walczyk & Griffith, 2007). These skills can be addressed by adding software that allows teachers to scaffold learning to exploit computer intervention (Englert et al., 2007; Graham, Harris, & MacArthur, 2006; Harris, Graham, & Mason, 2006). This type of implementation is well described by Edyburn as a “cognitive prosthesis” (2006) that is available

for all students until the needed skill is mastered when prosthesis can be discarded. The research base did not include an implementation across multiple buildings in different districts but indicated the success seen with individual students might be replicated in UDL general education classrooms (Acrey, Johnstone, & Milligan, 2005; Howard, 2004). (For more about the success of this pilot with TtS and VR software as a cognitive prosthesis please see the previous report.)

Methodology

Scores for the MAP assessment were provided by the participating districts. Because student identifiable data was not permitted, names and student numbers were not provided. The data included overall MAP scores for each classroom. Thus, the classroom is the basic unit of analysis. Two districts provided more specific demographic data that was examined with peer elementary schools. MO DESE data was reviewed for specific school demographics ("Annual reporting of school district data FTP downloading site," 2007).

Building MAP communication arts reporting

In School "A" one classroom from each of the following grade levels participated: 3rd, 4th, 5th, and 6th grades. In school "B" all 4th grades participated, but training and prior experience with the software was different for each teacher. In school "C" two 4th and two 5th grade classrooms participated while the rest of the classrooms did not. For school "A" the Communication Arts MAP achievement scores are compared with the same grade level classrooms in the same building. Individual scores were provided for the eMINTS classrooms only. The number of students participating is school "A" detailed in Table 1 below.

Analysis is based on published MO DESE scores for the building and district supplied scores for participating classrooms. The School "A" comparison is between pilot classrooms and

classrooms on the same grade level that did not participate in the pilot project from the same building.

In School "B" all three 4th grade classrooms participated in the pilot; however; there were variations in the teachers' training and prior experience. One teacher selected for the pilot received all the training, classroom computer upgrades, and software. The other two 4th grade teachers were not selected for the pilot. One teacher had used R&WG® in another state and was allowed to implement, at district expense, in her classroom. The third teacher was a veteran eMINTS teacher who felt, with the support of the other two 5th grade teachers, she could successfully implement. She was allowed to do so at district expense.

In School "B" 74 students participated in the pilot. Elementary schools with a population similar to School "B" were reviewed. Three comparison elementary schools were identified for MAP score analysis by reviewing total enrollment in 4th grade, minority status, free and reduced lunch, and Title II D status from MO DESE demographics ("Annual reporting of school district data FTP downloading site," 2007).

School "C" had both 4th and 5th grades participating. There were 74 total 4th graders; 34 were in pilot classrooms participating in the study. All the 4th graders took the MAP Communication Arts component. There were 62 total 5th graders with 30 in pilot classrooms and 32 in non-eMINTS classrooms. Two students in 5th grade did not take the MAP Communication Arts component.

Results

School "A"

Table 1 (see below) provides participant totals in eMINTS and non-eMINTS classrooms. The mean scores for both groups are provided by grade level also.

Grade level	Third Grade	Fourth Grade	Fifth Grade	Sixth Grade
Total participants by grade level	n=74	n=65	n=56	n=63
Total eMINTS participants	n=18	n=22	n=10	n=16
Overall MAP means by grade	650.7	664.9	670.7	675.3
eMINTS MAP means by grade	653.9	667.9	691.0	668.6

Table 1: Raw means grades 3 through 6

Figure 1 (see below) presents the eMINTS classroom scores and the overall school MAP mean scores. Standard deviations for School "A" were calculated for both the Terra Nova scores and MAP Communications Arts. Grades 3, 5, and 6 had standard deviations of more than 25 on both the Terra Nova and MAP. Outliers were identified, removed and standard deviations recalculated using SPSS (see box plot following "Examine" in Appendix A). Identifying the outliers (1 score in 3^{rd}, none in 4^{th}, 1 in 5^{th} and 2 in 6^{th}) and recalculating the means and standard deviations for both eMINTS and the overall class mean is presented in Figure 2. Across the grade spans the differences between adjusted means for MAP scores for Communication Arts is not statistically significant (see Appendix A, SPSS data following *Statistically Significant*).

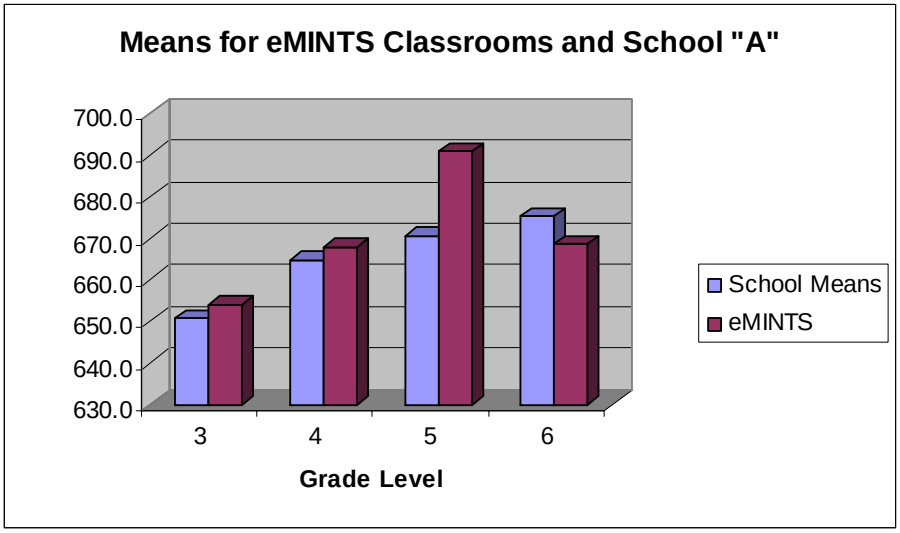

Figure 1: Communication Arts Scores for eMINTS and all of School "A"

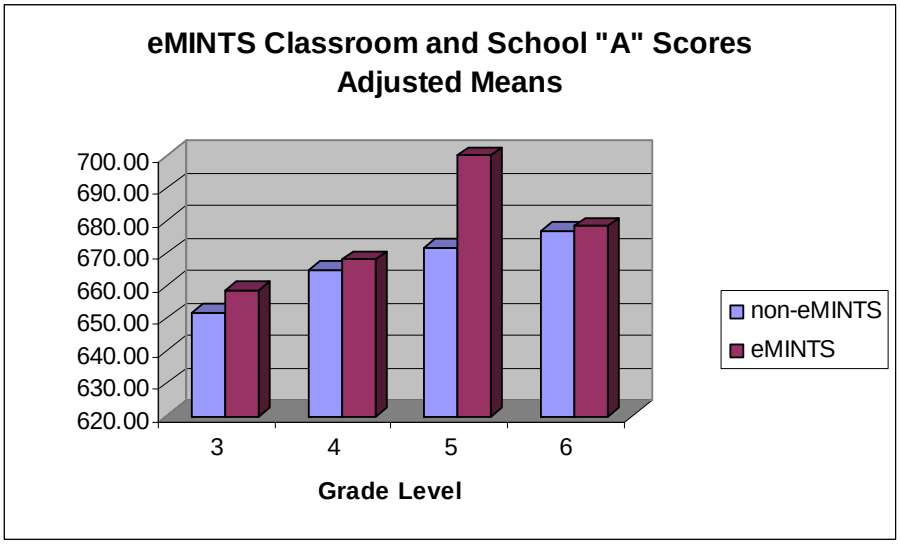

Figure 2 : Adjusted Means for eMINTS and all of School "A"

School "B"

In School "B" all three 4th grade classrooms participated at different levels. Only one teacher was trained with the software in this pilot project. One teacher had experience with the same software in another state. The third teacher did not receive training but felt with the collegial support she would be able to successfully implement in her eMINTS classroom. To find

peer populations to compare to School "B" achievement, three other elementary buildings with similar demographics were selected. Selection criteria included: total number of 4th graders in the building, free and reduced lunch participation, regional setting as suburb of major city, and the number of minority students. This information is presented in Appendix "B" Selection Criteria. Schools for comparison and those rejected also are listed in Appendix "B".

From the identified schools, percentages were used from reported MO DESE MAP scores for the 4th grade achievement levels to determine how School "B" performed in relation to peer classrooms in other districts ("Annual reporting of school district data FTP downloading site," 2007). Figure 3 below illustrates the results. Percentages for all the ranges are in Appendix B. The strength of the measure is very high for a statistically significant difference between the mean scores for the comparison schools and School "B" (see Appendix B for SPSS results).

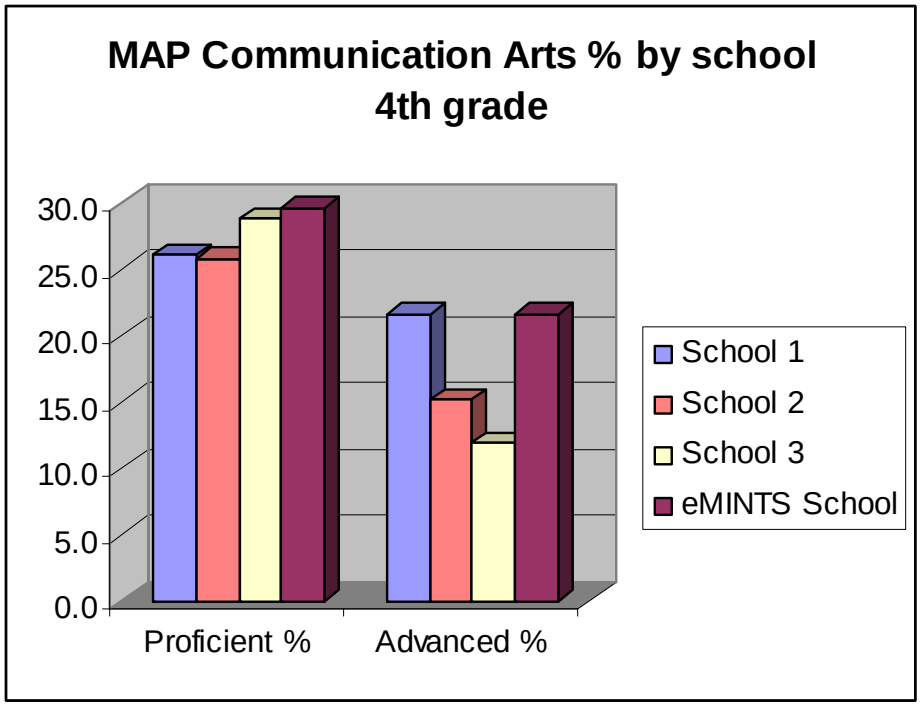

Figure 3: Peer schools % scoring in proficient and advanced ranges School "B".

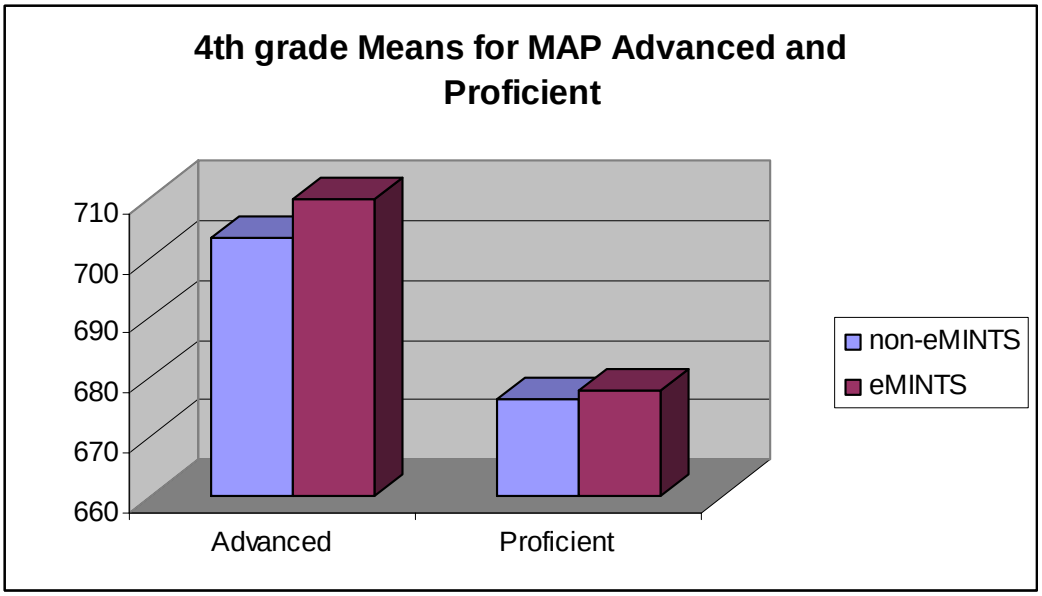

Figure 4 : Mean scores MAP communication arts 4th grade School "B".

School "C"

School "C" data was reported by grade level and classroom, participating and not participating in the pilot. Data reported was mean scores by MAP level. There were 64 total students in the 4th grade. There were 30 students participating in the pilot and 32 who did not. Two students did not take the MAP but took the alternate form of the MAP (MAP-A). The classes participating in the pilot project all scored higher than their non-participating peers for "proficient" and "advanced" levels. The means from the t-tests showed a trend that eMINTS classrooms has a positive effect on MAP Communication Arts scores even though the differences in the scores are not statistically significant (using the significance criterion of $p < .05$). See Appendix "C" for the t-test data for means.

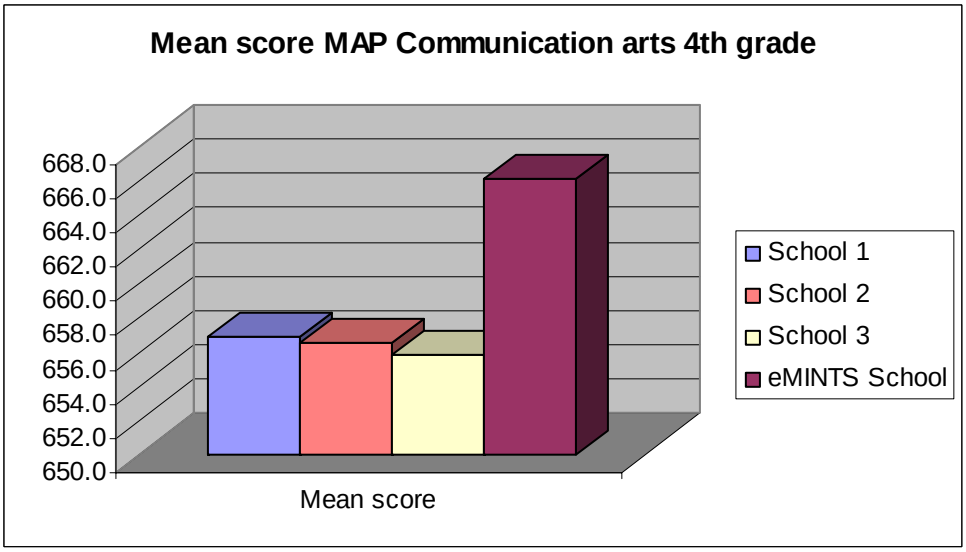

Figure 5: School "C" 4th grade MAP Means Communication Arts for advanced and proficient.

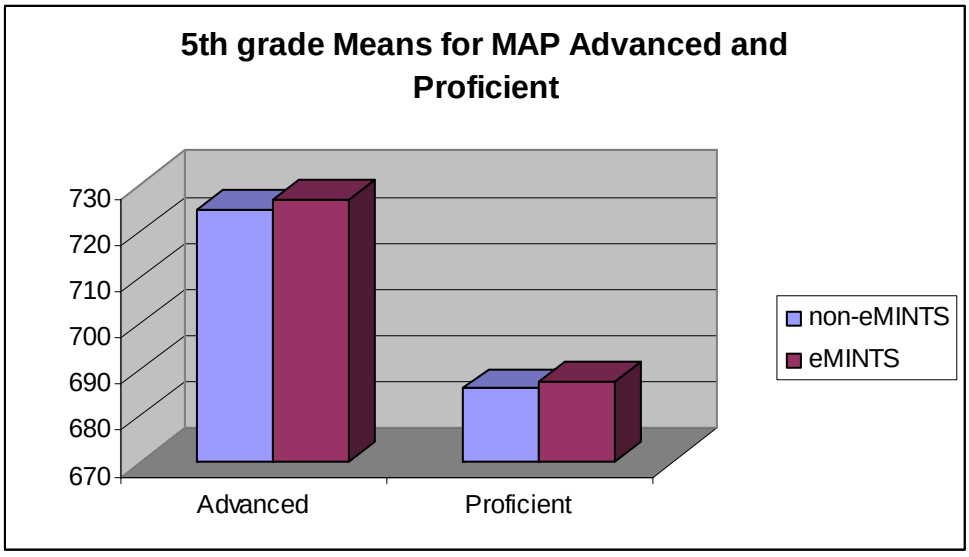

Figure 6: School "C" 5th grade MAP Means Communication Arts for advanced and proficient

Conclusion

Students in the pilot with access to TtS and VR software achieved higher mean scores on the MAP Communications Arts assessment than did their peers. This was true in all comparisons

despite different methodologies used. Although this positive trend to higher scores was not statistically significant, except in one case, the fact remains that a beneficial trend was seen across all the participating grade levels in this pilot program. Of interest, as schools reported MAP Communication Arts scores in different manners, each standard comparison (in building peers and peers from a different district) showed a positive trend for higher scores on the MAP assessment of Communications Arts for pilot participants. This positive trend for eMINTS participants was also supported across all grade levels.

For further inquiry

These findings suggest further inquiry is needed to fully explore the relationships between classroom UDL AT variables and standardized assessment achievement. All variations of comparison of this analysis showed a positive trend for students using TtS and VR software in technology-rich classrooms with higher scores found on the MAP Communications Arts assessment. Districts may see this implementation of UDL software as vital for all students to assist them in achieving to their highest potential.

One key facet for investigation would be to allow students with special needs to use all the software resources as mandated in their IEP on all components of the MAP assessment. Michael Muenks (telephone conversation, January/17/2008), MO DESE, Coordinator of Curriculum and Assessment, confirmed that AT can be used when specified in an IEP for any section of the MAP, except for reading the actual assessment items in the Communication Arts component of the MAP. The IEP needs to be very specific that MAP testing as well as normal daily classroom work assessments is to be completed with assistive technology. Students with special needs can use AT for writing and editing student responses in all components of the MAP, including the reading portion, when specified in the IEP (M. Muenks, telephone

conversation, January/17/2008). Outcomes from this experience would be of great interest to schools. Students could achieve at their highest level rather than being bound to paper and pencil.

Also of interest would be an examination of achievement by demographics across all classrooms in each school using TtS and VR software. Of most interest would be achievement of students with special needs, especially if in-school metrics can be used in the analysis. Struggling and emergent readers, English language learners, children with special needs and other students trying to work to their full potential participated in this pilot. As a follow-up to this study a longitudinal tracking of all students benefitting from this pilot is encouraged.

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Appendix A

For all SPSS testing assumption:

HO: There was no statistically significant difference in the mean scores of pilot participants with their peers not in the pilot.

HA: There was a positive increase in mean scores for pilot participants.

$H_0 : m_1 = m_2$

$H_1 : m_1 \neq m_2$

$\alpha = .05$, two tailed t-test.

School "A"

Descriptive statistics by grade level for MAP and Terra Nova for the data runs below; MAPA3 would be descriptive statistics for MAP scores, third grade, school "A." TNB4 would be descriptive statistics for Terra Nova scores, fourth grade, school "B." (Note, there are no "Missing" scores. SPSS assumes the longest list is the total n for each variable. "N Valid" is correct for each variable.)

Statistics

MAPA3

N	Valid	18
	Missing	4
Std. Error of Mean		6.94821
Median		656.0000
Std. Deviation		29.47875
Variance		868.997
Skewness		-1.206
Std. Error of Skewness		.536
Percentiles	5	573.0000
	25	640.5000
	50	656.0000
	75	673.2500

Statistics

TNA3

N	Valid	18
	Missing	4
Std. Error of Mean		5.87840
Median		84.0000
Std. Deviation		24.93993
Variance		622.000
Skewness		-1.322
Std. Error of Skewness		.536
Percentiles	5	7.0000
	25	56.0000
	50	84.0000
	75	92.0000

Statistics

MAPA4

N	Valid	22
	Missing	0
Std. Error of Mean		6.65082
Median		659.5000
Std. Deviation		31.19510
Variance		973.134
Skewness		2.014
Std. Error of Skewness		.491
Percentiles	5	634.3000
	25	652.7500
	50	659.5000
	75	672.0000

Statistics

TNA4

N	Valid	22
	Missing	0
Std. Error of Mean		3.70590
Median		67.5000
Std. Deviation		17.38219
Variance		302.141
Skewness		.193
Std. Error of Skewness		.491
Percentiles	5	37.9000
	25	58.7500
	50	67.5000
	75	82.2500

Statistics

MAPA5

N	Valid	10
	Missing	12
Std. Error of Mean		15.26215
Median		695.5000
Std. Deviation		48.26317
Variance		2329.333
Skewness		-.340
Std. Error of Skewness		.687
Percentiles	5	611.0000
	25	645.2500
	50	695.5000
	75	737.0000

Statistics

TNA5

N	Valid	10
	Missing	12
Std. Error of Mean		15.26215
Median		695.5000
Std. Deviation		48.26317
Variance		2329.333
Skewness		-.340
Std. Error of Skewness		.687
Percentiles	5	611.0000
	25	645.2500
	50	695.5000
	75	737.0000

Statistics

MAPA6

N	Valid	16
	Missing	6
Std. Error of Mean		9.06544
Median		675.5000
Std. Deviation		36.26178
Variance		1314.917
Skewness		-.718
Std. Error of Skewness		.564
Percentiles	5	589.0000
	25	651.0000
	50	675.5000

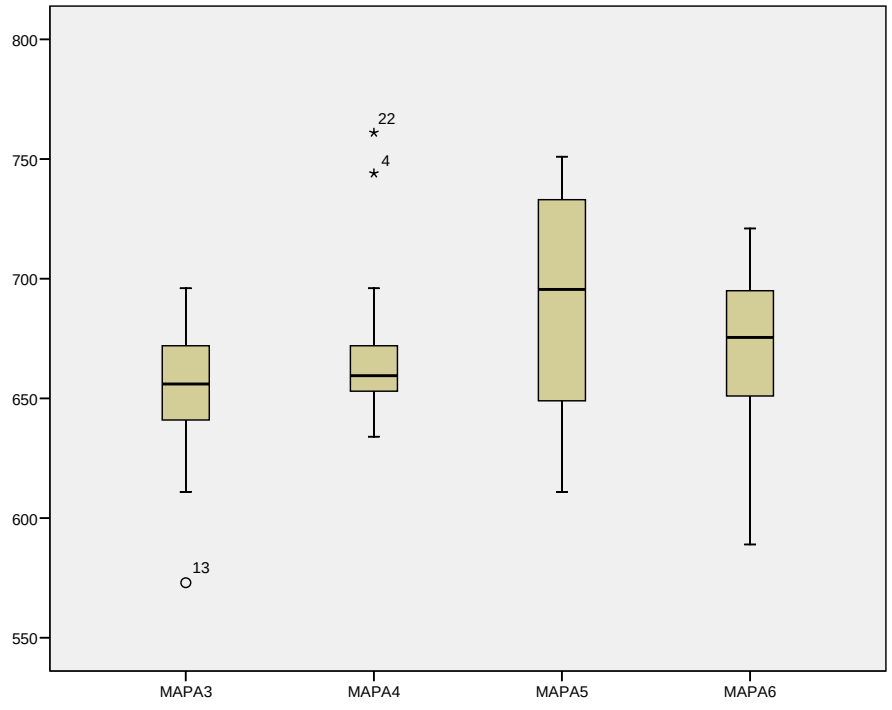
	75	695.5000

Statistics

TNA6

N	Valid	16
	Missing	6
Std. Error of Mean		7.24734
Median		61.0000
Std. Deviation		28.98937
Variance		840.383
Skewness		-.527
Std. Error of Skewness		.564
Percentiles	5	6.0000
	25	38.2500
	50	61.0000
	75	83.7500

EXAMINE
VARIABLES=MAPA3 MAPA4 MAPA5 MAPA6 /COMPARE VARIABLE/PLOT=BOXPLOT /STATISTICS
Outliers removed: 3rd n=1, 4th n=0, 5th n=1, 6th n=2



Statistically significant

Significance for school "A" for all grades combined. Not having individual scores for non-pilot students only a comparison across the grade spans can be calculated. Across all grades the differences between participating and non-participating classes.

Group Statistics

	delim_g	N	Mean	Std. Deviation	Std. Error Mean
School_A	.00	4	676.1625	17.69744	8.84872
	1.00	4	666.2850	10.82378	5.41189

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
School_A	Equal variances assumed	.763	.416	.952	6	.378	9.87750	10.37248	-15.50305	35.25805
	Equal variances not assumed			.952	4.969	.385	9.87750	10.37248	-16.83616	36.59116

Appendix B

School "B"

Selection Criteria

	4th MAP reportable n=	Free and Reduced Lunch	% African American	Tittle II D status
School B	74	20.7	8.8	Y
School 1	59	28.1	12.8	Y
School 2	66	19.8	9.4	Y
School 3	88	21.4	18.6	Y

Rejected Schools for comparison

Rejected schools	4th MAP reportable n=	Free and Reduced Lunch	% African American	Tittle II D status
School 4	76	22.6	27.2	Y
School 5	89	20.3	7.8	N
School 6	93	5.6	9.3	Y
School 7	77	23.7	13.4	N

All MAP communication arts percentages for School "B" and comparison schools including mean scores.

	Below basic %	Basic %	Proficient %	Advanced %	Mean score
School 1	12.5	39.8	26.1	21.6	656.9
School 2	6.1	53.0	25.8	15.2	656.5
School 3	11.9	47.5	28.8	11.9	655.8
School "B"	4.1	44.6	29.7	21.6	666.1

For data analyses, $\alpha = .05$. A two-sample t-test was performed to compare mean scores for participants and non-participants of the study.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
mean_score	Equal variances assumed	.	.	15.088	2	.004	9.70000	.64291	6.93378	12.46622
	Equal variances not assumed			.	.	.	9.70000	.	.	.

Appendix C

School "C"

Descriptive statistics for the relationship of the pilot participant classroom and comparison classroom mean scores two-tailed *t* test follow for advanced and proficient for both 4th and 5th grades follow.

The results indicate there were significant differences in performance between eMINTS and non-eMINTS classrooms. Means for 5th grade participants: Advanced = 726.83 and Proficient = 724.56. Means for non-participants: Advanced = 724.56 and Proficient = 685.92. Means for 4th grade participants: Advanced = 710.0 and Proficient = 677.86. Means for non-participants: Advanced = 703.45 and Proficient = 676.24. That is, the average performance score of eMINTS participants was higher (M=68.87, SD=12.3) but was not statistically significant from that of non-eMINTS participants (M=49.44, SD=10.38). These comparisons confirm a positive trend for participants in the pilot to score higher than peers that did not participate in the pilot.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
5th eMINTS Adv	Equal variances assumed	.212	.654	-.330	12	.747	-3.55556	10.77266	-27.02717	19.91605
	Equal variances not assumed			-.356	10.380	.729	-3.55556	9.97540	-25.67228	18.56117

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
5th eMINTS Prof	Equal variances assumed	.142	.710	.476	23	.638	1.46795	3.08283	-4.90938	7.84527
	Equal variances not assumed			.476	22.802	.639	1.46795	3.08407	-4.91501	7.85091

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
4th eMINTS Adv	Equal variances assumed	.638	.441	.638	11	.536	6.54545	10.25772	-16.03164	29.12255
	Equal variances not assumed			.451	1.150	.722	6.54545	14.49976	-129.569	142.65953

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
4th eMINTS Prof	Equal variances assumed	.056	.815	.267	19	.793	.97222	3.64720	-6.66147	8.60591
	Equal variances not assumed			.261	15.861	.798	.97222	3.72734	-6.93501	8.87945