

The page features several decorative elements: a large blue circle with a white ring and a smaller blue circle inside, located in the upper right; a smaller version of this same design below it; and a large blue circle with a white ring and a smaller blue circle inside, located in the lower right. Thin blue lines connect these circles to the text area.

Sixth Grade Student Science Content Achievement and *Adaptive Curriculum*

This report is an analysis of a quasi-experimental design to explore the effects of the *Adaptive Curriculum* science program on science content knowledge of sixth grade students in Isaac Middle School of the Isaac School District in Phoenix, AZ. The details of the implementation and the results of a science content assessment are reported. Students doing *Adaptive Curriculum* had statistically significant gains from the pretest to the posttest and had statistically significant greater gains from the pretest to posttest than control group students.

Peter Rillero, Ph.D., Helen Padgett, Ph.D., & Irfan Kula
Arizona State University

October 19, 2008



Introduction

An evaluation of *Adaptive Curriculum* was implemented with students from Isaac Middle School in the Isaac School District in Phoenix, AZ. The majority of students in the school are from families below the poverty line, as indicated by the high percentage of students (89.2%) receiving free lunches (76.7%) or subsidized lunches (12.5%). The school consists of grades sixth, seventh, and eighth, and 96% of the school's students are of Hispanic origins.

Implementation Details

Teachers implemented Activity Objects from the *Adaptive Curriculum* science library with their students. Treatment and control group teachers teach four classes of approximately 25 students each. There was one sixth grade treatment teacher and three control group teachers. The treatment teacher chose Activity Objects that were directly related to her curriculum. Starting in late March, she delivered two whole-class lessons with two Activity Objects, using a teacher computer and a projector with a SMART Board™. These two whole-class Activity Objects were completed in two weeks.

After the whole class presentations, the teacher was able to use the school's laptop cart in a six-day school rotation. So, for instance, if the teacher used the laptops with her students on April 9th, she would not receive them again until April 17th. This was six school days later; weekend days (Saturday and Sunday) and school holidays are not counted in the rotation.

The teacher implemented five Activity Objects using the laptop carts. There were usually 14 laptops with the cart. She started out having two students on each computer, although in most classes one or two students could work independently on one or two computers, as there were fewer than 28 students per class. After students completed two Activity Objects with this arrangement, for the last three Activity Objects she split her class in half and gave computers to one-half and an alternate assignment to the other half. Then, when half of the period was over, students switched tasks. This report describes the efforts to determine if *Adaptive Curriculum* helped students learn science content as indicated by their scores on content assessments.

Content Assessment

The content assessment was an open-ended question, where students wrote all they knew about plants. The assessment instrument is presented in Appendix 1. Pretests and posttest of the instrument was administered to treatment groups (students doing *Adaptive Curriculum*) and control groups, all of which were in the sixth grade.

Aggregate Pretest/Posttest Results

Completed pretests and posttests were obtained from 117 sixth grade students in the Isaac Middle School. There were 71 students in the treatment groups and 46 students were in the control groups. Table One summarizes the combined scores of all the students on the pretest and posttest.

Table 1.

Descriptive Statistics for Pre and Post Tests

Test	N	Range	Min	Max	Mean		SD	Variance	Skewness		Kurtosis	
	Stat	Stat	Stat	Stat	Stat	Std. Error	Stat	Stat	Stat	Std. Error	Stat	Std. Error
Pre	117	47	2	49	13.51	.863	9.33	87.11	1.53	.22	2.22	.44
Post	117	45	3	48	15.84	.791	8.55	73.15	1.28	.22	2.01	.44

As the table above indicates, the pretest mean (and standard deviation (SD)) was 13.51 (9.33) and the posttest mean (SD) was 15.84 (8.55). The scores on the pretest ranged from 2 to 49 and on the posttest from 3 to 48.

Disaggregated Pretest/Posttest Results

The purpose of a control group is to allow comparisons between the treatment group and control group. In this case, achievement gains of the treatment group are compared to achievement gains in the control group. Table 1 showed descriptive statistics for both groups on the pretest. The next four tables presents data for treatment group pretest, treatment group posttest, control group pretest, and control group posttest. The treatment group was comprised of students using *Adaptive Curriculum*; the control group was comprised of students doing their regular science education programs. Table 2 presents data for the pretest treatment group.

Table 2.

Descriptive Statistics for Pretests for Treatment Group Students

Treatment Group Pretest			Statistic	Std. Error
Pretest	Mean		10.14	.654
	95% Confidence Interval for Mean	Lower Bound	8.84	
		Upper Bound	11.44	
	Median		9.00	
	Variance		30.323	
	Standard Deviation		5.507	
	Minimum		2	
	Maximum		25	
	Range		23	
	Skewness		.912	.285
	Kurtosis		.412	.563

In Table 2, the pretest results of the treatment group students indicated a range from 2 to 25, with a mean of 10.14 (SD=5.507). The table also provides information concerning the distribution of pretest results. The skewness measure is 0.912 with a standard error of 0.285 indicating that the distribution is slightly positively skewed. The kurtosis score of 0.412 with a standard error .563 suggests that the distribution is normal.

Table 3 presents descriptive statistics for the posttest for students in the treatment group. According to Table 3, the range of student scores is from 3 to 32, with a mean of 14.80 (SD=6.898). The table also provides information concerning the distribution of posttest results. The skewness score of 0.563 with a standard error of 0.285 indicates that the distribution is slightly positively skewed. Moreover, the low kurtosis score is -0.002 with a standard error of 0.563 indicates that the distribution is normal.

Table 3.

Descriptive Statistics for Posttests for Treatment Group Students

Treatment Group		Statistic	Std. Error
Posttest Mean		14.80	.819
95% Confidence Interval for Mean	Lower Bound	13.17	
	Upper Bound	16.44	
Median		14.00	
Variance		47.589	
Standard Deviation		6.898	
Minimum		3	
Maximum		32	
Range		29	
Skewness		.563	.285
Kurtosis		-.002	.563

Table 4.

Descriptive Statistics for Pretests for Control Group Students

Control Group		Statistic	Std. Error
Pretest Mean		18.72	1.692
95% Confidence Interval for Mean	Lower Bound	15.31	
	Upper Bound	22.13	
Median		15.00	
Variance		131.763	
Standard Deviation		11.479	
Minimum		3	
Maximum		49	
Range		46	
Skewness		.866	.350
Kurtosis		-.233	.688

Table 4 (above) presents data for the pretest treatment group. From the table, the range of student scores is from 3 to 49, with a mean of 18.72 (SD=11.479). The skewness score of 0.866 with a standard error of 0.350 indicates that the distribution is slightly positively skewed. Moreover, the kurtosis score is -0.233 with a standard error 0.688 suggests that the distribution is normal.

Table 5.

Descriptive Statistics for Posttests for Control Group Students

Posttest Mean		17.43	1.548
95% Confidence Interval for Mean	Lower Bound	14.32	
	Upper Bound	20.55	
Median		14.00	
Variance		110.251	
Standard Deviation		10.500	
Minimum		4	
Maximum		48	
Range		44	
Skewness		1.308	.350
Kurtosis		1.144	.688

According to the Table 5 (above) showing the posttest result of the control group students, the range of students scores is from 4 to 48, with a mean of 17.43 (SD=10.500). The skewness score of 1.308 with a standard error of 0.35 indicates that the distribution is slightly positively skewed. Moreover, the kurtosis score is 1.144 with a standard error of 0.688 indicates that the distribution is normal.

Distributions of Scores

For both the treatment and control groups on both the pretests and posttests, the skewness and kurtosis values for these variables are between -1.82 and 1.82 and -1.31 and 1.31 respectively with standard error ranges between -0.35 and 0.35 and -1.38 and 1.38 respectively. Because of the relatively small size of the groups (treatment group = 46 and control group = 71), these values suggest a pattern that should be analyzed with the relatively robust *t*-test, with the understanding that non-normally distributed data increases the possible error in analysis.

Comparing Means of Pretest and Posttest in the Science Content Exams for the Sixth Grade Students

The sixth grade treatment and control groups used the same pretest and posttest content exam. The distribution of scores indicated that a paired sample *t*-test was appropriate to compare means. Table 6 presents sample size (N), means, standard deviations, and standard error of the mean statistics for the treatment and control groups on the pretest and posttest.

Table 6.

Paired Sample Statistics

Group		Mean	N	Std. Deviation	Std. Error Mean
Treatment	Posttest	14.80	71	6.898	.819
	Pretest	10.14	71	5.507	.654
Control	Posttest	17.43	46	10.500	1.548
	Pretest	18.72	46	11.479	1.692

Table 7.

Paired Sample Correlations

Group		N	Correlation	Sig.
Treatment	Posttest & Pretest	71	.796	.000
Control	Posttest & Pretest	46	.776	.000

Table 7 (above) presents correlations of the pretest and posttest scores. The statistically significant differences suggest that students who did better on the pretest tended to do better on the posttest. Table 8 presents the results from the paired samples *T*-test.

Table 8.

Paired Samples T-test

Group		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Treatment	Posttest - Pretest	4.662	4.171	.495	3.675	5.649	9.418	70	.000
Control	Posttest - Pretest	-1.283	7.420	1.094	-3.486	.921	-1.172	45	.247

The results indicate that the treatment group had a statistically significant increase in the scores from pretest (mean=14.80, SD=6.90) to posttest (mean =10.14, SD=5.51, $t(140)=9.418$, $p<.001$). There were no statistically significant differences for the control group from pretest to posttest.

In accordance with APA (1994) recommendations, it is suggested that in addition to statistical significance, effect sizes should be reported, as these are an indication of a practical significance of a result. Using the means and standard deviations of the pretest and posttest scores for the treatment group, a Cohen’s D of 0.7466 was calculated giving an effect-size (r) of 0.3497.

Comparing Treatment Group and Control Group Science Content Gains

The improvement (gain) from pretest to posttest can be computed for each participant by subtracting each student’s pretest score from his or her posttest score (Becker, 2000). In this study, the gain formula used is as follows: Valid Gains = posttest – pretest

The Valid Gains means, standards deviations, and sample size are presented in Table 9. The null hypothesis of no difference in improvement between the treatment and control groups can be tested by an analysis of variance on the gain scores using treatment (treatment vs. control) as a between subjects factor.

Table 9.

Descriptive Statistics for Valid Gains

Group	Mean	Std. Deviation	N
Treatment	4.66	4.171	71
Control	-1.28	7.420	46
Total	2.32	6.353	117

Table 10.

*Analysis of Variance of Treatment versus Control Group***Tests of Between-Subjects Effects**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	986.445 ^a	1	986.445	30.699	.000
Intercept	318.787	1	318.787	9.921	.002
Group	986.445	1	986.445	30.699	.000
Error	3695.213	115	32.132		
Total	5314.000	117			
Corrected Total	4681.658	116			

The valid gain scores (posttest – pretest) were analyzed in an analysis of variance with group (treatment vs. control) as the independent variable. This is presented in Table 10. There was a positive gain score in the treatment group ($M = 4.66$, $SD = 4.17$), and a slight negative gain score for the control condition ($M = -1.28$, $SD = 7.42$), these differences in gain scores were significantly different ($F(1, 115) = 30.70$, $p < .001$). The treatment group had a statistically significant valid gain from pretest to posttest when compared to the control group.

Conclusions

This report is of a study of science content exams of sixth grade students using *Adaptive Curriculum*. The majority of students in the school were of low socioeconomic families. The treatment group used science Activity Objects from *Adaptive Curriculum*. The control group students were from the same school and same grade but they did not use *Adaptive Curriculum*. The treatment group completed a total of seven Activity Objects. Two were done as a whole class with a projector, SMART Board™, and a computer. Five were completed as either one-student to a computer or two-students to a computer.

On the science content assessment, students in the treatment group scored statistically significantly higher on the posttest than on the pretest. There were no statistically significant differences on the pretest and posttests for the control group students. Comparisons between the treatment and control group for individual gains from the pretest to posttests, showed a statistically significant difference between treatment and control groups.

References

American Psychological Association. (1994). Publication manual of the American Psychological Association (4th ed.). Washington, DC: Author.

Appendix 1. Sixth Grade Content Instrument

What I Know...About Plants!

Pretest

Full Name _____

Period _____ Sixth Grade Teacher _____

Directions: In short, simple sentences, write down everything you know about plants. For example, if you were writing everything you knew about dogs, your list might include the following:

- 1. Dogs have fur.
- 2. Fur keeps dogs warm.
- 3. Dogs have eyes.
- 4. Eyes allow dogs to see.
- 5. Dogs eat meat.

Keep the sentences simple so that they only contain one idea. So do not write “Dogs have ears and a nose,” rather break this into two simpler statements, such as: (6) Dogs have ears. (7) Dogs have a nose.

Now, proceed to tell us all that you know...ABOUT PLANTS.

- 1. _____
- 2. _____
- 3. _____
- 4. _____
- 5. _____
- 6. _____
- 7. _____
- 8. _____
- 9. _____
- 10. _____
- 11. _____

There are more spaces on the other side of this page.

12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____
21. _____
22. _____
23. _____
24. _____
25. _____
26. _____
27. _____
28. _____
29. _____
30. _____
31. _____
32. _____
33. _____

If you need more spaces, please ask your teacher for another page.