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GLOBALORIA STUDENTS

*Quantitative Data Report: Examining Standardized Test Performance in
Mathematics Objective Used as Game Content and English Language Arts Objective
Related to Applying Critical Thinking in Sixth Grade Globaloria Students*

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I. Abstract

The following report summarizes changes across the year in assessment scores of sixth grade students engaged in the Globaloria social network for learning game-design at the East Austin College Prep Academy (EACPA) in Texas. Students in Globaloria used math content from a specific testing objective as the subject matter of their game, engaged in math curriculum design, and conducted research on a social issue. This report compares pre and post-test scores from all sixth grade students on the Texas Assessment of Knowledge and Skills (TAKS). Specifically, it examines two objectives that align with the tasks and competencies of game making: the learning objective content that students used as content in their math game, *Numbers, Operations and Quantitative Reasoning*. In addition, since research is a major part of the game design process, the objective designed to measure skills used in research, *Applying Critical Thinking*, was analyzed. Analysis of the scores showed that as with the 2009-10 study, students on average had very significant positive change in both objectives, across a short period of time. Additional research will be conducted to determine what aspects of Globaloria are helping to support student achievement in Mathematics and English Language Arts in this population.

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II. Background

What is Globaloria

Globaloria (www.Globaloria.org), a program established by the World Wide Workshop (www.WorldWideWorkshop.org) in 2006, is an educational intervention for students to develop digital literacies, STEM knowledge and global citizenship by designing and building original webgames in a wiki-based collaborative networked environment. Globaloria is a yearlong academic curriculum comprised of programmable wikis, blogs, game-design and programming tutorials, game-content resources, and a virtual support systems for educators and students. Students drive the design process, taking an original idea to final product. In a student-centered or 'workshop' classroom, students learn both technical and computational skills and gain content knowledge in preparation for college-level studies, especially in STEM curricula of science, technology, engineering, and mathematics. Educators engage in multi-year, blended (onsite and online), rigorous professional development that prepares them to manage and master this Constructionist learning environment (World Wide Workshop 2010).

Globaloria at EACPA in 2010-11

All students at East Austin College Prep Academy (EACPA) are required to participate daily in Globaloria for 75-minutes. The school is a new charter middle school, opened in 2009, designed for and populated by students who are from the surrounding economically disadvantaged community. The students are 80%

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Hispanic and 20% African American. Approximately 50% are English Language Learners.

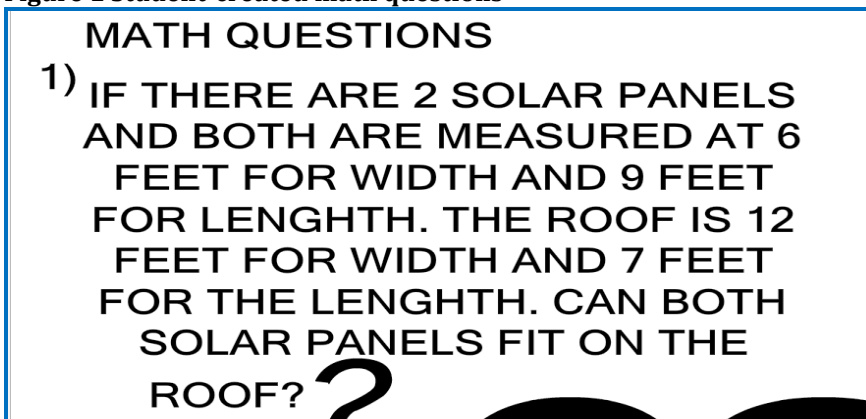
In the Globaloria class, educators use a student-centered approach of guiding students to find answers for their questions about their game-topic, among their peers and using available virtual resources, including live and asynchronous expert helpdesk and tutorials, rather than direct teaching, thereby enhancing research and problem solving skills. Educators receive just-in-time in-person and virtual training and support to refine their use of this approach. They also create lessons and adapt Globaloria tools to fit the needs of the students in this population, making the game design process accessible and relevant. Educators are also supported by a dedicated mentor and program manager who provides in-person and virtual support for developing games in the Globaloria network.

In 2010-11, the second year of the program and the school, all 95 sixth graders enrolled at EACPA designed web games in Globaloria based on the TAKS math objective known as Numbers, Operations and Quantitative Reasoning (NOQR). This objective includes math factors, solving word problems, and using math in real life situations. Using Globaloria's Constructionist approach to learning, the students made games that were designed to teach the concepts of the NOQR objective to the game's players. In order to do so, they needed to design math problems or activities that were embedded into game activities. Globaloria designers hypothesize that by doing this, students may build deeper understanding of this content, as

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demonstrated by their performance on standardized assessment. The approach is drawn from Constructionist theory, which states 'learning is most effective when part of an activity the learner experiences as constructing a meaningful product.' (Papert 1987). (See an example of student-designed math activities in Figure 1, below.)

Figure 1 Student-created math questions

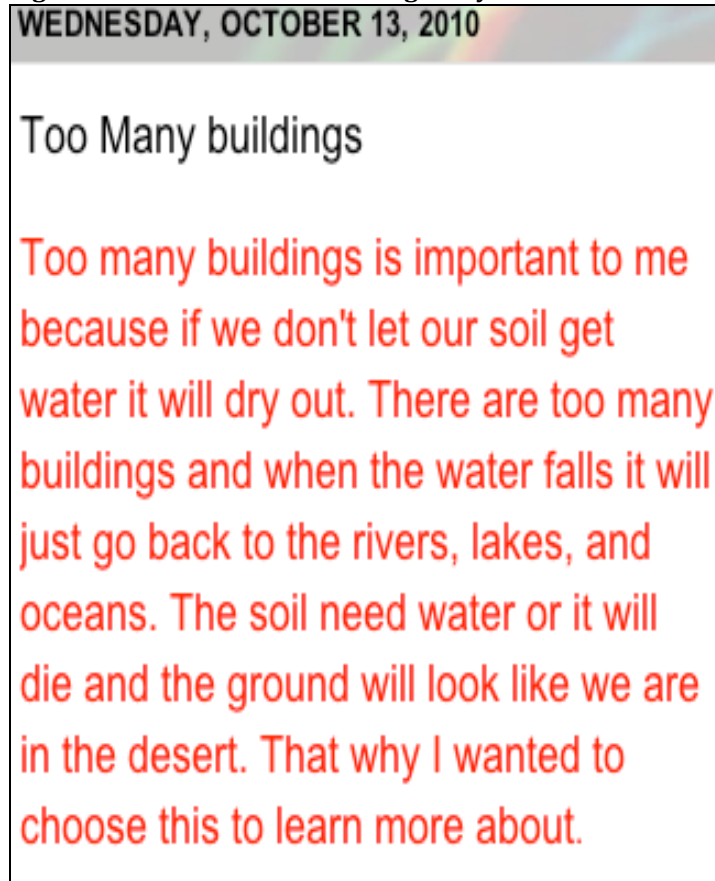


In addition to designing math activities for their games, all sixth grade Globaloria students engaged in class activities in which they learned how to research a topic, collect information, form questions and analyze information they gathered. All students spent time conducting research online with materials from the Globaloria curriculum and used the Globaloria wiki platform and blogs to present research findings. The Globaloria educator spent many weeks of the course modeling analysis of written work. (Examples of one student's research wiki pages and blog are included in Figures 2, 3, and 4 below.) Because students spent time reading and thinking about information related to a social issue, and then used the social issue as

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content for their game, researchers also examined the TAKS objective that measures critical analysis of written material, *Applying Critical Thinking Skills*.

Figure 2 Research in student blog entry



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Figure 3 Student research on wiki, Globaloria curriculum unit “Choosing a Topic”

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Comment on one of your classmate's blogs!

CHOOSING A TOPIC assignments

1 Ask Big Questions

★ Fill in the blanks: Our class is in the STEM knowledge community with a focus on math. A social issue that I would like to explore in my game is too many building.

List 3 questions people generally have about this topic:

- Question 1: Why are they so many buildings?
- Question 2: What is the tallest building?
- Question 3: How many buildings are there in the austin?

Of these three, choose *one* question you want to explore:

- Question: What is the tallest building?

2 Narrow Your Scope

★ Go to [Wikipedia](#). Use key words or copy and paste your selected question into Wikipedia's search box. Browse your search results and explore **internal** links (links that keep you within Wiki). List 3 different Wikipedia pages you think will help answer the question:

- 1. [Tallest Building](#)
- 2. [International Buildings](#)
- 3. [Empire State Building](#)

Of these pages, select *one* to read all the way through:

- Selected page: [One of The Tallest Buildings](#)


Text on this page entered by a student



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Figure 4 Student research on wiki page as part of "Choosing a Topic" Globaloria curriculum unit

= 1.

Author: no author
Title:What is Urban Sprawl?
Web address:<http://www.cwac.net/landuse/index.html> 
Copyright date:10/27/10
Date found:10/27/10
Facts:
1.The population of people grew by 17 percent from 1982 to 1997
2.Wisconsin has only .5% (13,000 acres) of its original grassland ecosystem
3.Sprawl increases car and truck traffic
Quotes:

Title of Article:[urban sprawl](#) 
Name of Website:wikipedia
Author:no author
Date Found:10/27/10
Date Published:10/09/10
Web Address:wikipedia
Important facts you found on this website:http://en.wikipedia.org/wiki/Urban_sprawl 
1.Low diversity of housing and business types
2.Higher per-capita use of energy, land, and water
3.Perceived low aesthetic value
Quotes:

Title of Article: Urban sprawl: The Big Picture
Name of Website:NASA
Author:NASA
Date Found:October 19, 2010

During November, the sixth grade classes were reorganized into five sections, using a version of ability grouping guided by their technology proficiency. The students were essentially organized into two 'advanced' sections and three less advanced sections, depending on the educator's evaluation of their proficiency in technology and content understanding. Students in the three 'less advanced' sections made games individually rather than in teams, because the educator found that they were making better progress by working independently. The students in these three groups made mini-games and focused on the math concept of factors. In the two 'advanced' sections, students worked in teams of two or three to make games about social issues that also engaged players in math activities that will help the game-player to learn the concepts within *NOQR*.

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For many specific examples of the specific math learning competencies that are aligned with the *NOQR* objective, please see Table 8 in Appendix. For more examples of the English Language Arts and Social Studies learning competencies that are aligned with Applying Critical Thinking objective, please see Table 9 in Appendix.

III. Methods

We analyzed scores from 82 students, which is 92% of the total number of students in 6th grade, pre and post. Exceptions were special education students who took a modified TAKS, students who did not take either the TAKS because of leaving EACPA, or students who joined the student body at EACPA after the pre-test was administered in October.

NOQR Scores: Students in 6th grade made games focused on one math objective as the content for their games. Since part of the game design process was using math concepts to create activities in which players of the game will engage, the students interacted with the assigned content more than with any other math objective. For this reason, we examine each student's performance on the *NOQR* objective. The first benchmark or pretest of the 6th grade TAKS test was administered on October 10, 2010. Students' scores on that assessment are used as pre-test scores here. The TAKS was administered in late April 2011, and the raw scores from the same objective on that assessment are included in Table 10 in the Appendix of this report.

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Applying Critical Thinking Scores: Observation and teacher progress reports documented that learning and modeling research skills was a major focus of the class. All students spent time conducting research online with materials from the Globaloria curriculum and used the Globaloria wiki platform and blogs to present research findings. The Globaloria educator used resources from outside of the course, including newspaper articles, films and educational websites, to model the research process. Because of the amount of time the students spent reading and thinking about information related to their social and science-related issue, educators and researchers identified the ELA TAKS objective that measures critical analysis of written material, *Applying Critical Thinking Skills*, as a measure of change in this area. (See Appendices, Table 10, *NOQR* TAKS Scores, Pre and Post, and *Applying Critical Thinking* TAKS Scores Pre and Post).

Table 10 is a comparison of the scores from the students' pre-test or benchmark raw score for the objectives and the students' raw score on the same objectives from the final TAKS administration in April 2011.

IV. Results and Statistical Analysis

The sixth grade students' scores in both Math (*NOQR*) and ELA (Critical Thinking) were much higher on the final administration of the TAKS test on average. Some

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students improved as much as 100% between the pre and post tests on the objectives examined.

In order to determine whether the change in raw student scores on Math Objective relating to NOQR was statistically significant, we took Benchmark/pre-test scores and post-test scores from each student in the focus group. The scores were analyzed using a two-tailed Paired Samples T-Test. The Paired Samples T-Test compares the means of two variables, computes the difference between the two variables for each case, and tests to see if the average difference is significantly different from zero. Performing this analysis, we find that the change in the scores of the students is 'very statistically significant'. See Figure 6 and 7 below for details about the statistical analysis.

Figure 6: Statistical Analysis of Applying Critical Thinking scores pre and post

Paired t test results for Applying Critical Thinking		
P value and statistical significance:		
The two-tailed P value is less than 0.0001		
By conventional criteria, this difference is considered to be extremely statistically significant.		
Confidence interval:		
The mean of Group One minus Group Two equals -22.27		
95% confidence interval of this difference: From -26.45 to -18.09		
Intermediate values used in calculations:		
t = 10.6074		
df = 81		
standard error of difference = 2.099		
Group	Group One	Group Two

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Mean	57.44	79.71
SD	17.9	18.61
SEM	1.98	2.06
N	82	82

Figure 7: Statistical Analysis of student NOQR scores, pre and post

P value and statistical significance:

The two-tailed P value is less than 0.0001

By conventional criteria, this difference is considered to be extremely statistically significant.

Confidence interval:

The mean of Group One minus Group Two equals -14.93

95% confidence interval of this difference: From -19.90 to -9.95

Intermediate values used in calculations:

$t = 5.9751$

$df = 80$

standard error of difference = 2.498

Group	Group One	Group Two
Mean	51.37	66.3
SD	24.44	23.53
SEM	2.72	2.61
N	81	81

To examine the change in student performance on the *Applying Critical Thinking* objective, analysts took raw scores of all sixth grade students, and then compared the scores from the first benchmark and the final TAKS test on this one objective, as in the previous analysis. The results were analyzed using a two-tailed, Paired Sample t-Test. This analysis found that the change in the scores of the students was 'very statistically significant.'

V. Limitations of Standardized Test Scores to Measure Student Achievement

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In this report, comparison is made between Benchmark (pre-test) scores and TAKS score for the same objectives from the Texas Essential Knowledge and Skills. The Benchmark instrument is designed to examine the same objectives, however, it is designed by a different entity than the TAKS test. It is possible that a difference in level of difficulty between the instruments could influence scores. Test administrators report that the benchmarks examinations are given in a serious testing environment at EACPA, but regardless of this, there is a tendency for students to be less focused during a Benchmark than during the actual high stakes testing administration. This also introduces a complex set of issues regarding differences in student attitudes about the importance of the assessment. Use of standardized tests and pre- test scores as a diagnostic tool is limited by these factors, and should be viewed as such.

VI. Findings

Results show substantial improvement of non-special education students from the Globaloria class at East Austin College Prep Academy in grade 6 on both the assigned math objective (NOQR) and Applying Critical Thinking. These findings align with results from the 2009-10 school year, when researchers found that participation in Globaloria supported a student's achievement on the specific TAKS

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objective that was assigned to her or him as the math content for his or her team's game.

Further research will compare the scores from these students to scores from another charter school serving disadvantaged students, or other similar populations. In addition, findings from this study form the basis for a longitudinal study of this group of students, where we will follow both their *Applying Critical Thinking* (ELA) and *NOQR* (Math) scores across their Globaloria experience.

VII. Conclusion

The findings above are important in that they build on results from examination of test scores of the previous year's sixth grade students (Minnigerode, 2010), which also showed higher than expected improvement on assessment scores on math objectives that were assigned to students as game content. Further, the current study examines the test scores to begin to address the interdisciplinary and higher level thinking aspect of Globaloria's impact. Results of this report suggest that participation in Globaloria, as part of East Austin College Prep Academy's overall curriculum, had a significant positive impact on students' achievement on standardized tests.

VII. References

Papert, Seymour. (1987) *Constructionism: A New Opportunity for Elementary Science Education*. National Science Foundation Award Abstract #8751190.

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APPENDICES

Table 8: Learning objectives

Specific Learning Objectives Aligned to the NOQR TAKS Objective	
The student represents and uses rational numbers in a variety of equivalent forms.	
Student compares and orders non-negative rational numbers;	Student writes prime factorizations using exponents;
Student generates equivalent forms of rational numbers including whole numbers, fractions, and decimals;	Student identifies factors of a positive integer, common factors, and the greatest common factor of a set of positive integers; and
Student uses integers to represent real-life situations;	Student identifies multiples of a positive integer and common multiples and the least common multiple of a set of positive integers.
The student adds, subtracts, multiplies, and divides to solve problems and justify solutions.	
Student models addition and subtraction situations involving fractions with objects, pictures, words, and numbers.	Student estimates and rounds to approximate reasonable results to solve problems where exact answers are not required.
Student uses addition and subtraction to solve problems involving fractions and decimals.	Student uses order of operations to simplify whole number expressions (without exponents) in problem solving situations.
Student uses multiplication and division of whole numbers to solve problems including situations involving equivalent ratios and rates.	

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Table 9: Learning Objectives

Specific Learning Objectives Aligned to Applying Critical Thinking TAKS Objective	
<u>Language Arts Competencies</u>	
Student evaluates his/her own research and frames new questions for further investigation.	Student summarizes and organizes ideas gained from multiple sources in useful ways such as outlines, conceptual maps, learning logs and time lines.
Student produces research projects and reports in effective formats for various audiences.	Student presents information in various forms using available technology.
Student evaluates his/her own research and frame new questions for further investigation.	Student uses compiled information and knowledge to raise additional, unanswered questions.
<u>Social Studies Competencies</u>	
Student incorporates main and supporting ideas in verbal and written communication.	Student uses a decision-making process to identify a situation that requires a decision, gather information, identify options, predict consequences, and take action to implement a decision.
Student uses a problem-solving process to identify a problem, gather information, list and consider options, consider advantages and disadvantages, choose and implement a solution and evaluate the effectiveness of a solution.	

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Table 10: All students' scores Pre/Post, Applying Critical Thinking and NOQR Objectives

Sixth Grade Student	PRE- Applying	Post- Applying	Pre-NOQR	Post-NOQR
Student 1	53	84	60	40
Student 2	38	53	50	100
Student 3	77	92	100	100
Student 4	84	100	60	70
Student 5	53	92	60	60
Student 6	92	92	100	80
Student 7	69	100	100	100
Student 8	69	100	70	100
Student 9	69	92	10	70
Student 10	69	92	90	100
Student 11	77	100	40	50
Student 12	38	100	40	80
Student 13	77	84	70	50
Student 14	61	100	30	100
Student 15	53	92	40	50
Student 16	30	77	80	60
Student 17	23	23	30	20
Student 18	30	77	50	70
Student 19	61	77	50	30
Student 20	30	53	50	90
Student 21	84	84	60	60
Student 22	38	38	10	10
Student 23	84	92	40	90
Student 24	69	100	100	80
Student 25	30	77	10	40
Student 26	61	77	0	50
Student 27	77	69	60	70
Student 28	61	61	30	50
Student 29	53	84	30	60
Student 30	77	84	50	90
Student 31	46	84	20	60
Student 32	69	92	40	70
Student 33	77	92	40	40
Student 34	77	84	40	60
Student 35	53	100	60	70

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Student 36	38	77	10	20
Student 37	53	92	70	80
Student 38	38	61	30	50
Student 39	61	69	61	70
Student 40	53	92	30	70
Student 41	30	69	70	90
Student 42	46	84	50	30
Student 43	61	84	50	60
Student 44	61	92	20	10
Student 45	38	77	20	60
Student 46	69	84		

Sixth Grade Student

Pre- Applying

Post- Applying

Pre-NOQR

Post-NOQR

Student 47	53	84	50	80
Student 48	53	92	90	100
Student 49	69	92	60	30
Student 50	38	92	30	80
Student 51	38	77	20	40
Student 52	46	30	70	60
Student 53	53	92	80	70
Student 54	38	84	30	20
Student 55	23	46	30	50
Student 56	84	92	60	50
Student 57	53	53	20	60
Student 58	84	84	60	90
Student 59	53	53	30	90
Student 60	92	84	70	100
Student 61	77	53	60	70
Student 62	61	92	90	100
Student 63	92	69	60	100
Student 64	61	84	30	50
Student 65	30	69	40	40
Student 66	53	69	70	80
Student 67	53	77	70	70
Student 68	61	46	80	90
Student 69	77	100	70	50
Student 70	30	15	20	30
Student 71	53	69	50	70

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Student 72	61	100	60	80
Student 73	46	92	80	100
Student 74	46	100	70	80
Student 75	61	77	30	60
Student 76	53	69	70	60
Student 77	53	92	70	80
Student 78	92	92	90	90
Student 79	69	100	40	70
Student 80	69	92	60	90
Student 81	38	61	10	70
Student 82	40	84	60	60