How Much Does the 24 Game Increase the Recall of Arithmetic Facts?

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ABSTRACT

Sixth grade students come to MS 331 with strong mathematics backgrounds from elementary school. Nevertheless, students often come with a dearth of skills when performing basic math computations. The focus of this study is to investigate the use of the 24 Game in quickening the ability of sixth graders to perform basic computations. The game reinforces skills along with strategy when finding correct solutions. Students practiced the 24 Game largely on homework assignments and to a lesser extent, during instructional time. Students were measured on their ability to compute arithmetic facts on one minute assessments. Each class showed positive growth as the rigor of the quizzes increased due to 24 Game exposure after three weeks. Students who practiced the 24 Game most frequently on their homework scored the highest. Non-participants on average scored lower than participants. The 24 Game creates cooperation, stamina, and excitement through problem-solving. The speed and accuracy of arithmetic skills for sixth grade students improved through the study period.

INTRODUCTION

Reaching lower-level students in the classroom requires varied instructional techniques.

Games in the classroom break the monotony of book work and give students an opportunity to embrace other skill sets. Games provide an excellent way of differentiating instruction and introducing productive competition between students. The 24 Game was created by Robert Sun of Suntex International in 1988.[1] The 24 Game is played around middle schools all over the nation. While the game began as an official box game, 24 can be made on hand at anytime. The game challenges students to create ways of reaching 24. Each number out of a series of 4 numbers is used once. Any math operation may be employed. Correct solutions for the 24 Game come from arithmetic facts. The game escalates in level—ranging from simple arithmetic to variable manipulation and Venn Diagrams.

Games like the 24 Game can be used for remediation. Remedial instruction, albeit disguised, helps students accomplish computational fluency which is essential for the foundational knowledge.[2] Students at MS 331 come into math with deficits in basic skills knowledge. Despite the reasoning for this, differentiated methods for filling in instructional gaps need to be employed. Traditional memorization and rote may not work for all students. The 24 Game allows students to make quick, rapid connections between math facts. They must flow in and out of operations accurately. The flexible utilization of such arithmetic is called understanding fact families. This method of understanding math derives its roots from the Singapore method of mathematics instruction.[3] If computations are incorrect, they receive

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[1] 2009 Suntex International Inc. http://www.24game.com/t-about-history.aspx Accessed March 15, 2009.

[2] Gathered from a presentation given by Dr. Helene J. Sherman, April 2009 at NCTM Annul Conference. Workshop titled "Error Patterns: Analyzing Students' Work and Instructional Alternatives.

[3] Gathered from Char Forsten's April 23, 2009 NCTM meeting. Workshop titled "Taking the

immediate feedback after explaining their process.

Participants will work on foundational skills in the form of the 24 Game. Working on adding, subtracting, multiplying, and dividing should greatly increase the speed and accuracy of their work in the future. Students will begin with low level problems and rise in difficulty after new ones are mastered. Through this problem solving process, students unknowingly complete hundreds of arithmetic combinations. They practice basic skills in a very simplistic, yet complicated way. After playing this game daily for two weeks the following is expected to occur: 1. Students have a greater retention and recall of tables needed as basic knowledge, 2. Lower level students has more positive attitudes towards class, 3. Students gain in problem solving ability. The basic skills practice that students will gain should help them accurately manipulate expressions while solving two-step equations. The quizzes will be timed. The work produced will be analyzed by looking specifically at arithmetic computations needed to solve the equations. The algebraic component will not be the sole marker of accuracy. It will be very important for students to show all work. Scores will be given as correct computations per minute. The quiz scores of participants in the after school program will be compared to non-participants. The effects of the 24 Game, like other games researched, aim to decrease anxiety, structure small group support, foster problem-solving practice, and produce frequent positive reinforcement. Games like the 24 Game deepen a student's desire to inquire and practice mathematics in different contexts.

LITERATURE REVIEW

Problem Out of word Problems With Singapore's Model Drawing Approach."

Problem solving ability

The 24 Game took place extensively in the Archdioceses of Erie, Iowa School District in 1994. The students had experienced extremely poor trends in the state test scores. After a program that occurred daily during the school year for 5-10 minutes, the district studied their new scores. Of 111 classes studied in the Erie district, 77 saw 92% increases in the understanding of "math concepts and problem solving." Students got into a pattern of deriving solutions without set procedures. The cognitive demand for this is considered high. Studies conducted at schools in the Bronx and Philadelphia also showed improvement in standardized test scores.[4] It is suggested that students performed better because the foundation for subsequent standards had been enforced through computational fluency. State tests often test for accuracy of computation during multiple choice sections. Students who know arithmetic well have the ability to obtain correct solutions if they understand procedures and concepts. They also spend less time on calculating. This gives students more time for thinking through problems and the reasonableness of their answers.

Other games show promising results in light of problem solving ability. In a middle school classroom, students were placed in different groups to solve algebra problems. The first group had direct instruction. The second group had to discovered answers to problems through inquiry. The last group had no small group instruction. They simply participated in a large classroom setting. The study revealed that students of a lower level did well with explicit instruction, while higher level students succeeded with the inquiry based approach. Both of the

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[4] 2009 Suntex International Inc. http://www.24game.com/t-aboutus-casestudy.aspx. Accessed March 15, 2009.

aforementioned groups performed at a better level than the larger group. Small groups proved to be helpful during the game. The 24 Game has similar attributes to the smaller groups in the Kroesbergen study.

Students will be instructed initially about the rules of the game. The game ensues with little to no teacher support. The first example of the game has explicit strategies for reaching answers. With practice, students begin to develop their own methods of approaching answers. This game is rather constructivist in nature. In small groups, students of lower level may do well under explicit instruction. In the long term, the constructivist approach of solving 24 should emerge. Students who work under this approach become better problem solvers because they must devise their own strategies. Despite either instructional approach, it is beneficial for students to work in small groups when compared to large group instruction (Kroesbergen, 2004).

Decreasing anxiety

Math anxiety is a phenomenon which exists in some individuals who struggle in mathematics. Students who struggle in math have much activity in the area of the brain that stimulates aggression and resentment while completing mathematics problems. Far too often, these are the students who disengage from the work and engage in off task behaviors. Students move their focus to other activities not conducive to succeeding in the assignment (Begley, 2003). Introducing games into the curriculum gives students who struggle an outlet in which performance can enhance and attitude turns increasingly positive. Games foster an opportunity for fun for students (Naseef, 2009). Games tend to mask the volume of work some problems have because of their structure (Dukes, 1987). Games present material in an untraditional manner. Students can move beyond problem sets and workbook pages. The classroom dynamic

also changes when games are introduced (Gutman, 2006). The change in procedure may even be enough to motivate students. Students who have a natural inclination to compete thrive during games. Students who need more encouragement may receive it during game time. Two forces are thought to drive student success--motive and values. Strong students tend to have a high values motive which stems from parental influences. Lower level students, for various reasons, tend to need more of a motive drive for success. Games, which have a clear winner and positive reinforcements within, create high motives for success. Motive drives student success most often in students of high and low ability level (Biernat, 1989). Students in a New York City middle school needed little enticement to play a math game as long as it felt fun. The focus of the game is winning for a student. Teachers focus more on student understanding. Both populations receive satisfaction while the game is in progress (Hu, 2008).

Small groups

Small groups enhance the learning experience for all students. Games like the 24 Game create points of entry for any type of student. Summers suggests that when placed in homogenous groups during games, students can create supportive networks for one another. They are not divided on basis of skill. Students in this age range are very cognizant of their levels of expertise. Within the small group, students will be quite similar on ability level. In this way, they will feel comfortable with their challenges. Higher ability students do not share the same type of comparison. Lower level students who did not care about math felt no discomfort (Summers, 2003). It is in the best interest of lower level students who do care about performance to be clustered together.

Positive Environment

Low level students need more engagement due to internal and external hurdles to success. Games, when conducted properly as a class, can create a more positive classroom environment according to DeVries. Students in the study were clustered into groups over a period of twenty days. They were given a set of problems for EQUATIONS to work on collaboratively (in a similar fashion to 24). After days of working in teams within the classroom, lower level students reported feeling more supported in their groups. Tasks which seemed daunting individually seemed less intimidating. Peer tutoring occurred naturally. As a class, positive reinforcement and understanding increased. The class culture became more inviting as a result of playing the game. The repetitious nature of computing with various number combinations allowed students to gain in skill level during the duration of EQUATIONS (DeVries, 1973). The 24 Game has been acclaimed to do the same according to teacher feedback to the company's website. The trend in commentaries points to excitement and enthusiasm towards math. Teachers had to do little to motivate students. Teachers began clubs and tournament because of the momentum the game starts.[5]

SETTING AND PARTICIPANTS

Three sixth grade classes at MS 331 in the central Bronx will be the sample for this study. One of the classes is a collaborative team teaching (CTT) class, while the other two are general education classes. Within CTT 40% are classified special education and 60% are general education students. The incoming sixth graders scored much higher than the six grade students

[5] Suntex International. (2009)."Educators Speak, http://www.24game.com/t-aboutusEducators.aspx

have in three years. 78% are on grade level in math. The amount of remediation that the 24 Game is intended to provide is not as dire as previous years. These students are at a much higher level on average.

The sixth grade classes featured in this study are 601, 603, and 604. The three classes will practice at least two 24 Game problems in their homework each night. At least one day per week during the class, students will play the 24 Game as a group challenge question. The classes have a majority of students with level 3 scores on their NYS Math test from fifth grade. Of the classes, Class 603 has the highest percentage of level 3 and 4 students (90%) and homework turn-in. Class 604 has a higher number of level 2s (five students), while Class 601 has the highest number of IEPs (individualized education plans) (9). Classes 601 and 604 have moderate daily homework turn-in rates (above 60%). There are few students however who do not do homework at all. These students tend to be the lowest performing mathematics students in the class.

INTERVENTION

Each of the three sixth grade classes taught this year were eligible for the project. Student had been introduced to the 24 Game as an enrichment activity on Friday before the pre-assessment. The rules of the game had been explained and students were informed that the game would start appearing in their homework for more practice. Regular practice with the game came as a contingency of completing the homework. Historically homework turnover is strongest during the first semester at the school. At the end of each week a quick assessment took place to measure their ability to do complex chains of arithmetic correctly. These assessments occurred

four times for analysis.

The pre-assessment consisted of twenty fill-in the blank problems which formed five arithmetic strings. The length of this pre-assessment proved adequate to complete in one minute. This length assumes that on average one calculation takes three seconds. One increase in the number of accuracy lowers the time of completion by three seconds. Students should increase in accuracy and speed after immersion into the 24 Game.

Pop Super Skills Sheet (Pre-Assessment)

1. 4 + 6=_____ - 7 =_____x 5=_____- 12=_____

2. 12 x 3=_____ / 6=_____ + 3=_____ x 9=_____

3. 13 - 5=_____ x 2=_____- 6 = _____x 6=_____

4. 25 / 5= _____ + 9 =_____x 3=_____ - 4=_____

5. 12/ 4 = _____ + 7 = _____- 6= _____ x 8=_____

Students were tested on their arithmetic proficiency based on their performance on weekly assessments posted below. Students had been introduced to the format of the quiz prior to the quizzes being handed out. Students were given one minute to work on the quiz. Students had been instructed to stop writing upon the sound of the timer. Quizzes were not discussed following their completion. Students had no time to reflect on the problems because the beginning of the mini-lesson began directly afterwards. Each of these skills sheets assesses their

understanding from the week prior.

WEEK 1: Super Skills Sheet 2 October 27, 2009

1. 12 - 9= _____ x 5 = _____ + 10 =_____- 9 =_____

2. 5 x 12 = _____/ 15= _____- 13 =_____ + 7=_____

3. 17 + 4=_____x 3=_____ - 2= _____- 10 = _____

4. 9 x9= _____ + 5 =_____ - 6 =_____/ 10=_____

5. 10 - 6= _____x 20 =_____/ 5= _____- 9= _____

WEEK 2: Super Skills Scramble 3—Go!!!!!!!!!!!!!!!!!!!!!!!!

1. 4x5=_____- 3=_____+ 5=_____/ 11=_____
2. 13+ 5=_____/6=_____x 12=_____- 10=_____
3. 12x 4=_____/8=_____-4=_____x 20=_____
4. 5x 6=_____/ 10= _____x 15=_____-15=_____
5. 3+ 12=_____x 4=_____/6=_____x 9=_____

WEEK 3: Super Skills Sheet 4

1. 13- 8= _____ x5= _____- 6=_____ x2=_____
2. 10x10=_____/ 25=_____x4=_____-3=_____
3. 30/6=_____x 12=_____-20=_____+4=_____
4. 13+ 11=_____/8=_____x16=_____-8=_____
5. 12x3=_____x6=_____+3=_____/11=_____

Students had been told that these skills were just to measure their ability to perform basic mathematics operations needed to be successful in later units. They had also been informed that I

would be looking for a 24 Champion for every class. Their homework were going to help determine the rightful champion. Students did not know the correlation between the 24 Game on their homework and their performance on the assessments. Following the last assessment (WEEK 3), students were asked about their progress as a result of the assessments and the 24 game. Students labeled themselves from 1-4 depending on the four types of students: 1. I tried/mastered the 24 questions every homework, 2. I sometimes attempted the 24 Game questions, 3. I attempted the 24 Game questions, but did not show my work, and 4. I did not play the 24 Game on my homework. This conversation formed a framework to discuss the concept of malleable intelligence.

DATA COLLECTION

Week 1 24 Game Practice

Students began to see at least two 24 Game problems on their homework immediately on Monday. Homework turn out has been high this year for students. The addition of the 24 Game did not decrease or increase turnout. Nevertheless, many students believed the 24 Game questions were optional--like extra credit. Several patterns emerged during week 1 concerning the 24 Game. Many self-conscious students despite their state test level often wrote notes to me about how they could not reach a solution. They did not show their attempts on their homework as to keep their work organized. Other students attempted to solve the problems without ever getting 24 as an answer. Students who successfully got 24 showed their solutions very proudly. Students struggled with showing their work for problems they attempted but could not solve. This resulted in many incomplete 24 Game questions on their homework. To encourage students to show their work regardless of the correct solution, I announced how I would evaluate their

homework with the 24 Game attached to it. The 24 Game became a separate grade for students as chronicled the quality of their success with the game. Students who did not show work at all for the game received no credit. Students who showed effort in finding a solution received completion credit. This included those who did not quite understand that the purpose of the game was to always reach 24. These students created their own math problems and believed this satisfied the game rules. Students who solved at least one problem correctly every night received a mark of commendation on their paper. I informed students that we would be selecting the 24 champion for each class and this would be the method of selection. They had to be held accountable for trying the problems. This legitimized the game as a measurable part of the curriculum. The game had been played once more at the close of class on Friday to reinforce its rules. Participation hovered around 40% of those students who regularly turned in homework. Assessment Two reflects work done during Week One.

Week 2 24 Game Practice

The first post- assessment had been issued to the class on Monday. Students were informed that these were simply skills trackers for the class--not a personal grade to punish them. These questions modeled the level of problems they completed on their homework. The problems included a moderate level of single-digit and double-digit arithmetic:

The 24 Game questions continued to be part of the homework nightly. Students who had initially been reluctant in showing their attempts to solve the problems began to show more work. The solutions were valued just as good arithmetic practice even if 24 had not been reached. Students who understood the system of evaluation knew that a penalty existed only if

they did not show their work for the problems. Still, some students did not complete their 24 game problems after the standards-based homework questions ended. During week 2 of the 24 Game immersion students played the game as a review station on Thursday. Students also played the game at the close of class on Friday in groups for prizes. Participation in the game increased as students became more familiar with possible strategies. Homework participation rose to about 70% attempting/completing the problems nightly.

By this time students gained labels based on how often they attempted the problems. Four categories of students emerged: 1.Students who had gained mastery, 2. Students who completed the 24 Game problems regularly regardless of accuracy, 3. Students who did not show completion of 24 Game, but attempted the problems, and 4. Students who did not do homework or the 24 Game at all. Assessment Three reflects work done during Week 2.

Week 3 24 Game Practice

Students began the week curious about what students were ahead in the 24 Game competitions. The second post assessment took place under the same conditions as the assessments given the previous two weeks. This document took into account more two-digit computations than the first two sheets. The students had two weeks of 24 Game practice. The homework turnout for the week decreased, perhaps because of Election Day holiday. Students did not have to come to school. The flow of the week had been altered. The 24 Game did not have class time designated to it as the previous week allowed. Overall week three did not retain the level of intensity produced from the 24 Game being played in class. Students who typically played the game on their homework continued to play, while less motivated or capable students omitted the game from their assignment. Rather than omit unsuccessful strategies more students

showed these unsuccessful strategies as evidence of their thinking. Participation fell to about 50% attempting/completing the game. Assessment Four reflects work done during this week. Students had to self-assess their participation in the game by labeling themselves as one of the following: 1. I tried/mastered the 24 questions every homework, 2. I sometimes attempted the 24 Game questions, 3. I attempted the 24 Game questions, but did not show my work, and 4. I did not play the 24 Game on my homework. Students had been informed in previous weeks that they received credit simply for attempting the problems and not finding the correct solution.

RESULTS

Theoretically growth is measured by net gain over time. As students grow, the level of rigor also increases. The quiz averages should change and be considered as progress. For example, a student who averages seven questions correct on each quiz grows even if the net gain is zero. This occurs because the level of difficulty demands quicker, more challenging computations to occur. Any negative values indicate do not represent gain, but loss. These students did not meet the same level of mastery they met a previous week, albeit with more challenging computations. The minimum for growth with consistent improvement is zero.

Preliminary discoveries

This study intended to explore the possibility of the 24 Game increasing the arithmetic ability of sixth graders. The preliminary assessment showed that some sixth graders could compute simple computations within one minute (cpm). The one minute time proved suitable for students to show comfort using mental math with basic algorithms (5+12=_x 2=_). The class that calculated most accurately within the minute was class 603 (13. 68 cpm). Class 604 had the

lowest rate per minute (7.82 cpm). These scores correspond to their state test rankings as well. Class 604 scored the lowest, but their homework return does not reflect lower intellectual ability. 601 scored better than 604 (10.67cpm), but they struggle more with homework return during the first week. Students relied on their mental math and elementary strategies (i.e. showing grouping marks for division) during the pre-assessment.

After one week students were given a baseline assessment with minimal 24 Game exposure. These scores are lower than the preliminary assessment which emphasizes arithmetic needed for the Level 1 24 Game (basic one digit, few two-digit computations). Class 603 scored the highest on the first assessment after a week of 24 Game exposure with a class average of 9.89 correct calculations per minute. 603 followed in their score of 7.81 correct cpm. 601 attained a score of 7.15 correct cpm. One week after these students received another assessment of their arithmetic skills.

Description of 601 Growth

601 AVERAGE CALCULATIONS CORRECT PER MINUTE (cpm)

	WEEK ONE (EASY)	WEEK TWO (MEDIUM)	WEEK THREE (HARD)
AVERAGE	7.15	9.32	8.05

601 NET GAINS OVER THREE WEEKS(in cpm)

	WEEK 1-2	WEEK 2-3	WEEK 1-3
AVERAGE	2.31, N=25	-1.07, N= 23	1.8, N=21
PARTICIPANT	2.73, N=15	-.84, N=13	2.0, N=12
NON-PARTICIPANT	1.7, N- 10	-1.3, N=10	1.2, N=9

N=NUMBER OF STUDENTS

For growth to occur, the difference in each week of the study had to be positive or zero--Week one compares to Week 2, Week two compares to Week 3, and then week one compares to Week 3. The study began with twenty-five students present and twenty-three students in later weeks due to absences or lateness. 601 is a first period class, so these factors impacted the class statistics more heavily than 603 and 604.

After minimal exposure to the game in homework, the class scored a net gain of 2.31 cpm after one week of the game. Regular participants scored higher than average (2.73 cpm), whereas non-participants scored 1.7 cpm. Scores form Week2-Week3 dropped when the level of difficulty increased. During this week students also had their schedules interrupted by Election Day. The class average of -1.07 cpm indicates that students dropped their accuracy when the level of questioning increased. This drop also correlates to a decline in game participation on the homework responses. By the end of the study and three weeks of 24 Game immersions, students had a total gain of 1.8 cpm responses correct per minute. Participants had a higher rate of accuracy than the average, 2.0 cpm, while non-participants had 1.2 cpm correct. Participants performed 40% higher than non-participants over the study period.

Description of 603 Growth

603 AVERAGE CALCULATIONS CORRECT PER MINUTE

	WEEK ONE (EASY)	WEEK TWO (MEDIUM)	WEEK THREE (HARD)
AVERAGE	9.89	13.66	13.31

603 NET GAINS OVER THREE WEEKS

	WEEK 1-2	WEEK 2-3	WEEK 1-3
AVERAGE	4.10, N=29	-1.72, N= 29	2.36, N=28
PARTICIPANT	4.17, N=24	-.1.38, N=24	2.5, N=23
NON-PARTICIPANT	3.8, N=5	-3.4, N=5	.40, N=5

N=NUMBER OF STUDENTS

603 began with a higher rate of accuracy after the first week of the 24 Game than 601 (9.89 cpm vs. 7.15 cpm). The class improved greatly after the second week of their quizzes. Week three showed a subtle decline in their scores. The class showed significant gains over the course of the study. They also had the highest rate of participation, 86%. From Week 1-2 participants scored close to the class average (4.17 cpm vs. 4.10cpm), whereas non-participants scored 7.3% lower. The class experienced a drop in accuracy when the rigor of the quizzes increased. The participants did better than average, but the non-participants did twice as poorly as the average (-1.72 cpm vs. -3.4 cpm). By the third week participants showed greater improvement than non-participants. The gains for participants were 525% greater than non-participants (2.5 vs. 0.4). The gains for 603 are comparable to 601, 2.36 cpm to 1.8 cpm.

Description of 604 Growth

604 AVERAGE CALCULATIONS CORRECT PER MINUTE

	WEEK ONE (EASY)	WEEK TWO (MEDIUM)	WEEK THREE (HARD)
AVERAGE	7.82	10.72	9.19

604 NET GAINS OVER THREE WEEKS

	WEEK 1-2	WEEK 2-3	WEEK 1-3

AVERAGE	3.07, N=26	-1.48, N=25	1.27, N=25
PARTICIPANT	3.4, N=17	-1.19, N= 16	2.29, N=16
NON-PARTICIPANT	1.78, N=9	-1, N=9	-0.67, N=9

N=NUMBER OF STUDENTS

604 scored similarly to 601 in their assessment score trends. Both of these classes have a similar level of students in them which struggle in mathematics. Like both classes, students failed to grow from Week 2 to Week 3. At this time the classes had 24 Game problems which went from level 2 to level 3 problems. Students struggled to make a consistent progress. Overall, students grew from the beginning of the study to the end of the study with a subtle increase in accuracy, 1.27 cpm.

The progress of 604 participants and non-participants mirrors the results of two previous classes. In a majority of cases participants scored higher than non-participants. They had more practice on their homework. Scores for participants were 47.6% higher than those who did not practice much their first week (3.07cpm v 1.78 cpm). The following week showed an interesting progression--the class dropped in progress from level 2 problems to level 3 problems. Participants did not outscore non-participants. Some participants scored surprisingly lower than anticipated. The overall growth from the easiest to the hardest problems showed that the class was able to 1.27 calculations more than they could three weeks ago even as the level increased. Participants scored over 400% higher than non-participants. Non-participants could not keep up with the cognitive demand of the level 3 problems. Their rate of progress should have a least been zero to show a progression in accuracy and challenge level.

CONCLUSION

The 24 Game increased the accuracy of arithmetic skills among three sixth grade class (n=84 students). The students practiced the game on their homework the majority of the time. Students also experienced the game in a group setting during the instructional period. Students of all ability levels experienced improvement. The study found that participants received the highest rates of improvements, but non-participants improved over the course of the study as well. They too experienced exposure to the problem-solving skills and arithmetic practice during class. During the instructional period students worked as a team and independently to solve 24 Game problems. The improvements made by the students will help them significantly with solving equations and algebraic expressions. The problem-solving skills gained will help their persistence in finding unknown solutions to future problems.

Using homework as a practice tool produced great results for students who regularly completed homework. For students who struggle to complete homework, the 24 Game had little opportunity to impact their computational skills and problem-solving ability. Traditionally, the 6^{th} grade homework turn-out correlated to their comprehension of material. This is not the case for the 2009-2010 school year; students receive credit for completion, not mastery. Using class time would have controlled the amount of exposure to the game, but the length of class limits this possibility. The enthusiasm in the classroom and risk-taking seemed to diminish somewhat when the game appeared on the homework assignments. Students had previously worked on the game in groups or in a competitive atmosphere. Seemingly confident, intelligent students buckled when completing some of the 24 Game problems outside of the classroom. Conversely, some students who would be more reserved in their sharing of strategies felt comfortable doing

the problems for homework. The atmosphere in which students complete the game may influence their motivations for completing the problems.

After the end of the study, I asked students if they felt that they were getting better each week after taking the assessments. Many of them remembered their progress from the week prior and noted an increase in number completed. I then revealed to them that the 24 Game had been used to help them improve each week. Those who practiced the game the most had the higher scores on the assessment each week. This led to a discussion on malleable intelligence, the belief that practice builds the stronger and quicker minds. The key to the 24 Game is practice, not inherent talent. A higher level student can work on finding several solutions and a lower level student can master basic facts when finding solutions. All students have the ability to improve no matter where they start. Each student benefits from the 24 Game's development of classroom culture based on malleable intelligence.

The 24 Game is part of the reformist perspective of education. Instead of teaching students procedures without connections, students learn through alternative methods. Teachers need further instruction in developing inquiry based activities. The 24 Game involves inquiry without much preparation. Other games allow students to explore different approaches to problem solving. The problem solving aspect of games inevitably increases students' persistence through challenging problems. Stamina and persistence in the math classroom has to be developed. Teachers must take this slowly. The 24 Game should help to raise student achievement, yet mastery of the game is not the larger goal. The larger goals of the game should allow students to feel like successful problem solvers. Playing games increases confidence. Since the 24 Game has several levels, students should find success at a variety of entry points.

Teachers may differentiate quite rapidly.

Games bring positive attributes to classrooms. This study quantifies the gains made by students after continually playing the 24 Game. Its impact on subsequent mathematics standards this year is unknown. The task becomes integrating games into a curriculum structured around the state test. To overcome this structure teachers have to properly map out when games are appropriate or even more favorable than traditional methods. Teachers can assess content that needs revisiting on a weekly basis. If teachers regularly identify misconceptions it is very possible to dedicate one day during the week for reinforcement/enrichment games. To properly carry out games it is imperative to have proper procedures set for games. Students need parameters for interaction to diminish the time taken out for management. The focal point of the teacher should not be discipline, but rather facilitation.

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