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The Effects of Drama on the Performance of at-Risk Elementary Math Students

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ABSTRACT

A sample of 26 at-risk fourth graders was randomly divided into experimental and control groups. The experimental group was taught geometry concepts using drama, while the control group received more traditional instruction. Fifty minute lessons per day were given for one week. Then, a multiple choice test to assess academic achievement was administered along with a Likert survey to assess interest and attitude towards math. A significant difference was found between the academic achievement of experimental and control groups. No difference was found in the interest and attitude toward math between experimental and control groups. Finally, no significant relationship was found between academic achievement and interest and attitude towards math. These results imply that drama can be an effective teaching tool but may be more beneficial over a longer time to students whose learning style best appeals to such instruction.

Review of the Literature

For many years, educators have varied in their definition of students considered to be “at-risk”. Some educators have considered at-risk students to be minorities or those living with one parent and statistically perceived to be low academic performers. Other definitions have included students who were already poor performers academically, failing to receive the proper monitoring and intervention from teachers in standard school programs. At-risk students have also been defined as students who are negatively impacted by characteristics of a school, such as inflexible schedules and narrow curricula (Hixson & Tinsmann, 1990). All of these definitions and factors in and of themselves have limitations. According to Hixson and Tinsmann, the degree to which a child is at-risk is a function of inadequacies in one or more of these above defined areas not compensated for in the others.

Over years of practice, researchers and educators alike have agreed that at-risk students show the greatest improvement from instruction emphasizing less repetitive drilling of skills and more innovative methods of learning including higher order thinking skills and cognitive reasoning (Knapp, Shields & Turnball, 1995). A case study by Baxter and Woodward in 1997 demonstrated that at-risk students in mathematics showed a modest improvement in performance on standardized tests after a year long involvement in a classroom characterized by an innovative instructional method focused on conceptual problem solving and utilization of math games rather than traditional computational practice. The researchers speculated that with more specialized instruction in the innovative approach, such as by having additional teachers in the classroom, poor

performing math students could realize even greater improvement in their math scores (Baxter & Woodward, 1997).

All innovative instruction involves using a “thinking curriculum” in which students “acquire content as they plan, evaluate, solve problems, make decisions, construct or critique arguments, compose essays, and so on.” The curriculum involves a holistic approach to learning and teaches students how to complete meaningful complex tasks in increasingly challenging environments. It inherently encourages students to take a more active role in the learning process (Finnemore & Tinzmann, 1990). Furthermore, schools are encouraged to provide all students, including those at-risk, with as many diverse activities as possible in order to experience success in learning. Arts activities integrated into learning units allow students who are expressive to show other students that they can do some activities well (Costello, 1996). For years, arts educators have claimed that art forms, such as drama, could be used to help children learn to read, write, calculate and understand scientific concepts (Hetland & Winner, 2001).

Defined in educational terms, drama is involving students in improvised roles within an imagined context to help create awareness or understanding of an idea. The goal is that learning emerges through the process of developing and improvising skits and sketches. Students think about ideas through role-playing them and are better able to understand their thought processes once they step out of the role (Andersen, 2002). Heining stated that drama has been used extensively in the language arts classroom to enhance children’s development in oral communication, reading and writing (as cited in Tatar, 2002). It has also been used frequently to help students learn social studies lessons and develop social skills inside and outside the classroom (Martin, 1993). Author and

teacher Mark Whal has demonstrated great success in getting children to remember math concepts such as number relationships and addition facts by communicating through drama (Wahl, 2002). The research suggests then that drama techniques could be used as an innovative way of helping some at-risk math students successfully learn mathematical concepts.

Why Drama Works

Drama can be an important tool for teaching. It was Dorothy Heathcote, the "world's pre-eminent classroom drama expert" (Catterall, 2002) who first stated that drama is a powerful and effective method of teaching instruction because it helps connect ideas of learning to real life situations. Drama also helps engage students in meaningful communication and provides the interaction they need to effectively internalize new knowledge (McMaster, 1998). According to Smith, as cited in McMaster, 1998, drama is effective because it is based on the premise that "an involved child is an interested child, an interested child will learn, and drama directly involves the child" (p.574).

Gardner (2003) suggests that drama is effective because it is one way of tapping into the different intelligences that students possess to help them learn and realize success in academia as well as life. In his Multiple Intelligences Theory, he proposes that each person's intelligence is made up of not one but several independent and autonomous modes of learning that can work alone or with each other to develop knowledge and process ideas. One of the eight basic areas of intelligences that he identifies is that of the bodily-kinesthetic intelligence or "body-smart" intelligence which relies on learning by doing. Drama and role playing fit into this realm of learning. Drama is also an effective means of utilizing one's intrapersonal and interpersonal intelligences which deal with

how individuals understand the way they think, act and interact in different situations. Gardner claims then that incorporating art forms such as drama into curriculum instruction is highly effective because it helps reach the students who are weak in linguistic and logical-mathematical intelligences, those most commonly associated with the focus of most schools (Armstrong, 2000). Gardner's theory provides a foundational incentive therefore for teachers to incorporate and experiment with multiple pathways of instruction in order to help students understand concepts in their most effective way. Because each individual possesses all the different forms of intelligence in one way or another, teaching with methods that emphasize the stronger intelligences may help to strengthen the other areas that are weak (Multiple Intelligence Theory, [on-line]).

Despite its strong association with and support of the multiple ways in which students learn, teachers sometimes avoid using drama because they fear it will involve too much preparation time (McMaster, 1998). However, studies have shown that drama can have a positive effect on multiple areas of learning.

Innovative Approaches to Teaching Mathematics

Because logical, sequential thought is so firmly associated with mathematics and thus firmly entrenched in most curriculum (Tales as Tools, 1994), it does not seem like an area where drama could have a significant impact. However, the traditional approach to teaching mathematics continues to be ineffective for many students and therefore remains an area where experimentation is needed to determine the best practices for learning. Greenwood asserts that one of the primary reasons students fail to achieve success in mathematics is that they are traumatized by the traditional teaching styles that

require too much formula and rule memorization as well as intense drilling and practice of these formulas and rules (as cited in Ozel & Ufuktepe, 2002). The National Council of Teachers of Mathematics Standards articulates that the most important goals for any student in learning mathematics is in terms of process and attitude rather than grasping specific content or basic skills. In other words, students need to learn how to work out math problems, value them and gain confidence in their ability to do mathematics (Borasi & Siegel, 2000). Different approaches have been taken to foster these goals in light of the ideas established by Gardner and others in the way students learn. For example, Borasi and Siegel (2000) conducted research to evaluate the effects of integrating reading with mathematics. They created the "Reading to Learn Mathematics for Critical Thinking" project to specifically look at how reading mathematically rich texts such as essays, articles and stories about the subject could help students learn and retain ideas by seeing how specific concepts and techniques were used in the real world, how professional mathematicians solve problems and how the answers they encountered frequently in textbooks actually came about. Through a variety of reading strategies that encouraged students to draw and represent their own interpretations of text and to socially interact and discuss the texts they were reading, Borasi and Siegel found that students came to a better understanding of mathematics as a practical discipline in the real world, developed a better attitude towards it and formulated a better understanding of specific mathematical concepts and content. Furthermore, they stated that reading these texts embodied talking, writing, drawing and engaging in mathematical activities that enacted the text.

Storytelling has also shown to be an innovative and effective method of teaching mathematics. One of students' most powerful skills is that of imagination and stories and

story telling taps into that power by way of engaging students and encouraging them to use creativity to reason through and understand difficult concepts (Tales as Tools, 1994). In one first grade classroom, a teacher helped her students understand addition and subtraction by getting them to relay tales of the reasons why certain fish or other animals would visit a polar bear floating on an iceberg. In a higher education classroom, a teacher used stories of mythology to help students understand statistical problems. This teacher reasoned that storytelling is effective because it allowed him to share with students certain symbols such as myths that everyone could understand. It also placed unfamiliar concepts in a more familiar setting. Whether it is preschool math students or undergraduate math majors, Nash concludes that stories are always effective at both highlighting important concepts as well as maintaining interest level among students (Nash, 1993).

Drama and Mathematics

Often, story telling is used as the framework for building drama into a math lesson. Armstrong (1994) used both techniques to help a group of first grade students learn the concept of time. He began by telling the students a story about a fictional land that had no time and how everyone in the town was constantly confused because they were always missing appointments. Adventurers journeyed to a place called the “Land of Time” and met an Irish family with 12 children named O’Clock. Twice a day, each child would stand high on a hill and chant out the hour of the day he or she was named for. The O’Clock family moved to the land with no time to live on a hill in that land and become the citizens’ new reference point for telling time. At this point in his story, Armstrong

shifted to using drama as the students in the classroom took on the roles of the different O'Clock children who each had one big hand and one little hand. The students acted out the position of a particular time of day on a big five foot high plywood clock face and sang a cute rhythm while the other students danced to the tune of "Rock Around the Clock". From this dramatization of telling time, the students were able to return to their desks and easily draw out a clock showing different times of day. Armstrong's use of drama worked because he effectively utilized the bodily-kinesthetic as well as interpersonal and intrapersonal intelligences discussed earlier to ultimately help these students understand the concepts. Wahl (2001-2002) believes tapping into these intelligences is the key element that makes drama so effective in teaching mathematics.

When teaching a lesson on addition facts for example, Wahl would get students to think of 10 as the "ruler" or "king" of a place called Numberland. He would invite the students to explore this land so they could discover that most whole numbers living there have the characteristic of their ruler 10 in someway. Examples he would use would be numbers such as sixty being "six tens" or sixteen being "six and ten". He would then use such dialogue as the following to help students connect ten's importance to the addition and subtraction of numbers.

> Then how does 9 feel? (*Almost* important.) We could describe 9 as "Hungry for 1." So when it meets 7 it says "How would you like to hang around with a ten?" The 7 says "Wow! Of course!" The 9 says "You only have to make one sacrifice. You must give up one and be a 6." The 6 says "It's worth it" and hands over 1, and together they are six-teen (six and ten). The moral of this story is that when 9

meets any number in Addition Land (even 47) it asks for one and becomes a ten. [on-line]

Thus, by thinking about adventurous places such as Numberland, Addition Land or Multiplication Land or learning to use metaphors and connections such as positive and negative numbers possessing moods and emotions when something happens to them, children are given a creative way to learn math concepts.

A very effective approach at using drama to teach math was created by Ozel & Ufektepe (2002) when they developed an interactive musical and dramatic presentation called “Math Show” to help students remove traumatic feelings about learning math and to show teachers that abstract mathematical concepts can be better grasped by many students when presented using drama, music and concrete applications. During the one and one half hour production, students were guided dramatically by famous math historians through activities characterized by social interaction and creative expression of a variety of math concepts. The show targeted all different learning styles. The aim of the show was to get students to understand individual problem solving strategies and collective thinking. A sample of 500 students was surveyed from the population of 10,000 students who attended the show between October 1998 and June 2001. 80% of the students surveyed indicated a desire for their math classes to be similar to the Math Show and 90% indicated that mathematics can be fun when taught in a non-traditional format. Ozel & Ufektepe ultimately concluded that a broader and more varied approach to teaching mathematics can increase students’ interest and attentiveness during lessons and

that dramatizing or setting concepts to music can facilitate better internalization of those concepts.

Conclusion

In summary, research has shown that drama can be an effective tool in strengthening students' abilities in verbal and language development, social studies, social skills and mathematics. It works primarily because of the many ways in which students process information and learn. For at-risk students, drama's power is especially appealing for students and teachers alike. Recent policies such as No Child Left Behind (NCLB) have continued to encourage the inclusion of academically at-risk students in heterogeneous classroom environments so that assessment of achievement can be equally provided to all students (NCLB, [on-line]). This has made it especially crucial for teachers to use methods and structures that will be effective with students possessing diverse styles of learning. According to Sheinbach (1996), math education in particular should encompass instruction that combines visual, auditory and kinesthetic modalities, use concrete representations of math concepts and involve games and mnemonic devices to aid in memory tasks for solving problems. Quite often, it is because of these unique learning styles that students with learning disabilities or weaker math backgrounds often devise creative non-standard solutions to problems simply because they do not remember the standard taught procedure. Students need to be given the opportunities to discover their learning styles and be encouraged to apply them in the mathematics classroom (Borasi, 1996). The research is clear that in all academic areas including mathematics, drama can be an efficient strategy of achieving this important goal of helping at-risk

students succeed in mathematics and develop a greater interest and enjoyment of the subject. The purpose of this research is to explore the hypotheses that drama has an effect upon the academic performance of at-risk math students as well as their attitude and interest in learning mathematics.

Methodology and Procedures

The purpose of this study was to determine the effects of using drama to teach or reinforce math concepts to a group of at-risk elementary math students. The study was also conducted to determine if using drama to teach math had a positive effect on the students' attitude and interest in learning mathematics.

The population for this study was a Title I elementary school in a mid-size Northeast Tennessee city. Of the 359 students in the school, 84.4% were white, 7.8% were Hispanic, 6.7% were black, and 1.1% were Asian. The school contained 184 males and 175 females. 50.6% were considered to be economically disadvantaged.

The sample of this study consisted of a fourth grade class in the school. The total number of students participating in the study was 26. Of the 26 students, 14 were female and 12 were male. The sample was 80.8% white, 7.7% black , 7.7% Asian and 3.9% Hispanic. Thirteen students were randomly assigned to the experimental group, and thirteen were randomly assigned to the control group. In the experimental group, 11 of the students were white, 1 was black, 1 was Hispanic and 0 were Asian. In the control group, 10 of the students were white, 1 was black, 2 were Asian, and 0 were Hispanic. There were 7 boys and 6 girls in the experimental group, and 5 boys and 8 girls in the control group.

One of the instruments used to collect data was a multiple choice test designed by the Harcourt School Publishers in conjunction with the Tennessee math standards for fourth grade. The test consisted of 20 questions dealing with concepts in the categories of

measurement and geometry. The test was considered reliable because it was consistent in the structure of its questions and what information it desired from the students. The test was considered valid because the types of problems were indicative of the measurement and geometry concepts taught or reinforced during the experimental lessons.

The second data collection instrument was a questionnaire given to the students before and after the experiment to assess their interest and attitude towards mathematics and how a particular teaching style would influence it. The questionnaire was modified from one administered by Ozal & Ufuktepe (2002) to students after their participation in their math show. The pretest questions were disguised in a general interest survey administered to the students prior to the beginning of the experiment.

Procedures

Before conducting this study, permission was granted from the school principal and the director of schools. The next step was to compose a letter to the parents informing them of the research project that their students would be involved with.

Prior to the beginning of the experiment, all of the students in the sample took the general interest survey imbedded with the four target questions regarding attitude and interest in mathematics. The students were then randomly assigned to two groups. The experimental group received math lessons in geometry and measurement using specialized instruction in drama and kinesthetic movement. Homework assignments revolved around this specialized instruction as well. Simultaneously, the control group was taught the same concepts using a more traditional method of instruction involving more rote paper and pencil assignments. At the end of the week's instruction, both groups

were administered the same post-test. Each student in each group also completed the questionnaire consisting only of the four math interest survey questions.

The lessons covered the concepts of points, lines, rays and angles and how to measure the distance traveled from one location to another when shown on a grid. The duration of each day's lesson was 50 minutes with approximately 15 minutes of homework each evening.

Results

Research Questions

Three research questions were used to guide the analysis of data.

Research Question #1

Is there a difference in the academic performance of at-risk elementary students taught math using drama and those taught by traditional techniques?

Research Question #2

Is there a difference in the change in attitude and interest in math of at-risk students as a result of the particular instructional method given?

Research Question #3

Is there a relationship between the academic performance of at-risk elementary students and their attitude and interest in learning mathematics?

Each research question was followed by a research hypothesis. Research questions 1 and 2 were analyzed using t-test for independent means. Question 3 was analyzed using Pearson Product Moment Correlation.

The results for question one indicated a significant difference between the experiment and control groups ($t(18.94) = 3.293$, $P = .004$). The results are displayed in Table 1.

Table 1

T-test for Independent Means for Experimental and Control Groups on Academic Achievement

Group	M	SD	df	t	Sig. (2tailed)
Experimental group	80.00	14.142	18.24	3.293	.004*
Control group	94.62	7.489			

Note *p < .05

The results for research question 3 and 4 indicated no significant difference and relationship respectively. The null hypotheses were retained.

Discussion

In regard to the research hypothesis of whether or not drama had an effect on the academic performance of at-risk elementary students in math, the results indicated that there was a significant difference in the two groups taught by the differing methods. The mean test score for the experimental group was 80.00 while that of the control group was 94.62. Therefore, the null hypothesis was rejected. However, the mean scores indicated that the experimental group receiving instruction using drama performed significantly lower on the final test compared to the control group who received instruction by traditional teaching methods. This result was contradictory to that suggested by the literature. The lessons taught to the experimental group utilized lots of kinesthetic movement as well as creative mnemonic devices to help the students learn and recall the characteristics of lines, rays, and angles. Both Armstrong (1996) and Wahl (2001-2002) would suggest, based on their research and experience, that the experimental group should have scored much higher on their test or demonstrated a better understanding of the concepts because of the utilization of such devices. The researcher feels that one factor contributing to this discrepancy was that the geometric concepts taught were more visual mathematically and less process and problem solving in nature. The control group may have faired better because they were given more opportunities throughout the unit of instruction to actually draw and identify the figures rather than try and relate to them dramatically or symbolically. The results suggest that geometry concepts might not be an area of mathematics that lends itself to as much nervousness in learning or achieving at math as other areas involving a lot of process steps or rote memorization (as cited in Ozal & Ufuktepe, 2002). The researcher does feel however that had the students been given

more time to learn additional concepts by use of dramatic techniques, they may have demonstrated better success academically. In Baxter and Woodward's 1997 study, the performance of at-risk students improved after a full one year involvement in an innovative math classroom (Baxter & Woodward, 1997).

In regard to the second research question concerning changes in attitude and interest in learning mathematics as a result of a particular teaching technique, the results indicated that there was not a significant difference between the two groups. The mean Likert score for the experimental group at 13.00 was higher than that of the control group at 12.62, but this was not enough difference to make the results significant. Therefore, the null hypothesis was retained. Though 90% of the sample of students surveyed that attended Ozal & Ufuktepe's math show indicated an improved interest and attitude towards math if innovative music and drama were a part of their math lessons (Ozal & Ufuktepe, 2001-2002), the students in the experimental group of this research did not indicate any significant change in attitude or interest at the end of the unit of instruction. Much like the case with research question number one, the researcher feels that had the students had a longer period of exposure to instruction over several weeks time, the results may have been different. The researcher also feels that the lack of difference in attitude and interest was related in great part to the particular learning style of the student rather than the instruction that a particular group received. Those students in the experimental group who enjoyed the drama methods taught to them likely saw math as a more fun and enjoyable subject to learn. The researcher observed that during the course of the research, several of the students lacked motivation when asked to participate in many of the drama activities taught. The researcher feels that for these students, the

drama may not have been a good fit for their particular learning style. This observation was in agreement with Hetland and Winner who found that students first needed to find success in an artistic technique such as drama itself before experiencing success in a more academic subject (Hetland & Winner, 2001). Therefore, the students needed to first feel successful attempting a dramatic assignment or activity or feeling confident in its execution before they would even be able to make the connection between the dramatic activity and the math concept it was attempting to teach. This would seem to indicate that it might be best to first identify the various learning styles of each student and refocus the research on using dramatic techniques with those students who best learn by means such as kinesthetic movement where drama best relates.

In regard to the third research question of whether or not there was a relationship between the academic performance of at-risk students and their attitude and interest in learning mathematics, the results indicated that there was not a significant relationship between the two. Therefore, the null hypothesis was retained. The Pearson Product Correlation for this analysis was $r = .228$ resulting in an r^2 value of 0.052 or 5.2%. This indicates that the students' academic performance in math is only slightly affected by their attitude and interest in learning math. Almost 95% of the academic performance of the students could be attributed to something else. The results however were commensurate with the literature. Though the research suggests that innovative teaching methods incorporating techniques such as drama, storytelling, and kinesthetic movement can lead to an increased interest and attentiveness during lessons and ultimately facilitate a better internalization of the concepts (Ozal & Ufuktepe, 2001-2002), there is no guarantee that the students will ultimately perform better academically. One of the

reasons this research was conducted in the area of math was that the review of the literature demonstrated the positive effects drama has had on the academic success of students in other disciplines. The researcher wanted to see if drama could have a similar positive effect in math performance. Much like with the first two research questions, the researcher feels that a longer period of instruction might have yielded more significant results.

Conclusions

In conclusion, this research was conducted to explore the effects of drama on the performance of at-risk elementary students in math. This study found that there was a significant difference in the academic performance of students who learned math by means of dramatic teaching methods and those that did not. However, the resulting difference was contrary to that predicted based on the literature review. The results of the study also found that the particular teaching technique did not significantly change the attitude or interest in learning mathematics. Finally, the study found no significant relationship between the academic performance of the students and their attitude and interest in learning math regardless of the technique taught.

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