EFFECTS OF USING CREATIVE PROBLEM SOLVING IN EIGHTH GRADE TECHNOLOGY EDUCATION CLASS AT HOPKINS NORTH JUNIOR HIGH SCHOOL

By

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ABSTRACT

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The purpose of this quasi-experimental study was to determine whether the number of creative responses would improve if junior high students were exposed to creative problem solving instructions on a daily basis. The hypotheses of this study were that there is no significant difference in both the quantity and variety of creative responses from students that receive 15 mini lessons in creative problem solving techniques.

The subjects of this research were 50 eighth grade Technology Education students at Hopkins North Junior High, Hopkins, Minnesota during the third term of the 1998 – 1999 school year. The pretest and posttest instruments were simply pieces of paper with spaces for 40 monograms. During the pretest students were asked to draw as many potential monograms using the initials for the high school as possible in 5 minutes. The posttest asked students to draw as many potential monograms using the initials for the junior high school as they could draw in 5 minutes. The students in the treatment group received a series of 10 mini lessons on creative problem solving techniques that were approximately 5 minutes in duration. Both the pretests and the posttests were analyzed in terms of the number of monograms generated as well as the variety of monograms produced by the students in the treatment and control groups.

The result of the study showed a significant increase in the number of monograms produced by students in the treatment group in comparison to those produced by the students in the control group. However, there was no evidence of a significant difference in the variety of their monograms produced by the treatment and the control groups.

While the variety of responses was similar in both groups, the number of responses did increase in the group receiving treatment. Therefore, one of the conclusions of the study was that the mini lessons were effective in increasing the number of monograms produced. Furthermore, the lack of gains made in terms of the variety of monograms generated suggests students need richer lessons in creative problem solving techniques with more opportunities for practice and application.

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CHAPTER I

Introduction

Context of the problem

Creative problem solving skills are important to business and industry. A common complaint is that our college graduates are too helpless when called upon to solve a problem where new paths are demanded (Guilford, 1987, p. 42). General Mills, Kodak, United Parcel Service, AT&T, and many other companies recognize the importance and value of their employees gaining skills in creative problem solving. Twice a year, General Mills offers courses in Creative Problem Solving for managers and product design teams, and management encourages a work environment in which creativity can flourish. The Minneapolis Chamber of Commerce is encouraging schools to prepare the upcoming workforce to seek creative solutions for everyday problems.

Students encounter problems everyday. How will I get my homework done? How will I get home from practice? I really want that new, blue 18-speed all terrain mountain bike, how can I get it? While the problems may seem dissimilar, a creative approach to solving each of these problems can lead to unexpected results. Students need the tools and skills to become deliberately more creative. Creative problem solving skills can be taught.

Critical thinking skills are a higher order skill involving the synthesis of information and thought. Richard Paul (1992) defines critical thinking as "thinking about your thinking while you're thinking in order to make your thinking better." For students to be prepared for the world they live in, it is imperative they leave school capable of reasoning and of understanding the importance of disciplined thinking.

Critical thinking is the integration of many skills and abilities such as communication, problem solving, creative thinking, and collaborative learning, as well as others (Paul, 1992). These skills are necessary in both the school realm and the world of work. In order to ensure the development of critical thinking skills, the building blocks need to be in place. Education usually uses the problem solving approach to introduce students to the thought processes necessary to arrive at a solution. These thought processes include identifying the problem, gathering information about the problem, generating potential solutions to the problem and developing and testing the optimal solution to the problem.

Many subject areas use problem-solving techniques in order to encourage thinking and learning. Students build upon previous learning; therefore, new knowledge or thought patterns must be attached to that which is already known.

> Problem solving is a critical process skill that involves virtually all aspects of existence. It is clear that problems of various types exist and that not all problems are technological. Problem solving has been identified and promoted by many disciplines including mathematics, psychology, the physical sciences, the arts and more. In different contexts, and in unique ways, all employ the problem solving process (Wu, Custer, Dyrenfurth, 1996, p.37).

McCade (1990) believes "problem solving ability is a key factor in creating an independent learner" (p.49). While many subject areas use problem solving, technology education, by design, implements the problem-solving model throughout the coursework.

According to the Technology for All Americans (International Technology Education Association, 1996), technology education programs assist students in learning about the processes that apply to design and problem solving. The founder of Odyssey of the Mind, and technology education teacher, Samuel Micklus (1990, p.12) comments, "the best way to develop creative thinking skills is to participate in problem solving activities." Roger Firestien (1997, p. 4) goes a step farther and asserts, "creative problem solving is based upon the belief that all people are creative, that creativity skills can be taught, and everyone can learn to problem solve better." J. P. Guilford (1987) long ago linked the two activities when he stated the following.

> Problem solving and creative thinking are closely related. The very definitions of those two activities show logical connections. Creative thinking produces novel outcomes, and problem solving involves producing a new response to a new situation, which is a novel outcome. (p. 38)

Technology education courses very often use a design brief to identify the problem. The brief then directs the student to move through problem solving steps to achieve a solution. Hopkins North Junior High in Minnetonka, Minnesota uses this approach as well.

Then why teach a creative approach to problem solving? Roger von Oech (1983, p. 22) suggests, "the more often you do something in the same way, the more difficult it is to think about doing it any other way." Roger Firestien (1997, p. 4) states that by "being overt about the process of coming up with creative ideas and applying them to problems you will get innovative solutions. How will being overt about teaching creative problem solving yield results?”

Statement of the Problem

Given the fast pace of technological development in our global economy, business and industry needs creative problem solvers to remain competitive. Public education is being asked to play an important role in preparing young people for the challenges of the work place by providing its students with creative problem solving skills. One potential strategy for developing these skills is to engage students in a series of mini lessons on creative thinking strategies over a period of several weeks. However, the effectiveness of such an approach has not been established. Therefore the purpose of this study was to determine if the number of creative responses would improve if students were exposed to creative problem solving techniques on a daily basis.

Research Design

The creative responses were measured by administering a pretest at the beginning of the school term and a posttest at the end of the six-week term. The subjects in this investigation were eighth grade, technology education students in the third term, winter 1999, at Hopkins North Junior High School in Minnetonka, Minnesota. Students were randomly assigned to the class by the scheduler. One class, as the control group, took the pretest at the beginning of the term and the posttest at the end of the term, as required by the instructor. The other class, as the experimental group also took the pretest. The experimental group participated in a daily five-minute activity on creative thinking as part of their regular class. At the end of the six-week term, the posttest was administered to the experimental group. Each group consisted of approximately 30 students. Results were compared based on the number of responses and variety of creative responses on the posttest.

Hypotheses

The specific hypotheses that this research sought to test were:

1. There will be no significant difference in the number of creative responses from students who received 15 mini lessons on creative problem solving techniques and those who did not.

2. There will be no significant difference in the variety of creative responses from students who received 15 mini lessons on creative problem solving techniques and those who did not.

Purpose of the Study

The purpose of this study was to determine whether the number of creative responses would improve if junior high students were exposed to creative problem solving mini lessons on a daily basis. While this sample is small, the results may lead to further investigation into including creative problem solving in the classroom. This is important because the business community contends these skills are important and that recent graduates do not possess these skills.

Justification for this research was underscored by the implementation of the Technology for All Americans Standards. As districts and states look at the standards, the ability to show positive results adds to the support these standards garner. The ability to show that instruction within technology education courses prepares students with skills valued by business and industry recognizes that schools can respond to current student needs.

The amount of research in the field of technology education is extremely limited. Technology education provides students with important life skills. As a discipline, research is necessary to show the importance and significance of technology education.

Significance of Study

The significance of this study was to provide teachers at North Junior High School with support for including creative problem solving instruction in their curriculum. Guilford (1987, p. 42) asserts, "…even more important than drill in thinking exercises is the step of imparting knowledge of the nature of creative thinking." Rather than drill, teachers may begin to explain their thought processes and encourage creative thinking.

Secondly, the results of this study can be used to instruct students in the creative problem solving skills necessary for the workforce. According to Mumford and Simonton (1997, p. 26), "the conditions confronting organizations place a premium on creativity and innovation, one cannot expect that simply acknowledging the need for creativity and innovation will necessarily result in a sudden burst of new ideas." With this in mind, it is critical to take time to improve student skills for creative problem solving. The information gathered was shared with school colleagues and parents in appropriate forums.

Limitations of the Study

The limitations of the study were as follows:

1. The instrument was not a standardized test, and therefore would have only local significance.

2. Students were assigned to the class by the scheduler. Students were not tracked according to academics, although band and choir offerings have an impact on the size of a class as well as the student population in the class. This could not be avoided in the schedule.

Assumption

Every effort was made to monitor similar forms of instruction throughout the building. However, the research had to assume that the students' responses were not influenced by any other extraneous forms of analogous instruction between the administration of the pretest and the posttest.

Definitions of Terms

For the purposes of this study, the following definitions of terms were used.

Quantity: The number of monograms produced by each subject in 5 minutes.

Variety: The number of unique monograms produced by each subject in 5 minutes.

Critical Thinking: Thinking that is purposeful and goal directed.

Problem solving: The systematic approach to identifying a need and arriving at a solution.

Creative problem solving: The process of identifying challenges, generating ideas, and implementing innovative solutions to produce a unique product.

CHAPTER II

Review of Literature

Introduction

The purpose of this study was to determine whether the number of creative responses would improve if junior high students were exposed to creative problem solving instructions on a daily basis. This chapter will discuss what the literature revealed about the education system in relation to critical thinking, problem solving, and creative problem solving. The business community highly values problem solving and thinking skills; businesses spend money teaching these skills to their employees.

Public Education

The education system does not fare well in the literature. From elementary school through college, students were taught there was one "right" answer to a problem. Two plus two always equals four. "Students also learned that the quicker they got the right answer, the smarter they were (Hayes, 1989, p.18)." Creativity was never given the attention it deserved in standard educational settings. There seems to be no place in the traditional school curriculum for creativity training (Halpern, 1984, p.57). It is widely represented in the literature that the public education system does not understand how to teach critical thinking skills effectively. Implicit in education is the notion that thinking is simply intelligence in action, just as traffic is cars in motion (de Bono, 1982, p. 33).

> Many of us teachers assert that it is our main objective to teach students how to think, and this means also to think constructively. Certainly, if we succeeded in this objective, there should be much evidence of creativeness in the product. I am convinced that we do teach some students to think,

> but I sometimes marvel that we do as well as we do. In the first place, we have only vague ideas as to the nature of thinking. We have little actual knowledge of what specific steps should be taken in order to teach students to think. Our methods are shotgun methods, just as our intelligence tests have been shotgun tests. It is time that we discarded shotguns in favor of rifles (Guilford, 1987, p. 44).

While much is said about schools not including creative problem solving in their curriculum, Houtz (1994, p.160) appreciates that with the number of factors involved (how very complex real schools and classrooms are), educators cannot assume all the roles necessary to achieve the environment in which creativity can thrive.

Guilford recognized that the development of creative thinking is not known for achieving miracles. If it were possible to lift the population's problem solving skills by a small amount on the average, the summative effect would be incalculable. He also realizes that creative problem solving usually occurs outside the academic setting. In order to achieve widespread results within the population, the methods of training needs to be incorporated in the academic world.

The goal of education seems to be stockpiling information. Memory work contributes to cognition and memory; but does not approach the functions of productive thinking and evaluation. Skills must be developed for using information as well as for storing it. Instruction should be problem-centered. The student should encounter many problems; problems that are difficult enough to be challenging, but not so difficult as to discourage effort. Creative behavior should be rewarded with intrinsic rewards being the most effective. Skills in evaluation should not be overlooked, but personal criticism should be kept at a minimum. Students should be taught to be flexible in their thinking (Guilford, 1987, p. 60).

Guilford also noted that the setting and climate of the school must support creative learning. He suggests that the curriculum be designed around various kinds of problems. Students should be given the chance to discover information - not have it disseminated to them.

Problem solving

According to Von Oech (1983), problem solving is a distasteful task performed when something goes wrong. While many people think of creativity as a pleasant "task" resulting in something new. Yet creativity is actually a problem solving process

According to Thayer-Bacon (2000, p. 12), the basis for scientific reasoning can be traced back to Aristotle: we develop hypotheses and then test them to see if they really work before we draw any conclusions. Critical thinking is a tool that can help us find solutions and justify our arguments. There is something creative about all genuine problem solving. Although it is easier to see problem solving events in the work of the scientist and technologist, they also abound in everyday personal affairs. We can say that any kind of artist also solves problems. In this case, the problems are concerned with self-expression and communication (Guilford, 1987, p. 46).

Creative Problem Solving

According to Torrance (1972), America is historically recognized as a leader in mechanical inventions. The founding fathers were innovative in bringing new forms of government into the world. Torrance recognized that social and legal systems have not been so fortunate with innovations because there is no reward system for innovative social ideas. The patent system richly rewards the inventor and innovator. He said we must reward creative behavior to encourage its existence.

Considered the leading proponent of creative thinking, Torrance studied the results of creativity testing at different times. He notes that before 1960 there were few studies. In 1972, he reported on the results of 142 studies of creative thinking in children, which utilized ten different types of interventions. Of the 142 studies, 102 were successful. In 1983 he reviewed a total of 308 studies of creative thinking programs involving school age children using different approaches in teaching creative thinking. Again, the success rate was 70% (Torrance, 1987, p. 192).

A basic timeline of critical thinking skills in education, according to Mayer (1988, p. 29), recognizes that the 1930's and 1940's saw an influx of creativity training in industry, followed by the 1950’s, which tried remediation of problem solving in college students. The 1960's were a time of teaching productive thinking skills to elementary school children; while in the 1970's and 1980's there was direct teaching of thinking skills.

Creative Problem Solving and Employment

In working with businesses and organizations to teach thinking skills, de Bono (1985, p. 23) came upon a useful tool by using a variety of colored hats to identify different types of thinking. The artificiality of the hats helped establish rules for the game of thinking. Wearing a red, green, or blue hat requires that participants think in a certain way, or they change the way they may be thinking. De Bono asserts that the more the hats are used, the more they will become part of the thinking culture. This makes focused thinking much more powerful.

Many businesses and organizations put this and other thinking programs into practice. The environment within General Mills supports creative solutions. General Mills routinely offers creative problem solving courses for division leaders and teams. Employees implement the strategies learned and build a repertoire of creative ideas and approaches.

Basadur's (1987) research addressed the increasing awareness in business and industry regarding the tools available to increase organizational creativity and effectiveness. With training these tools can be learned and systematically applied. However, increasing the creative performance of an organization requires more than just training. To sustain such increases over time requires the managing of many mediating variables, which if unattended, can totally undo training effects. Experience shows that when senior managers visibly model the attitudes and thinking skills associated with creative problem solving training, subordinates are much more likely to try using them on the job.

Creative Problem Solving and Higher order thinking skills

According to Hayes, three tests are applied before an act is considered creative. First it must be original, second it must be valuable and finally the person who performed the act is considered to have special mental abilities.

Creative problem solving does not occur in a vacuum, it allows people to build upon previous work or change previous assumptions. Thayer-Bacon (2000, p. 128) recognizes the difference between critical thinking represented by Rodin's Thinker, and what she calls constructivist thinking, where she uses the image of a quilting bee. This moves thinking from a solitary, logical reasoning activity to one where thinking represents a social endeavor, where knowledge is not found but is constructed by people as they interact with the world and people around them. Similarly, Bailin (1988, p. 52) asserts that creativity today is defined as a specific process or mode of thought. Once creativity is viewed this way, it can be taught.

Edward deBono (1978) was the leading advocate of direct teaching of creative thinking skills. His instructional materials were widely adopted in England, Australia, Ireland, and Venezuela. In Venezuela, every school child takes a two-hour course each week in thinking skills. He also defends the reduction in time spent teaching information in order to focus on the direct teaching of thinking.

Creative Problem Solving and extra curricular activities

During the 1970's, creative thinking skills' importance received credible support with the introduction of national and international interscholastic competitions. Future Problem Solving Program and Odyssey of the Mind both encourage the introduction and practice of creative thinking. E. Paul and Pansy Torrance founded the Future Problem Solving Program with the goals of helping students to: (1) develop richer images of the future, (2) become more creative in their thinking, (3) develop and increase their communication skills. (4) develop and increase their teamwork skills, (5) integrate a problem solving model into their lives, (6) develop and increase their research skills. Each year, program participants suggest topics for the following year. Through a voting process, the topics are chosen as the problems for state and national competition for the following year. Government and community organizations also submit problems for the teams to research and address.

Sam Micklus and Theodore Gourley founded Odyssey of the Mind, a creative problem solving competition, in 1978. This program encourages teamwork as the students work on a creative solution to a long-term problem. This program was designed for highly creative students capable of developing unusual ideas and insights. Evaluation is based upon the performance of the participants. Some problems may be non-linguistic where the participants do not speak as they present their solution. Mechanical devices and industrial design become an integral part of the solution. Spontaneous problems are also a part of the competition challenging the ability of the participants to "think on their feet." Teams advance from local, district, and state meets to the world competition held annually (Torrance, 1987, p. 199).

Technology Education

As a course of study, Technology Education teaches problem solving and encourages students to transfer these skills to other applications. Students very often "find" the solution as they work through the problem at hand. According to Thode, (1997, p. 24) we need to get away from parameters that limit how and what we teach, and use problem solving activities to meet the exploratory nature of our students.

Design & Technology

Using design briefs, students are presented with a problem they need to solve. These may be real life situations, or teacher directed situations. The skills for problem solving and evaluating the results need to be taught for the student to be successful. The International Design Society of America (IDSA) participates in the International Technology Education Association (ITEA) annual conference in order to increase teachers' awareness of how the design process can be incorporated into a thriving curriculum.

Summary of Literature Review

The literature does not show educational systems in a very favorable light as it approaches the creative problem solving process. The necessity of working with large groups of students and having them conform to the educational system produces students who have difficulty being innovative.

Some programs were put into place to teach the skills of "thinking outside the box" (Von Oech, 1983, p. 10). Extra curricular activities, such as Odyssey of the Mind, and Future Problem solving programs were developed to expose students to creative thinking.

Businesses value employees that have the ability to think creatively. In order to accomplish this, businesses bring in special instructors to train their managers and employees in how to develop a workplace that will incubate creative thinking. Technology education teaches problem-solving skills. Looking for more solutions and thinking about thinking will help students to think creatively.

CHAPTER III

Methodology

Introduction

The purpose of this study was to determine whether the number of creative responses would change if eighth grade students at Hopkins North Junior High were exposed to creative problem solving techniques on a daily basis. The following narrative will describe the subjects, instrumentation, treatments, data collection procedure, and the data analysis techniques used in this study.

One potential strategy for developing creative problem solving is to engage students in a series of mini lessons on creative thinking strategies over a period of several weeks. However, the effectiveness of such an approach has not been established. Therefore the purpose of this study was to determine if the number of creative responses would improve if students were exposed to creative problem solving techniques on a daily basis.

The creative responses were measured by administering a pretest at the beginning of the school term and a posttest at the end of the six-week term. The specific hypotheses of this research were:

1. There will be no significant difference in the number of creative responses from students who received 15 mini lessons on creative problem solving techniques and those who did not.

2. There will be no significant difference in the variety of creative responses from students who received 15 mini lessons on creative problem solving techniques and those who did not.

Subjects

The subjects in this study were students at Hopkins North Junior High in Technology Education course winter of 1999. The fourth hour class was the control group. The fifth hour class was the experimental group. The students were assigned to the classes by the scheduler. The fourth hour class had 21 participants and the fifth hour experimental group consisted of 24 participants.

Instruments

Based on the variables identified in the review of literature, a simple instrument was developed (see Appendix B) to gather and organize the number of responses to measure the total number of responses (quantity), and the number of different kinds of responses (variety). The assumption was that the number of different kinds of responses equals the number of creative responses. The pretest consisted of oral directions (see Appendix A) instructing the students that they would have five minutes to design as many different monograms as they could using the Hopkins High School initials. Each student was given a sheet with blank cells for 40 monograms.

At the end of the term, the posttest was administered in the same manner. This time the students were to use the initials of North Junior High for the monogram and they again had five minutes to design as many different monograms as they could. The test instruments were collected at the end of five minutes.

Two adults agreed to code the instruments. The coding scale is included in Appendix C. The same scale was used for the pretest and posttest. In cases where the coders did not agree, a third person also coded the instrument. Each instrument was coded for the total number of responses (quantity), and for the number of unique responses (variety).

Pilot Test

In order to ensure that the language of the instructions fit the situation, a group of five junior high students from the neighboring school participated in a pilot test, which was administered during the last week of October. Students were asked to stay after school for participating in the test. After the pretest was completed, students were asked if they understood the instructions, or if there was anything that was not clear. The pilot test helped to refine the questions and define the coding sheet.

Procedures

Two weeks before the term started, a letter requesting permission for student participation in the study was sent to the home of each student registered in the eighth grade, technology education course. A stamped envelope was included to facilitate return of the permission slip.

On the first day of the term, students in the fourth hour control group and students in the fifth hour experimental group took the pretest. Two adults rated the pretest for total number of responses (quantity), and the number of different responses (variety). The treatment of the experimental group consisted of a five-minute creative problem each day for 25 days. Students were asked to record their responses in a notebook.

Using information from science (SCAMPER) and from Thinkers Toolbox (Seymour, 1977, pp. 40-52) a notebook containing a collection of creative problem solving tools was used for 15 days. Each day different tools were introduced such as; eliminate, combine, substitute, exaggerate, associate, reverse, etc.

The next five days consisted of problems, which rewarded common responses with one point and creative responses with three points. Examples of these problems are included in Appendix D. Students turned in their notebooks daily to receive points.

The last five days consisted of nonlinguistic problems such as; given 50 toothpicks, 4 straws, and 1 piece of clay, build a structure that will support 10 nails for 3 seconds. Scoring was based upon each 4" increment in height that supported the ten nails put on one at a time.

After 25 days, each group took the posttest. Two adults again rated the instruments for the total number of responses (quantity), and the number of different responses (variety).

Data Analysis

Each student generated two instruments, one the pretest, and the other the posttest. They were identified as being members of the control group or treatment group as well as being male and female. The data consisted of the total number of responses produced by each student. This was a number from counting the number of cells that had a design in them. The coders then evaluated each design according to a scale provided in Appendix C. Only the first response in any category was counted. If the student produced the same type of design it would not be recorded a second time. The quantity of different responses was noted on the coding sheet. This was a numerical value that could be compared against other student responses. Each student had a total of four measures; pretest quantity and variety, and posttest quantity and variety. The results from the control group and the treatment group responses were then compared to see if there were any significant changes in the responses.

CHAPTER IV

Results

Introduction

The purpose of this study was to determine whether the number of creative responses would change if eighth grade students at Hopkins North Junior High were exposed to creative problem solving instructions on a daily basis. The following narrative will describe the experimental design and the number and variety of responses produced by the control group as well as the treatment group.

Experimental Design

A pretest was administered to eighth grade technology education students enrolled in term three of the 1998-1999 school year. Students were assigned to the course by the school scheduler. The fourth hour class was the control group and the fifth hour class was the experimental group. The sample consisted of 21 students in the control group and 24 students in the treatment group. The treatment consisted of daily five-minute instruction in creative problem solving techniques for five weeks. The classroom teacher conducted the treatment instruction as part of the daily curriculum. A posttest was administered at the end of the six-week term. Students were asked to design as many different monograms as possible within five minutes for the pretest and posttest. The results of this study can be generalized to the eighth grade population at Hopkins North Junior High School.

Number of Responses

One of the hypotheses that the study sought to test was there would be no significant difference in the number of creative responses among students that received instruction in creative problem solving techniques and those that did not. The students had five minutes to design as many different monograms as possible. The instruments were coded for the total number of responses (see table 1).

Table 1

Pretest Posttest Number of Responses

Group	Pretest	Posttest	n
Control	9.2	9.4	21
Treatment	12.1	16	24

The null hypothesis was rejected. The increase in the number of responses among the control group was negligible while the increase in the number of responses for the treatment group proved to be significant. Students that received instruction in creative problem solving techniques increased the number of monograms they were able to produce within the five-minute time frame.

Variety of Responses

Another hypotheses that the study sought to test was there would be no significant difference in the variety of creative responses among students that received instruction in creative problem solving techniques and those that did not. The students had five minutes to design as many different monograms as possible. The instruments were coded for the number of different types of responses based upon the rating scale in appendix C (see table 2).

Table 2

Pretest/Posttest Variety of Responses

Group	Pretest	Posttest	n
Control	6.1	6.0	21
Treatment	6.3	7.3	24

The null hypothesis was supported. There was no significant increase in the variety of responses among either the control or treatment group.

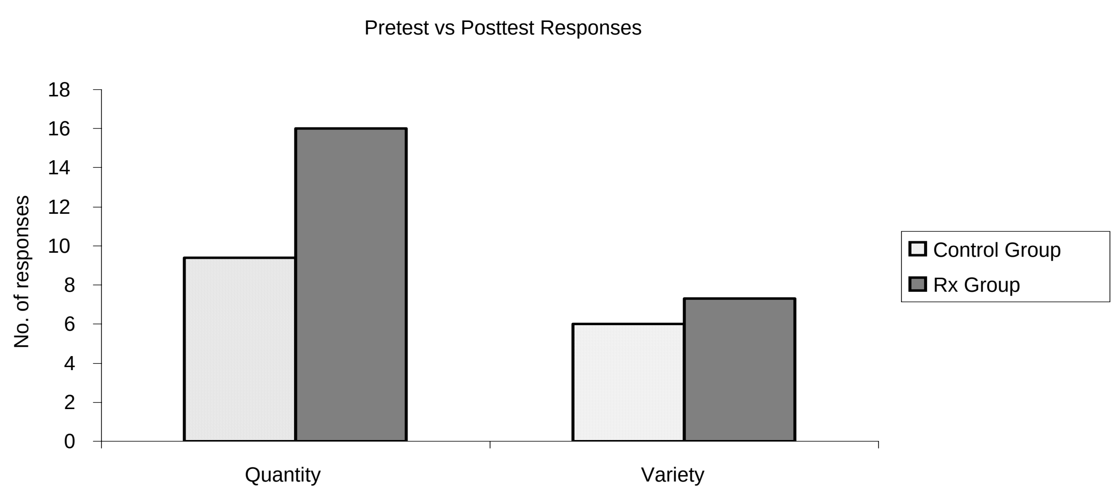

Figure 1 Pretest versus posttest number of responses.

The increase in the quantity of responses is evident when looking at figure 1. The increase in quantity of responses among the control group is significant. The variety of responses change was negligible. Therefore, both of the hypotheses were rejected.

Control Group versus Treatment Group

One of the hypotheses the study sought to test was that the number of responses would increase for students that received instruction in creative problem solving techniques. The results of the posttest for the control group and the treatment group show a significant increase in the total number of responses for the treatment group. The results of the posttest variety of responses for the control group and the treatment group show no significant increase in the quantity of the variety of responses (see table 4).

Table 3

Posttest Number and Variety of Responses

Group	Number	Variety	n
Control	9.4	6.0	21
Treatment	16	7.3	24

Table 3 displays the relationship between the posttest responses based upon control group or Rx group. There was no posttest difference in creative responses between the eighth grade students in the experimental group and the control group.

Table 4

Variances - t test for Equality of Means

	t value	df	2-tail Significance
Quantity Pretest	-2.644	43	.05
Variety Pretest	-.638	43	Not
Quantity Posttest	-3.367	43	.01
Variety Posttest	-1.882	43	.00

CHAPTER V

Summary, Conclusions, and Recommendations

Introduction

The purpose of this study was to determine whether the number of creative responses would change if eighth grade students at Hopkins North Junior High were exposed to creative problem solving instructions on a daily basis. The following narrative will describe the study and present its findings, conclusions, and recommendations.

The Design of the Study

This study administering a pretest to eighth grade technology education students enrolled in term three of the 1998-1999 school year. Students were assigned to the course by the school scheduler. The fourth hour class was the control group and the fifth hour class was the experimental group. The sample consisted of 21 students in the control and 24 students in the treatment groups. The treatment consisted of daily five-minute instruction in creative problem solving techniques for five weeks. The classroom teacher conducted the treatment instruction as part of the daily instruction. The results of this study can be generalized to the eighth grade population at Hopkins North Junior High School.

Findings

The result of the study show significant increase in the number of monograms produced by students in the treatment group in comparison to those produced by the students in the control group. However, there was no evidence of significant difference in the variety of monograms produced by the treatment and the control groups.

Therefore, one conclusion of the study was the mini lesson was effective in increasing the quantity of monograms produced by students. Furthermore the lack of gains made in terms of the variety of monograms generated suggests students need richer lessons in creative problem solving techniques with more opportunities for practice and application.

Summary

The specific hypothesis of this research were:

1 Eighth grade students who participate in creative problem solving instruction will increase the number and variety of creative responses.

The results fail to reject 1 because the variety of creative responses did not increase. The number of responses did increase significantly during treatment period.

2 There is no difference in creative responses between eighth grade students that participate in creative problem solving instruction and those that do not.

The results fail to reject 2 because no observable difference occurred in the treatment group as measured against the control group.

While the results in increased quantity may seem encouraging (or at least suggest more continued study), this particular experiment failed to reject both hypotheses.

Conclusions

For students at North Junior High School, teachers could increase the quantity of responses if instruction on creative problem solving techniques takes place in the classroom. This research project did not confirm that the number of *creative* responses increased significantly. It could be projected that as students consistently increase the quantity of responses, the variety of responses would begin to increase as well. As students have more opportunities to practice creative problem solving, responding in such a manner may become more expected.

More time instructing students in the process of creative problem solving may lead to a greater variety of responses. The time spent in instruction was limited in scope. With continued instruction and varied approaches to creative problem solving students may increase not only the number of responses, they may also increase in creativity by building upon each others responses or trying to develop a different response.

Creating an environment that encourages creative responses is also important. Students need to know that more than one response is possible and desirable. Students may build upon the responses from others and are encouraged to do so. Students need a safe environment that allows creative expression and unusual responses. Teachers need to accept many different responses and make sure that tangent responses or outlandish responses do not cause ridicule, as that may be the response that triggers a solution for someone else.

Recommendations

Teachers should spend time discussing the thinking process. This would help students to begin to "think about thinking." Students learn about facts and figures from a young age and need to be exposed to creative problem solving styles of thinking. Students need to know there is no one "right" answer and many responses may provide the solution. Students can build upon the ideas others present and combine or eliminate various elements of a solution. As students discuss their thinking and practice a creative problem solving approach they will be better prepared for school and beyond.

Create an environment that encourages creative responses. Students should be encouraged to apply the steps of problem solving and look for more than one possible solution. As students become aware that more than one solution is possible, they will look beyond their first response and continue to search for other possibilities. Teamwork opportunities also encourage students to work together to find many solutions. In a school where many teachers use a creative problem solving approach, students will become comfortable with expressing unusual responses. In a school setting, it is imperative that students can express themselves without fear of ridicule. Working to create such an environment is essential for the success of a creative problem solving approach.

Technology education teachers need to participate in action research within the field. Technology education applies the curriculum that many other disciplines teach. To garner support and credence among the various departments, research that shows the results of what technology educators do is critical. Research is needed in creative thinking in order to determine the most effective method or methods to develop student skills in creative problem solving. While this study shows a slight increase in the quantity of responses, would the variety of responses results differ if students were exposed to creative thinking over a longer period?

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Appendix A

Pretest instructions:

Write your name and hour on the small piece of paper inside the grid paper you received. You will have five minutes for this exercise. Do not compare your work with anyone else, work alone and work quietly. A monogram is a logo that uses the initials of the owner to decorate or identify an item. Monograms may be seen on letter jackets, luggage, or shirts. Using the initials for the high school (HHS) to design as many different looking monograms as time allows. Place each monogram in a separate cell on the grid. If you fill one side, turn the paper over and continue with additional monograms on the other grid. Are there any questions? Again, design a monogram using the initials HHS and design as many different looking monograms as possible. Begin now.

After four and one half minutes:

You have 30 seconds remaining.

After five minutes:

Please put your pen or pencil down and turn in your papers. Thank you.

Posttest Instructions:

Write your name and hour on the small piece of paper inside the grid paper you received. You will have five minutes for this exercise. Do not compare your work with anyone else, work alone and work quietly. A monogram is a logo that uses the initials of the owner to decorate or identify an item. Monograms may be seen on letter jackets, luggage, or shirts. Using the initials for North Junior High NJH design as many different looking monograms as time allows. Place each monogram in a separate cell on the grid.

If you fill one side, turn the paper over and continue with additional monograms on the other grid. Are there any questions? Again, design a monogram using the initials (NJH) and design as many different looking monograms as possible. Begin now.

After four and one half minutes:

You have 30 seconds remaining.

After five minutes:

Please put your pen or pencil down and turn in your papers. Thank you.

Appendix B

Instrument

Appendix C

Rating Scale for Creative Problem Solving Pretest Posttest

Subject _____

________ Number of Responses

Variety of Responses:

Check all that apply.

_____ Individual letters

_____ Connected

_____ Stretched Horizontally

_____ Stretched Vertically

_____ Inverted

_____ Block Style Letters

_____ Reversed

_____ One reversed one forward

_____ One large one small

_____ One below the line

_____ Other design in monogram

_____ Bubble

_____ Script

_____ Squiggle

_____ Layered

_____ Shadow

_____ Outside Shapes

_____ Letter Shapes

_____ 3D

_____ Shading

_____ Math Symbols

_____ Missing parts

_____ Intertwined

_____ Stylized

_____ Total number of variety of responses

Appendix D

Notebook of daily instructions for creative problem solving.

Lessons for Creative Problem Solving

To be used in Technology Education Classes at Hopkins North Junior High

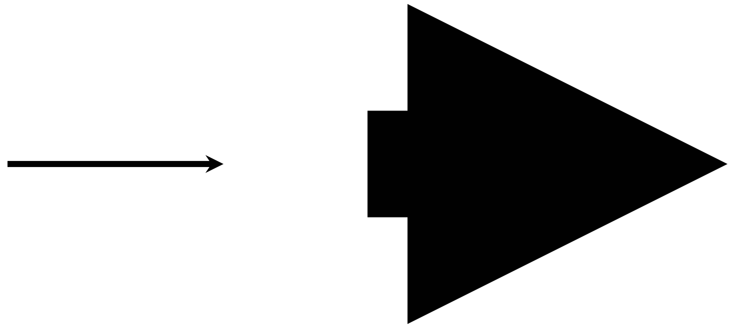
Compiled by Mary Kay Myrmel
January 1999

Instructions for implementing these lessons in the classroom.

Use a warm-up activity with the class. These are either individual responses or the class is divided in half to respond. After the warm-up continue on with the tool of the day.

Write the name of the tool on the board.
Ask for ideas as to the definition – list two or three.
Read the definition and the description.
Mention how many applications the students are expected to complete.
Explain the application and hand out necessary supplies.
These lessons should take five to seven minutes from beginning to end.

EXAGGERATE



Name of Tool: Exaggerate

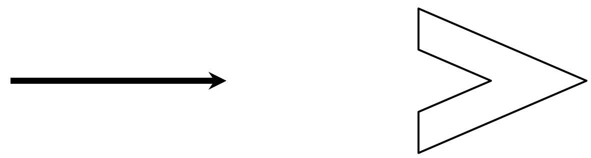
Definition: Overstate, blow up; make outrageous; stretch the point; make bigger.

Description: Exaggerating features is a technique often used in design. For example, to five a new look to fashionable clothes, the designer may exaggerate the shoulder pads or lapels. Push button telephones with very large buttons were devised specifically to help people with impaired vision. Cartoonists exaggerate the features and movements of their characters to make us laugh. Advertisers often use exaggeration to call attention to a feature of a product.

Activity: Draw a caricature of Elvis or draw a Family Circus map for getting a drink of water in school.

Materials needed: Picture of Elvis, Family Circus cartoon

Eliminate



Name of Tool: Eliminate

Definition: Omit; take away; get rid of.

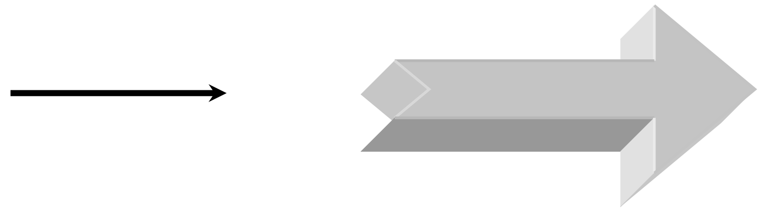
Description: Using this tool allows you to solve the problem by simplifying the situation, getting down to the very essence of the matter at hand. Sometimes a problem is a problem simply because there is clutter from extraneous material, or more than can be comfortably handled. Such challenges can be solved by eliminating unessential components or by limiting assumptions.

Activity: The school board has determined that eight classes over two days are too expensive. In order to meet the budget three classes need to be eliminated from the schedule. What three classes would you eliminate and still assure that you receive a well-rounded education?

Your name is too long to fit on the computer printout, what letters would you eliminate?

Materials needed: sheet of paper

Elaborate



Name of Tool: Elaborate

Definition: Add details; make something new by adding on to something already created.

Description: Sometimes a solution to a problem can be found by adding something new to an existing product or situation. For example, when personal tape players like the Sony Walkman first appeared, they were quite popular. As the market for these items reached a plateau, the product was elaborated upon by the addition of an AM/FM radio, thus creating a new product. New automobile designs are often elaborations upon existing ideas. Edison improved the telephone by elaborating on the original microphone assembly and creating the carbon microphone cartridge used to the very day.

Activity: The snow shovel is basically a stick with a wide blade attached to the end. Elaborate on the design of the snow shovel to make it a more effective snow removal tool. Draw and label your new design.

Materials needed: snow shovel

Compare

Name of Tool: Compare

Definition: Contrast one thing with another; show what is different and what is alike.

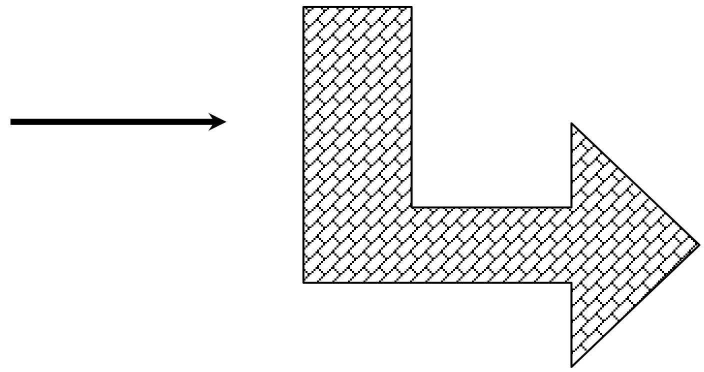
Description: Comparing a problem with something else that may have some similarities to it often helps us see key elements that we might otherwise overlook. Many creative people have solved problems with this tool. For example modeling one based upon the wing structures of birds first satisfied the quest for a flying machine. This resulted in the creation of working gliders. When the Wright brothers designed their first powered airplane, they benefited in turn from the design of those gliders.

Activity: You will be driving soon. To help you prepare it is important to notice the different kinds of roadways. Compare highways to side streets. List the attributes of each type of road. Which things are different? Which are the same? What features help you to identify a highway?

Your parents have agreed to buy you a new bicycle, but they don't know the styles of bikes. They have asked you to identify the differences between a mountain bike and a BMX bike. Which bike is better for your situation? Why?

Materials needed: Picture of BMX bike and mountain bike.

Associate



Name of Tool: Associate

Definition: Pair up; relate one thing to another; form mental connections between things.

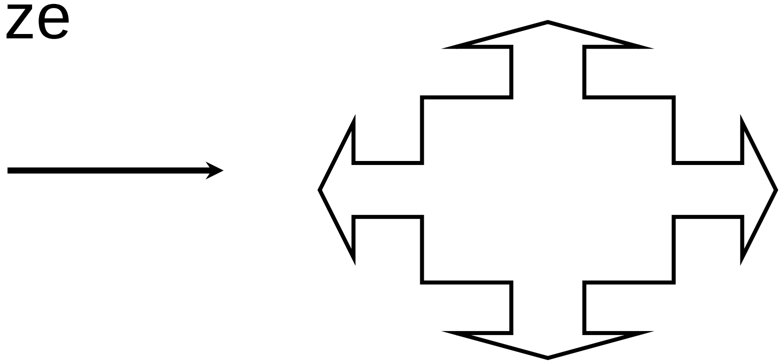
Description: Association is a way to release a flow of ideas from the subconscious mind. When we freely associate on a word, by writing any other words that come to our mind, we often spark new ideas or insights that help us to get passed a creative block. In the first stage of the association process it is important not to judge any of the ideas being generated, but simply to record them for judging later on.

Activity: Play the word association game. What words come to mind (Write as many as possible) when you think of . . .

Popsicles	Atlantic Ocean	Hard
Mars	Disney World	Intel
Blue Man Group	forest	cool
Euro	giggle	Johan Sebastian Bach
Sweet	New Zealand	rocks

Materials needed: Paper and pencil

Hypothesize



Name of Tool: Hypothesize

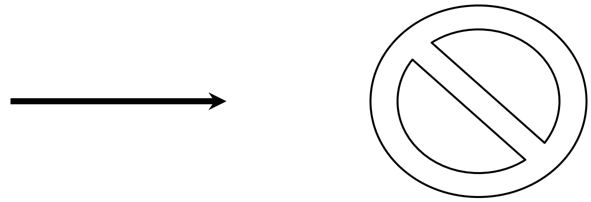
Definition: Assume, suppose; make a good guess based on some knowledge, aware that it won't always turn out to be true.

Description: Often when we find a problem hard to solve, we can make it easier by standing back from it and examining the underlying assumptions. By creating hypotheses about the problem, we can identify erroneous assumptions that limit our range of solutions. For example, in the early days of the space industry, an engineer questioned the need for expensive shock absorbers used to cushion the opening of solar panels after launch. By hypothesizing that such shock absorbers weren't needed, and by verifying this hypothesis with experiments, he was able to solve a million dollar problem and keep the project on schedule.

Activity: Your school is looking at a new schedule for next year to reduce hallway congestion. One possibility is that students stay in the same classroom and the teacher come and go. Hypothesize how this may work for students, for academic teachers, for elective teachers. Do you think this plan is likely to be put in place? Why or why not? What other alternatives are there?

Materials needed: Paper and pencil

Symbolize

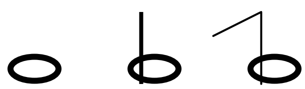


<u>Name of Tool: Symbolize</u>

Definition: Represent; stand for, bring to mind.

Description: Symbolism is a way of solving problems in communication. With a single well-chosen visual symbol, we can convey a wealth of complex information. International symbols help overcome language difficulties. Businesses rely on their corporate logos not just to tell us who they are, but also to communicate the essence of what they have to offer. A simple design can sometimes evoke special reactions. Thus, when we see a pair of “golden arches,” we know that a fast-food restaurant is near. But even further, we are likely to find ourselves thinking how good some French fries would taste; the logo tempts us to stop in and make a purchase.

Activity: In math the symbols + - x / represent plus, minus, multiply and divide. In music the symbols



Stand for whole note, half note and quarter note.

What would happen if each country used different symbols?

List common symbols or what they represent.

Peacock	Stoplight	U.S. Flag
Octagonal sign (stop)	Smokey the Bear	Apple Computers
UPS (United Parcel Service)	N Northwest Airlines	Camel Cigarettes
BMW Car company	Mustang Ford car co.	Red circle with line through it (No)

Materials needed: Pictures of logo or symbols

Separate

Name of Tool: Separate

Definition: Divide; take apart; break into component parts.

Description: With this tool the problem solver can get a new perspective on the problem by breaking it down into parts and looking at each part separately. This often generates novel solutions to problems. For example, when George Washington Carver successfully convinced farmers to plant peanuts, he had the challenge of coming up with applications for this crop. By separating peanuts into their various components – oils, fats, and other chemicals – he created dozens of practical inventions ranging from cooking oil to whitewash.

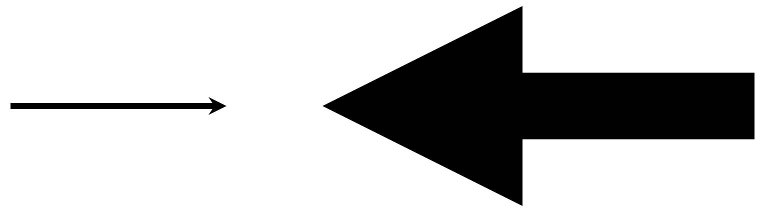
Activity: The band director has played a CD of the school fight song. You have been asked to write the final stanza of the fight song. If you separate the assignment into parts, the task won't seem so enormous. How can you do this?
Listen for the variety of instruments, listen for the melody, and find words that are meaningful.

As a team of five people you have been given a box of K'Nex building system and a plan. You have been asked to have the roller coaster operational in four hours. How would you separate this task into manageable parts?

One person to sort parts, two people building one end of the roller coaster and two people building starting at the other end.

Materials needed: Paper and pencil

Reverse



Name of Tool: Reverse

Definition: Make opposite; turn backwards; reflect as if in a mirror.

Description: Sometimes we can solve problems by reversing some of the elements or assumptions. For example, architects designing housing clusters will often use a few basic floor plans and then reverse the layouts in some of the houses to provide more variations. Reversible jackets were designed to allow one coat to have two completely different appearances. Guessing at the answer and then working backwards can solve some difficult math problems.

Activity: Write the alphabet backwards.
Write the song “Innsy Winsy Spider” backwards. What do you have to do to be able to write the words?
Are you tired of playing Monopoly the way the rules are written so you decide to reverse the rules. What might you change? How would that affect the outcome?

Materials needed: Monopoly board, recording of “Innsy Winsy Spider.”

Reduce

<u>Name of Tool: Reduce</u>

Definition: Decrease; lessen; miniaturize.

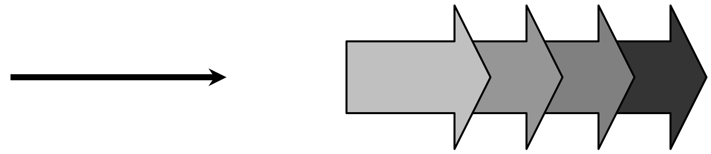
Description: Thinking small can solve some problems. Years ago, before the invention of miniaturized electronics, the smallest radios weighed several pounds. Even the first "portable" radios were quite bulky. Now, tiny radios can be found in watches. As another example, when the world was experiencing a shortage of oil some years back, car manufacturers started creating engines that reduced the need for fuel. This reduction in fuel consumption solved two problems: it helped conserve a natural resource, and also it lessened the production of pollutants.

Activity: Recycling programs use the logo "reduce reuse recycle." What are ten or more ways you can reduce the impact on landfills?

What electronic items would you like to reduce in size? What benefits would result? What is needed in order to reduce the size?

Materials needed: Recycling poster, scale and cd in case.

Combine



<u>Name of Tool: Combine</u>

Definition: Join or put things together.

Description: Numerous inventions are the result of combining two known things to create something completely new. The combination of erasers with pencils took place so long ago that we might think pencils were always made that way – but it isn't true. This combination made pencils much easier to carry and use. The combination of peanut butter and celery creates a delicious snack. The combination of a radio and a clock created the clock radio, allowing people to awaken to music instead of an alarm bell.

Activity: The Swiss Army Knife is a combination of packet knife, tweezers, and scissors. The Leatherman is a combination pliers and screwdriver. What other tools could you combine that would be useful, convenient and compact?

Materials needed: Swiss Army knife (with permission), and Leatherman.

Warm-Ups

1. You will have 60 seconds to answer the following question. Please write your answer on a piece of paper and do not say anything out loud.
   When does six come after seven besides in numbers such as 76, 276 etc.
   Collect the papers and ask for anyone that would like to share their answer. If no one got the answer you may choose to give the answer today or tomorrow. Answer: In the dictionary.

2. Here is the Answer – What was the question?

I will read an answer. You will come up with a question that fits the answer. Please write your question on a piece of paper. You may come up with more than one question. You will have 60 seconds.

Example: The Dodgers.

Who won the game?
What's your favorite baseball team?
Who did Jackie Robinson play for?
What is the name of the major league team that plays in LA?

Answers:

Hawaii, In a lake, Let's go investigate,

Write your questions on a piece of paper. You will be asked to read one question.

3. Write the following sentence on the board just as it appears.

Take away 1 toothpick, move some others and leave 1.

Each student receives 12 toothpicks.

Draw the example of how students are to lay out the toothpicks and have them cover their answer. Walk around and check solutions.

Answer: ONE

Warm-Ups continued

4. Divide the class in half. Use the word air in as many unusual words or word combinations as you can. You may also include words which have the letters air appearing in that order somewhere in the word. Example: airplane, hair.

One point for common responses, three points for creative responses. Each team takes turns with each person taking a turn in order. If the next person cannot answer the other team gets to try. You cannot repeat words already given.

Common responses: hot air, cool air, air conditioner, airport, cold air, airplane, air pressure, air tank, etc.

Creative responses: hair, stair, fair, hair brain, etc.

5. Write your answer to the following problem on a piece of paper. If it takes 3 minutes to boil and egg, how long will it take to boil 3 eggs?

Answer: 3 minutes - all in one pot.

6. Divide the class in half.

For the birds:

Name as many unusual birds as you can. One point for common responses. Three points for unusual responses. If the next person on your team cannot answer, the other team gets to try.

Common responses: Any living bird.

Creative responses: Lady Bird, Big Bird, Donald Duck, Thunderbird, Woody Woodpecker, Firebird, Larry Bird, Road runner cartoon character.

7. Write your answer to the following question on a piece of paper. I have exactly $1 with 11 coins. I have 3 kinds of coins and no more than 5 of any one kind. What coins do I have?

Answer: 1 quarter, 5 dimes, 5 nickels

Warm-Ups continued

8. Divide the class in half.

Wrecks
Name as many kinds of wrecks as you can. One point for common responses. Three points for creative responses. If the next person on the team cannot answer, the other team gets to try.

Common responses: Car wreck, wrecking ball, shipwreck

Creative responses: Dinosaur Rex, Rex reed, Skylab, King Rex, Von Hindeburg, Challenger

9. Divide the class in half.
You will have three minutes to respond. There is a dollar bill on the table in front of you. Talk to the dollar. One point for common responses, three points for unusual responses. If the next person cannot answer, the other team gets to try to respond.

Common responses: Any break up of the dollar such as 4 quarters, 10 dimes, etc. Minor alterations of a previous statement.

Creative responses: "How do you feel, inflated?" " Where are you now that I need you?" "You look green George." Etc.

10. Write your response to the following problem.

Express 10 using only two 8's as digits.

Answer $\frac{8}{.8}$