Chapter 2

REVIEW OF LITERATURE
Review of literature is of utmost importance for a researcher. It is the basis of most of the research projects, in the physical, natural, social sciences and humanities. It helps the researcher to know what already has been done and what remains to be done. Without the review of literature, a researcher will never be able to contribute to furthering the knowledge in the field in which he works.

In the words of Brog, "The literature in any field forms the formulation upon which all future work will be built". The survey of related literature is an important step in conducting educational research. Any piece of research requires an adequate taciturnity with the work, which has been done in that area. It is through the accumulated research of the past that the researcher can contemplate a good research design, locate the gaps and find the trends in that particular field of research. The review of related literature helps in expanding upon the context and background of the study.
The overview of the related literature involves locating reacting and evaluation of research as well as the reports of casual observations and the opinions that are related to the individuals planned research project. The general purpose is to help research worker develop a through understanding and insight into work already done on the areas left untouched or unexplored. The related studies also enable the researcher to search out many more related problems as suggested for further research.

Survey of related literature avoids the risk of duplication, provides theory explanations or hypothesis valuable in formulating the problem and contributing to the general scholarship of the investigator. It is true that the review of related literature would develop the insight of the investigator.

In India, research on creativity is very scanty and major emphasis has remained either on test construction or on correlating different factors of creativity with other variables like personality, intelligence achievement, etc. However, only few studies have been directed towards the development of creativity.

In this chapter, the researcher has made an effort to make an overview of the literature pertaining to the problem. The studies surveyed belong mainly to three different dimensions such as:

- Problem Solving
- Inquiry Training
Jarial (1981a) developed verbal and non-verbal instructional materials to develop creativity among high school students and found that the post-test creativity mean scores of students of verbal and non-verbal experimental groups were higher than those of the verbal and non-verbal control groups. The findings of this study are optimistic that this method can be used to improve creative abilities of school children.

Jarial and Sansanwal (1984) tested the effect if verbal and non-verbal instructional material along with the interaction effects of socio-economic status and sex on the verbal and non-verbal creative thinking abilities of the students. The study was carried out on 160 urban students of class IX. The training programme for developing verbal as well as non-verbal creativity contained 25 exercises each. The verbal creativity training exercise had the content from the immediate environment of the students, i.e. home, school and society providing training in the whole process of creativity, whereas, the non-verbal creative training exercises had content based upon geometrical figures and sketches and it intended to provide training to the students in combinatory thought processes. The conclusions reported are: the treatment in verbal and non-verbal instructional materials to develop creativity among high school students and found that the post-test creativity mean scores of students of verbal and non-verbal experimental groups were higher than those of the verbal and non-verbal control groups. The findings of this study are optimistic that this method can be used to improve creative abilities of school children.

materials has proven to be significantly effective in developing the mean verbal and non-verbal creativity scores of students respectively; and the interaction between the treatment and SES significantly affects the student's mean gain in verbal creativity score (with mean differences between high and low SES groups showing significantly only under the controlled conditions and not in the case of treatment.

Maltzman\(^2\) and his association in 1959 at the university of California conducted a series of research studies on originality training and asserted that the results support the hypothesis that "originality is a learned form of behaviour which does not differ in principal from other forms of operant behaviour".

Meadows and Parnes (1959) evaluated the creative problem solving courses developed by them in terms of gain in creativity. They found that the group receiving instruction through the experimental programme attained significant increments on the measures of quantity and quality of ideas. The results were interpreted to indicate that the creative problem-solving course produces significant increase on certain ability measures associated with practical creativity as well as on personality variable dominance.

In another evaluative study, the same investigators, Parnes and Meadows (1959)\(^3\) studied the effects of brainstorming on creative problem solving by trained and untrained subjects. Two problems designed to measure creative ability were given to both the groups. One problem was administered under deferred judgment instructions and the other under on current judgement. The result indicated that the subjects trained in a creative problem-solving course emphasizing deferred judgment principle produced a significantly greater number of ideas of good quality. The findings are intercepted to indicate that the deferred judgement instruction is an effective method of extending the incubation period and thereby increasing the production of ideas.

Nirpharak (1980)\(^4\) developed a special training programme and pre-test, post test, experiment was designed to study efficacy in developing creative appreciation. The independent variable in the experiment was training in creative appreciation, lasting for twenty-five school periods of thirty-five minutes each and the dependent variable was creativity as measured by Torrance test of creativity.

---


thinking. It was found that the experimental group as compared to central group showed marked improvement in all aspects of creativity after receiving training over the control group as well as over its own pre-test scores.

Olten, et. al. (1969) conducted study with self instructional material for development of creativity, to find out the extent to which the productive thinking programme can develop creative thinking among fifth grade students. The sample was of 740 students studying in the fifth grade in different schools. The students showed significant increments in thinking and problem solving performance on wide variety of productive thinking measures. These instructional benefits occurred virtually for all types of students regardless of sex or general I. Q level.

Bhaskara (1982) prepared verbal creativity instructional material for enhancing creative thinking abilities of 6th standard children and to determine the relationships of verbal creativity


instructional materials with certain variables, viz. different creative potentials, levels of socio-economic status, sex and rural-urban background and their interaction on the students of 6th standard in Bangalore district of Karnataka. The experimental study revealed the following conclusions. Verbal creativity instructional material significantly improved the creative thinking abilities of middle and low creative potential students, high middle SES students and boys excelled girls in terms of significant gains on verbal creativity.

Anderson (1963) also studied the comparative effects of two methods of development of creative problem solving abilities in an industrial art course. The two treatments given were a series of nine brochures containing selected materials and short ideation exercise given to one experimental group and the brochures with nine oral imagination exercises to other group based on Osborn’s brainstorming principles. The control group was taught through the traditional method. Pre and post test scores were obtained on the selected measures of Torrance tests of creative thinking and final test scores measuring attainment of course objectives were also obtained.

__Anderson (1963)__7 also studied the comparative effects of two methods of development of creative problem solving abilities in an industrial art course. The two treatments given were a series of nine brochures containing selected materials and short ideation exercise given to one experimental group and the brochures with nine oral imagination exercises to other group based on Osborn’s brainstorming principles. The control group was taught through the traditional method. Pre and post test scores were obtained on the selected measures of Torrance tests of creative thinking and final test scores measuring attainment of course objectives were also obtained.

---

In all the three replications of the study, the order of adjusted mean creative thinking scores favoured the experimental group in which a combination of brochures and Osborn's brainstorming technique was used.

Parnes (1972) designed his developmental study for programming creative behaviour to assertion to what degree the auto-instructional programme, based on creative process and used with different models of presentations, increase the high school students' creative behaviour as measured by various tests of creative ability. Two experimental groups received only the programme and other two experimental groups were presented the programme by instructor with opportunity to interact to responses of others. The experimental group met for the two periods per week for thirteen weeks during one semester. On the other hand, control group received no training. All the students involving in the study were pre and post tested on eleven psychological forms of four of the Guilford's test of creativity and one item from classroom creativity observation schedule (encouragement of pupil divergence). The findings indicated that the experimental groups out performed the control group on almost all the measures. The instructor taught

---

groups tended to be more markedly and consistently superior to control group as well as the groups receiving programmes alone.

Moslemi (1973) designed controlled experiment with pre and post test to answer the question whether creativity is innate or can be developed. The general hypothesis that intensive training unit with audio-visual materials can enhance creativity was tested on 101 tenth grade students from four classers. The experimental group was exposed to the three-week's training unit. The data did not support the hypothesis, and significant differences occurred only on verbal fluency and flexibility in favour of the experimental groups.

Flescher (1963) has tried to clarify the relationship between creativity and achievement in study in which the validity of implications concerning the comparative influence of unusual creative thinking and exceptional intelligence in the learning process has thoroughly been studied. He designed this study in the manner involving the two groups left out by Getzols, Jackson, and Torrance in their studies; one characterised by non-extra ordinary intelligence and creativity, and the other by high creativity and high intelligence. He found that there existed a significant relationship between intelligence and scholastic performance while creativity was not related to academic success.

Shan, Hans Raj (1989) conducted a study on effectiveness of certain curricular activities in the development of creative thinking of high school students of the background hilly region of Jammu. The main objectives of this study were to study the effect of teaching through the curricular activities of brainstorming, problem solving, project activity and quiz in comparison to the traditional method of teaching, on the verbal fluency, flexibility, verbal originality and total verbal creative thinking of students. The study revealed that the groups of the students taught science using various curricular activities, namely, brainstorming, problem solving and quiz and project activity, gained significantly in verbal fluency, verbal flexibility, verbal originality, elaboration, non-verbal originality, total non-verbal originality, total non-verbal creative thinking and total creative thinking (verbal and non verbal) as compared to the groups taught by the traditional method of teaching. Problem solving, quiz and project activities were found to be equally effective, though significantly more so in comparison to the use of project activity in the development of total creative thinking among the high school students.

Gupta, Krishna and Kumari (1988) \(^{10}\) conducted a study on the creative development of secondary school children in relation to sex, intelligence and urban and rural background. The study focuses on

the creative development of secondary school children in relation to sex, intelligence and urban and rural background. Two thousand urban and rural students, between the age of 11-15 years studying in Government aided secondary schools situated in Aligarh district were selected to form the sample of the study. The tools used were: creativity thinking tests (verbal and non-verbal) developed by Giriraj Kishore and Mohsin's General Intelligence Test. The study revealed that urban and rural boys and girls developed rapidly in creativity from the age of 11 (Grade VI) to the age of 13 (in the case of boys) and 14 (in the case of girls-Grade VIII), but later there was a sharp decline up to the age of 15 years (Grade X). It was found that in general, girls showed excellence as compared to boys in creative development between the ages of 13-15 years, both in urban and rural areas. The trend of creative development of boys and girls were not linear. Urban students were superior to rural students in creative development, especially during the age of 11-15 years.

Mukhopadhyay, Kishore, K. Chakrabarti, Pranab, K and Kundu, Ramnath (1990)\textsuperscript{11} conducted a study on creative development of children. The study was planned to investigate the effect of parental education, sex and hobbies on the creative development of children. The sample comprised 80 most creative and 80 least creative children of the age group 10-11 years studying.

\textsuperscript{11} Mukhopadhyay, Kishore, K. Chakrabarti, Pranab, K and Kundu, Ramnath (1990), Ibid.
in class V of urban and semi urban schools. The tools used included general verbal ability test, developed by the researcher a modified version of Torrance tests of creative thinking and an interview schedule. Education was found to be related to creativity. Parental sex as an isolated variable had no impact on creativity. Parental hobbies had a significant impact on creative development. The interaction effect of parental education and sex was important in relation to the development of creativity.

Pandey, A. K (1989) conducted a study of divergent thinking in relation to scholastic achievement, cognitive style and self-concept and interest pattern. This study assumes that divergent thinking is the genesis of creativity, which happens to be the goal of present day education. Class teaching in our country has, unfortunately, been convergent in nature. The emphasis is, therefore, to be laid on divergent thinking. Three hundred and forty nine students of standard X from urban and rural schools of 24 paragons of West Bengal formed the sample of the study. The study revealed that there was a significant relationship between DT and cognitive style, self-concept, interest pattern and scholastic pattern. There was a significant deference between field dependent and field independent cognitive style on the criterion of DT. There was a unique constellation of cognitive and affective correlates of DT existing in terms of common factors.
Olten, et. al. (1969)\textsuperscript{12} conducted a study to find out the extent to which the productive thinking programmes develop creative thinking among fifth grade students. The sample was of 704 students learning in 44 classes of fifth grade in different schools. The students showed significant increments in thinking and problem-solving performance on a wide variety of productive thinking measures. These instructional benefits occurred virtually for all types of students regardless of sex or general IQ level and were especially marked of students in classroom having environments which were judged to provide relatively little support and encouragement to the development of creative thinking.

Roka\textsuperscript{13} (1976) approached the problem of creativity development indirectly. He trained the teachers in changing their questioning behaviour in terms of four types of questions, i.e. cognitive memory, convergent, divergent and evaluative question. His results indicate that the students gain in terms of knowledge and creative thinking when the teachers asked divergent questions. They

\textsuperscript{12} Olten, et. al. (1969), "The Development of Productive Thinking Skills in Fifth Grade Children", Research in Education.

\textsuperscript{13} Roka, S. D (1976), "A Comparative Study of Verbal Teaching Behaviour Patterns and Students Achievement in Terms of Instructional Objectives", Ph. D Thesis in education, Barado, M. S. University of Barado.
gain in divergent thinking ability and application of knowledge was very high.

Deshmukh (1979)\textsuperscript{14} designed a study to find out experimentally, if appropriate manipulation of teaching-learning process could promote creativity. The procedure consisted of surveying of existing classroom instruction process for conditions to develop creativity ability of pupils and conduct an experimental to investigate the efficiency of role-playing and brain storming techniques in the development of creativity. For this experiment, the investigator taught the experimental group A by the role-playing techniques and group B by the brain storming techniques. The control group C was not given any treatment. Teaching through role-playing and brainstorming was characterised by high positive motivation, pupil involvement, positive peer interaction and encouragement to unusual responses, which was primarily divergent in nature. Further, brainstorming was found to be more interesting and effective in establishing teacher-pupil rapport and in encouraging unusual responses than teaching through role-playing.

Reddy, Mohender, S. (1989)\textsuperscript{15} conducted a survey on the development of reasoning and creativity among the standard IX students, to find out whether there is any relationship between the two. Four hundred pupils from 20 Government and private schools of Hyderabad city formed the sample of the study. The tools used included a battery of reasoning test developed by the investigator, and the non-verbal test of creativity by Baqer Mehdi, mean, SD, correlation, analysis of variance, and percentiles were used for the analysis of data. It was found that private and Government school students differed significantly on reasoning ability. The Government and private school students differed significantly on creative thinking in favour of private school students. The boys from private schools were better than boys from Government schools in reasoning ability.

Kusuma (1997)\textsuperscript{16} studied the factors affecting creativity and found that socio-economic status is an important factor in fostering creativity. The influence upon the person’s creativity may be both positive and negative. From the very nature of the inner conditions of an individual, if cannot be forced but may be stimulated to emerge


and there may be an optimum level under the favourable environment conditions.

**Staso (1978)**\(^17\) designed his study to test the hypothesis that students who receive creativity training in the context of stimulation game play would retain and transfer divergent thinking skills learned during the treatment. The results indicate no significant differences in mean scores among the experimental groups. The reason of failure of play-training treatment is extended as non-development of the conditions of cognitive and emotional functioning, adequate and emotional functioning adequate structure and opportunities for involvement.

**Halley Gaz (1985)**\(^18\) studied the effects of socio-economic status and problem solving training methods on the creative response styles of 47, 45-6 years old disadvantaged black children by randomly assigning them to 1 of 3 problem solving training situations socio-drama, verbal, or control divergent production was measured by responses to 3 open ended problems on the thinking creatively in


action and movement. Test results show that fluency in verbal kinetic integrative modes was affected by SES with middle class subjects performing significantly better in verbal modes and disadvantaged subjects. Performing better in kinetic mode of fluency and originally. The kinetic and integrative modes of solutions were affected by problem solving training. It is suggested that level of development is more significant determinative of creative response styles than SES and the problem solving training may strengthen existing preference for creative expression.

Clewell, and Anderson (1991) revealed "Women in Mathematics, Science and Engineering". The research highlights the barriers middle school girls face in math, science, and engineering classes. Barriers include teachers, parents, and society's impact on girls' 1) attitudes and perceptions, 2) achievement and performance, 3) course enrolment and participation, and 4) career interests and aspirations. This study is particularly important because women/girls are often studied with regard either to gender or ethnicity, but rarely considering both, as in this study. Teachers must help girls bring down the barriers they face by encouraging them to 1) have positive attitudes about themselves in math, 2) enrol and participate

in math and science classes, and 3) explore careers in math and science.

Blevins-Knabe, Belinda, and Musun-Miller, Linda (1991) studied "Parental Beliefs about the Development of Preschool children's Number Skills," This research indicates that parents' belief in girls' math ability affects girls' belief in their own ability. A study was completed with parents of 4- and 5-year-old children about their children's number skills. Parents of boys indicated that their sons would be able to solve all math tasks sooner than parents of girls indicated that their daughters would be able to solve math tasks. The parents' beliefs about the girls could clearly be detrimental to their daughters' beliefs about math and their performance in math. Teachers, then, must encourage parents of girls to have higher expectations for their daughters.

---

Deborah (1991) studied "The Impact of Cooperative Learning on Suzy and Janie's Attitudes about Math". The importance of this lies in its statement that girls would enjoy problem solving, increase their time on problem solving tasks, and have positive emotional reactions to problem solving tasks, if they were taught in a cooperative setting. The study explores the impact of cooperative learning on two sixth grade girls (one Afro-American, one Euro-American). The results show that the two girls had more positive attitudes about problem solving tasks when it was taught in a cooperative setting. Teachers need to use cooperative learning techniques in order to foster positive attitudes toward in their female students.

Peel, Tina et al. (1991) presented "The Comprehensive and Problem-Solving Study." For teachers who like to use TV programs as part of their classes, this study shows that TV can


improve boys' and girls' problem-solving skills and encourage them to have positive feelings toward activities. The paper indicates that TV encourages problem-solving skills in such a manner that children are able to transfer the skills to new problems. Success with the problems on the show elicited feelings of happiness, gladness, and pride in the students.

Li, Anita, Adamson, Georgina (1992) brought forward "Gifted Secondary Students' Preferred Learning Style: Cooperative, Competitive, or Individualistic". This research shows the crucial impact that the orientation of a math classroom has on female students' involvement in and enthusiasm for math. Gifted senior high school girls prefer working in non-competitive, individually oriented math classes, while boys prefer working in competitive, individually oriented math classes. If math classes were individually oriented but less competitive, girls would be more enthusiastic about math.

McSheffrey (1992) studied "Mathematics Experiences of Women and Girls: A Narrative Inquiry." This work suggests that teachers' ability to connect math to real-life situations affects female students' math experience. The narratives of 7 women and 15 girls about math experiences in school are examined. Many of the subjects cite 1) the influence of teachers' behaviours on students (teachers who made students feel important, cared for, etc...), 2) the influence of parents (their support or lack of support), 3) personal decisions regarding attitudes towards math, and 4) the attitudes of boys toward girls. Many of the stories emphasize how teachers made students feel in the classroom. Many of the women and girls state that their best math teachers were the teachers who made connections between math and real-life situations.

Patricia (1992) put forth "Math, Science, and Your Daughter: What Can Parents Do. According to this study, parents

---


play a crucial role in their daughters' math and science education. The study describes ways that parents can encourage their daughters in math and science. It suggests that parents talk to their daughters about the importance of math and its necessity in certain careers. In another section, the brochure encourages parents to foster positive attitudes in their daughters toward math and science. This publication is a useful tool for teachers to use to inform parents of their ability to improve girls' attitudes and participation in math and science classes.

Schwartz et. Al (1992)26 researched on "Equal Education for Female Students." This research indicates that teachers must consider girls' mental and physical development and the effect of their own attitudes and behaviours on girls' participation and performance in all subjects. When girls begin to mature physically, they focus more on their bodies and less on their intellectual abilities or themselves as people. As a result, their self-esteem decreases. Girls' learning style is more cooperatively based and therefore does not mesh with the independent, non-collaborative thinking encouraged in most classrooms. Finally, this paper states that

teachers unconsciously pay more attention to male students than to female students. It suggests that teachers must consider girls' developmental issues as they interact with them, by drawing female students' attention away from their bodies and focusing it on their intellectual abilities. Teachers should pose tasks that are more cooperative during problem solving skill instructions in order to support girls' learning style. Finally, teachers must constantly evaluate their behaviour toward male and female students to ensure that the attention they give students is not gender-biased.

Barry (1993) investigated "Research Implications for Science and Mathematics Teachers". This research gives examples of the strategies successful teachers use to make their science and math classroom environments conducive to science and math achievement among girls. The study encourages students, especially female students, to write (i.e. write about their thinking process when solving a problem). Others explore issues such as girls' attitudes towards problem solving skills and future careers, student and teacher relationships in math and science classes, and gender
equality in classes. The paper provides teachers with strategies, such as the use of writing in classes, to improve their classroom environments so that girls will be comfortable and encouraged to do problem-solving skills.

Orenstein and Fran (1993) researched on "Utilization of Teacher Workshops to Enhance Early Exposure to Gender Equity and Mathematics Education for Young Girls in Preschool Settings." The research showed that in order to prevent gender-biased behaviour in the classroom, teachers must first be aware of it. This study used 20 preschool teachers, attempted not only to increase teachers' knowledge of gender equity, but also to encourage them to apply their knowledge in their classrooms. After the teachers participated in the study, they were more aware of gender-biased behaviour in their classrooms and could begin to eliminate it and to create classroom environments in which boys and girls would have an equal opportunity to learn in a classroom setting.

---

Lisa (1994)\textsuperscript{29} studied "Sexism in the Classroom." This study shows teachers' critical role in girls' success in math and science. It suggests that girls' low participation and their negative attitudes towards math and science are greatly affected by teachers' attitudes. The study provides a self sexism-quiz teachers can take in order to identify specific classroom attitudes towards girls that may affect their instruction in class.

Sanders (1994)\textsuperscript{30} studied on "Lifting the Barriers. 600 Strategies that Really Work To Increase Girls' Participation in Science, Mathematics and Computers." This study gives teachers strategies for encouraging girls to be excited and involved in mathematics, science, and computers. In the Computer Equity Expert Project, 200 math, science, and computer teachers created 8 strategies to increase girls' participation in math: 1) focusing specifically on girls, 2) designing activities, 3) emphasizing usefulness, 4) highlighting the social aspect, 5) watching language for sex stereotypes, 6) eliminating biased practices, 7) spreading the word and 8) doing it all next year. The study recommends that these


strategies be used in classrooms, extracurricular activities, educational policies, and outreach efforts.

Sharma, D (1994)\(^{31}\) conducted an experimental study by organising activities like brainstorming, problem solving, quiz and project work in a science teaching class. She found that after the investigation, the students of the experimental group showed significant gains with respect to verbal fluency, verbal flexibility, verbal originality and non-verbal creative thinking.

Basadur, Michael G. DeGroote (1995)\(^{32}\) studied the "Efficacy of Creativity" and put forth the importance of creativity to the well being of society as a whole is becoming increasingly recognized and emphasized. Research has shown that effective organizations are simultaneously efficient and creative. Both improved and new methods and result from creativity. Fortunately, there are methods for enhancing and maintaining the creativity. The most effective methods for enhancing and maintaining creativity recognize that creativity is multifaceted. For one thing, there is no single agreed definition of creativity that in itself makes the study and measurement


\(^{32}\) Basadur, Michael G. DeGroote (1995) "Efficacy of Creativity", DeGroote School of Business, McMaster University, 1280 Main Street West, Hamilton, Ontario, L8S4M4, Canada.
of creativity difficult; and complex one reason that creativity is multifaceted is because so many factors contribute to its development and expression.

**Gutbezahl (1995)** investigated "How Negative Expectancies and Attitudes Undermine Females' Confidence and Performance." According to this study, parents' and teachers' expectations for girls in academic achievements have an enormous impact on girls performance. Girls internalize their teachers' and parents' negative expectations, which become self-fulfilling prophecies. Because girls believe that they cannot achieve more through problem solving skills, they do not achieve more in academics. Their poor performance reinforces parents and teachers' negative expectations and feeds the cycle of negative expectations and lack of achievement. Clearly, teachers' and parents' expectations for girls' performance must be raised if girls are to have the opportunity to achieve more in academics.

---

Patricia (1995)\textsuperscript{34} presented "What Works and What Doesn't? Ways to Evaluate Programs for Girls in Math and Science Series," This study helps teachers evaluate their math and science programs with regard to success with girls. Seven sections suggest how programs should be evaluated, what questions should be asked of participants in the program, and what variables should be examined in pre- and post-participation tests. Some of these variables include 1) attitudes toward math and science, 2) math and science courses girls are planning to take, 3) career interests, 4) math and science activities girls do voluntarily, and 5) girls' knowledge of women in science. The study is a useful tool for teachers because it allows them to evaluate the success of their math instruction and classroom environment for girls' attitudes and participation in math and math-related fields.

Pettitt and Lisa (1995)\textsuperscript{35} studied "Middle School Students' Perception of Math and Science Abilities and Related Careers". According to this research, middle school students do not recognize the subjects that they must study in order to have specific careers. In a survey of 162 students about their career aspirations and their feelings about sex stereotypes in certain professional fields, students responded that society accepts many different careers for women and men. However, they tended to choose sex-stereotyped careers when filling out the survey. Girls felt that they would be capable of becoming doctors or veterinarians, but they did not want to have science-related careers as adults. Boys stated the opposite. Neither the boys nor the girls recognized the relation between the study of math and science and their future career aspirations. Because this study indicates that girls may not realize that their preferred future careers can require course work in science and math, it seems prudent for math and science teachers to discuss with students the many professional fields that require math and science.

\textsuperscript{35} Pettitt and Lisa,(1995), "Middle School Students' Perception of Math and Science Abilities and Related Careers", paper presented at the 61st Biennial Meeting of the Society for Research in Child Development, Indianapolis, IN, March 30-April 2, Lisa M. Pettitt, Dept. of Psychology, University of Denver, 2155 South Race St., Denver, CO 80208.
Swetman and Daniel (1995)\textsuperscript{36} put forth "Rural Elementary Students' Attitudes toward Mathematics," This research showed that girls' positive attitudes towards mathematics decline as they grow older. Initially girls have more positive attitudes towards math than boys do, but as they continue in school, girls' attitudes become more negative. In order to improve girls' performance in math, teachers need to facilitate positive attitudes in girls towards math.

Hanson and Katherine (1996)\textsuperscript{37} explored "Teaching effectively and equitably to Females." An exploration of girls' learning styles, attitudes, and behaviours in classes shows the importance of analyzing the curriculum and attitudes of teachers when attempting to understand girls' relation to divergent thinking.


Gill and Judith (1998)\textsuperscript{38} revealed ""Shedding Some New Light on Old Truths: Student Attitudes to School in Terms of Year Level and Gender". The research indicated that middle school and high school girls have positive attitudes toward school but negative attitudes toward mathematics. It focuses on the gendering - the separation of boys and girls - of Australian schools through the study of 7th, 8th, and 10th graders in coeducational programs as well as girls-only schools. Despite some authors' belief that separating boys and girls for math improves girls' attitudes towards math, the results indicate that even when girls are taught in all-girl schools, they still have negative attitudes toward math. With regard to teachers, the paper suggests that separating boys and girls during math instruction does not improve girls' negative attitudes toward math.

James (1998)\textsuperscript{39} studied the "Effects of Alternative Assessment from the Student's View". According to this study, teachers' use of


alternative assessment improves elementary and middle school girls' involvement in classroom achievements. While in this study, learning ability did not change, the girls' attitudes towards classroom activities did improve over the year in which alternative assessment and non-traditional activities were used. Alternative assessment techniques and non-traditional activities appear to be ways to improve girls' participation and attitudes in classes activities.

Suddendorf and Fletcher-Flinn (1998) investigated "Children's Divergent Thinking Improves When They Understand False Beliefs". This research utilized longitudinal and cross-sectional methods to investigate the relation between the development of a representational theory of mind and children's growing ability to search their own minds for appropriate problem solutions. In the first experiment, 59 preschool children were given 3 false-belief tasks and a divergent-thinking task. Those children who passed false-belief tasks produced significantly more items, as well as items that are more original; in response to divergent-thinking questions than those children who failed. This significant association persisted even when chronological age and over verbal and nonverbal general

---

40 Suddendorf and Fletcher-Flinn (1998) "Children's Divergent Thinking Improves When They Understand False Beliefs". Thomas Suddendorf, Department of Psychology, University of Auckland, Private Bag 92019, Auckland, New Zealand, E-mail: http://t.suddendorf@auckland.ac.nz/
ability were partialed out. In a second study, 20 children who failed the false-belief tasks in the first experiment were retested 3 months later. Again, those who now passed the false-belief tasks were significantly better at the divergent thinking task than those who continued to fail. The associations between measures of divergent thinking and understanding false beliefs remained significant when controlling for the covariates. Earlier divergent-thinking scores did not predict false-belief understanding three months later. Instead, children who passed false-belief tasks on the second measure improved significantly in relation to their own earlier performance and improved significantly more than children who continued to fail. False-belief task performance was significantly correlated to the amount of intra-individual improvement in divergent thinking even when age and verbal and nonverbal skills were partialed out. These findings suggest that developments in common underlying skills are responsible for the improvement in understanding other minds and searching one's own. Changes in representational and executive skills are potential causes of the improvement. Much research has recently been devoted to the study of the development of a representational theory of mind. By about age 4 most children understand that people, including themselves, may misrepresent the world. This understanding of false belief is evidence for a representational theory of mind, because it implies an understanding that mental states are attitudes to representations of the world, rather than attitudes to direct copies of reality. Although some research
suggests that even 3-year-old children may be able to pass simpler versions of classic theory-of-mind tasks (Chandler & Hala, 1994; Saltmarsh, Mitchell, & Robinson, 1995; Sullivan & Winner, 1993) and may have an implicit understanding of belief (Clements & Perner, 1994, 1997), many researchers maintain the traditional view that fundamental cognitive changes are responsible for 4-year-olds' understanding of false beliefs (e.g., Flavell, 1993; Olson, 1993; Perner, 1995).

Audrey (1999) put forth the “Class, Race and Gender in American Education.” This study indicates that societal attitudes about race, class, and gender affect standardized tests and the traditional tools used to measure success in school. It highlights the fact that girls’ grades in math and English decline as they get older, yet boys’ grades improve. It also shows that Whites tend to perform better on the SATs (South African Tribes) than Afro-Americans. The paper suggests that standardized tests should not be used before the third grade because they are culturally and gender-biased. If teachers use standardized tests or tests in general, they should examine them to be sure that the wording of questions does not include societal attitudes or stereotypes about class, race, or gender.

If such attitudes or stereotypes are present in the working of questions (or otherwise), teachers should discontinue the use of such tests in their classes. Teachers must carefully examine standardized and regular, everyday tests in order to insure that their students are not being subjected to culturally or gender-biased tests.

Roberta, and Julie (1999) investigated on "Changing Gifted Girls' Attitudes." The objective of the study was to help gifted girls achieve even greater heights in academics. A study was initiated with academically gifted 4-7th grade girls that included activities, which 1) improved self-esteem, 2) developed positive attitudes, 3) dealt with problem-solving skills, 4) encouraged girls to become involved in problem solving skills and inquiry activities outside school, and 5) explored careers. In the study, it was found that the girls who had gone through it scored significantly higher on all subjects. The study helps girls deal with emotional and developmental issues as well as improving their attitudes and performance in math. The study stresses that teachers can improve gifted girls' performance in by working with them on problem-solving skills and inquiry activities.

Stipek, Deborah, et al (1999)\textsuperscript{43} found "Gender Differences in Children's Achievement-Related Beliefs and Emotional Responses to Success and Failure. This research indicates that girls have lower expectations for themselves than boys, and that girls believe they do not have problem solving ability. When girls do poorly in classroom activities, they attribute their poor performance to their inability to have problem solving skills. This study explores the beliefs of third-graders and junior high school students (male and female). It shows that girls' beliefs begin early in their education and persist into junior high school (and probably beyond). Therefore, starting at the elementary school level, teachers need to; 1) encourage girls to have higher expectations for them, and 2) offer girls alternative, positive explanations of their performance.

Vosburg (1999)\textsuperscript{44} studied "The Effects of Positive and Negative Mood on Divergent-Thinking Performance". The study was based on the hypothesis that that positive mood may facilitate creative problem solving. However, the study has also shown


\textsuperscript{44} Vosburg (1999) "The Effects of Positive and Negative Mood on Divergent-Thinking Performance", University of Bergen, Norway.
positive mood may be detrimental to creative thinking under conditions favouring an optimizing strategy for solution. It is argued herein that the opposite effect is observed under conditions promoting loose processing and satisfying problem-solving strategies. The effects of positive and negative mood on divergent-thinking performance were examined in a quasi-experimental design. The sample comprised 188 arts and psychology students. Mood was measured with an adjective checklist prior to task performance. Real-life divergent-thinking tasks scored for fluency were used as the dependent variables. Results showed natural positive mood to facilitate significantly task performance and negative mood to inhibit it. There was no effect of arousal. The results suggest that persons in elevated moods may prefer satisfying strategies, which would lead to a higher number of proposed solutions. Persons in a negative mood may choose optimizing strategies and be more concerned with the quality of their ideas, which is detrimental to performance on this kind of task. A preponderance of the empirical literatures on mood and creative problem solving emphasizes the facilitating effect of positive mood. Most of these studies employ three types of tasks: insight problems, categorization tasks, and remote associates. Because divergent-thinking tasks represent an important element of creative problem solving and because they have not been addressed as frequently, they were targeted in this study.
Judy (2000) revealed "Sex differences in Science Museums." This research indicates that girls need to learn in a cooperative atmosphere and those they need to have more math and science-related experiences, since they have fewer such experiences than boys. It also states that girls are cooperative learners, rather than competitive learners. In order to encourage girls' performance, teachers should consider a more cooperative approach (group learning) as well a curriculum that gives girls more experiences.

Murray, Sujan, Hirt, and Sujan (2000) tested the hypothesis that positive mood can promote cognitive flexibility and put forth more directly and found positive mood participants were able to see relations between concepts. They were also superior in distinguishing the differences between concepts. Murray et al. bridged their findings to creative problem solving by arguing that participants in a positive mood are better able both to differentiate between and to integrate unusual and diverse information. Closely related to this suggestion was Fiedler (1988), calling attention both to


46 Murray, Sujan, Hirt, and Sujan (2000) "Positive Mood may Promote Cognitive Flexibility", Suzanne Vosburg, 1111 River Road, Apartment C6. Edge water, NJ 07020. E-mail: mailto:%20s.vosburg@worldnet.att.net.
loosening and to tightening processes in the context of mood. He used the terms loosening and tightening to characterize the psychological function of cognitive processes under positive and negative mood, respectively. In his view, loosening processes are most likely to accompany positive mood.

American Association of University Women (2001)\textsuperscript{47} presented a research, which showed that girls' self-esteem, confidence in their abilities, expectations for life, interest in challenging courses and rewarding careers, and pursuits in math and science decline, as they get older. Teachers may contribute to girls' problems by giving them less attention or a lower quality of attention during class; therefore, teachers must be careful not to limit girls' potential in math and science by using gender-biased practices. Especially during math instruction, teachers must be sure to call on girls for answers to questions, and to give them praise when appropriate.

Eccles, Jacquelynne et al. (2001) studied “Age and Gender Differences in Children’s Self and Task Perceptions during Elementary School”. The study brings forth that even at a very young age, boys and girls feel more or less competent in certain subjects. According to this study of 1st, 2nd, and 4th graders, boys tend to feel more competent in sports and math, whereas girls feel more competent in reading and music. Clearly, teachers need to raise girls’ feelings of competence in math. However, teachers could also incorporate reading and music into math lessons (or incorporate math into reading and music lessons); this would show girls that math is present in subjects in which they already feel competent.

Basadur and Hausdorf (2003) measured “Divergent Thinking Attitudes Related to Creative Problem Solving and Innovation Management”. He found that in an increasingly complex and changing environment, creativity is becoming recognized as a critical success. The identification of attitudes toward creativity and the subsequent development of creative thinking are important mechanisms to encourage creativity. Attitudes toward creativity can

---


indicate potential for behaving in a creative manner. This research identifies three divergent thinking attitudes related to creativity, as “valuing new ideas”, “creative individual stereotypes”, and “too busy for new ideas”. The study used various psychometric and substantive analyses with 2 large samples including students, both boys and girls. Basic scales were established to measure all 3 attitudes. This research also provided a psychometric methodology for identifying and developing measures of variables associated with creativity attitudes and behaviours. This framework may be useful to other researchers.

Alice and Sherryl (2004)50 investigated “Cognitive Therapy and Research”. He found that Life stress is associated with depression, although it accounts for only about 10% of the variance. Social problem solving has been found to be a moderator of the stress-depression relationship in adults and children. This study extends research in this area by testing whether social problem solving moderates the relationship between stress and depression among adolescent girls and whether the moderating role of social problem solving is specific to certain domains of social problem solving. The hypothesized role of specific social problem-solving deficits in the association between stress and depressive

symptomatology was supported. The study concludes that social problem solving - depression - stress - affect the divergent thinking among adolescence girls.

**Barak and Goffer (2004)**\(^{51}\) studied the “fostering systematic innovative thinking and problem solving”. The study aimed to illuminate different means of nurturing creativity particularly in the context of problem solving and to examine the potential implications for education. The study shows that there is a large gap between conventional wisdom, which maintains that education is intended to foster creative thinking among pupils. The cumulative experiences indicated that pupils can learn efficient techniques for solving a problem, by ‘playing’ systematically with ideas, in order to achieve new results. The notion that methodical courses can trigger pupils’ incentive to be innovative and original, and can foster teamwork is almost absent from the field of education. Educators and scholars in education pay little regard to teaching and exploiting methods to fostering systematic original thinking and problem solving. The challenge in education is to find an optimal combination and balance between fostering activity based on openness and ‘disorder’, on the

one hand, and imparting systematic methods for innovative thinking
and problem-solving, on the other.

Campbell and Campbell-Kibler (2005) researched on "Girls
and Math". He found that Girls are taking almost the same number of
math courses as boys (2.9 vs. 3.0). However, they are less apt to
take Trig or Calculus. While boys still outnumber girls in upper-level
math, girls are no longer uncommon and while women are not
entering careers that need math in numbers equal to men, neither
are women a rarity in these fields. At all levels there has been
increased awareness of the under representation of women in math,
science, and engineering and what this could mean for the country,
as well as for individual women.

Donald and Bennett (2005) investigated the “effect of
allowing examinees to select questions on a test of divergent
thinking”. In this study, he explored how choice, that is, al­
lowing examinees to assign themselves to test questions, affected
examinee performance and test characteristics for a measure of the

52 Campbell and Campbell-Kibler (2005) "Girls and Math: Enough is
Known for Action", Springer Netherlands, 0159-6123 (Print) 1754-
1865 (Online), 13.1230/A: 1005599210585, 720-822.

53 Donald and Bennett (2005) “Effects of Allowing Examinees to
Select Questions on a Test of Divergent Thinking Educational
Testing Service”, Princeton, New Jersey.
ability to generate hypotheses about a given situation. Four forms of this experimental test were randomly spiralled within a large sample of students taking the computer-based Graduate Record Examinations General Test, with two of the forms allowing examinee choice. Results suggested that items were in fact differentially attractive to examinees, indicating that in some form choice was operating. Furthermore, performance was significantly higher when a given item was chosen than when it was required. There was some indication that internal consistency was improved by allowing examinee choice.

Katherine (2006)\textsuperscript{54} brings forth "Math Equity in the Classroom: A Vision of Reform from the Urban Mathematics Collaborative". The paper recognizes that: "until recently, the United States had been able to meet its needs for a mathematically trained workforce by providing advanced study for a small, elite segment of its school population, typically Anglo and male. However, the causes [of inequity] lay with mathematics education and with the disjuncture between schools and the lives of their students. Mathematics curriculum, textbooks, and instruction often failed to speak to the lives and concerns of females and other under represented groups.

\textsuperscript{54} Katherine Hanson (2006), brings forth "Math Equity in the Classroom: A Vision of Reform from the Urban Mathematics Collaborative"; Education Development Centre, USA, California, EDC 55 Chapel Street, Newton, MA 02458-1060.
Consequently, these groups were cut off from real opportunities for success in mathematics." The paper offers a view of equity embodied in six propositions: High achievement/high expectations; Student access to rich mathematical content; Student assessment and equity; Teachers' professional development; and School restructuring and equity.

Michael, Mumford, et. al (2006)\textsuperscript{55} found the "Domain-Based Scoring of Divergent-Thinking Tests: Validation Evidence in an Occupational Sample". The intent of this study was to investigate the predictive validity of these tests using a domain-specific scoring system that considers how divergent-thinking skills are manifest in a particular performance setting. The study has bought forward some evidences that accrued for the validity of divergent-thinking tests. It has not been overwhelming. One problem with many of these studies is that they have not looked at divergent thinking in a population where creative problem solving is a requirement for performance. Another problem with many of these studies is that they have not focused on aspects of divergent thought that are most

strongly related to performance in the domain at hand. Accordingly, in this study 1,818 respondents were asked to complete a divergent-thinking measure. When performance indices obtained in this sample were correlated with scores on the divergent-thinking test, divergent thinking was found to predict performance, even when intelligence and expertise were taken into account. Furthermore, aspects of divergent thinking specifically related respondents' creative problem-solving efforts, such as the use of principle-based alternatives, as well as complex and realistic alternatives, were found to be particularly good predictors of real-world performance. The implications of these findings for the development and application of divergent-thinking measures were found positive.