CHAPTER – II
REVIEW OF RELATED LITERATURE

2.1.0 INTRODUCTION

The present study was related to effect of concept mapping strategy in mathematics on achievement and mathematical creativity in relation to anxiety in mathematics. In this chapter research studies pertaining to the concept mapping, concept mapping and achievement, concept mapping and creativity, mathematics anxiety and studies related to Concept mapping and anxiety; mathematics anxiety and mathematics achievement; math anxiety and mathematical creativity have been reviewed, these studies are given in the following captions.

2.2.0 STUDIES RELATED TO CONCEPT MAPPING

Manjula (1990) concluded that there is requirement to incorporate concept mapping with the creative person as one of the main approaches to teach science in schools and supply possible methods to assist students. This study was quasi-experimental in nature. Non-randomized pre-test and post-test design was used. The intact groups of eighth class as an entire were considered as experimental (47) and control group (42) for the study, from 2 native schools of Mysore city. The data obtained were analyzed descriptively and inferentially by calculating percentages, mean, standard deviation and “t” values and analysis of variance. The analysis of data disclosed that the experimental group students had performed higher in comparison to the control group on the achievement test, method skills and concept attainment test on the post-test occasion. This was proved through the “t” values obtained for achievement test (9.66); process skills (6.34) and therefore the concept attainment test (4.40). The analysis of students’ (experimental) attitude towards concept mapping disclosed that nearly ninetieth of them had a really positive perspective. The F values obtained (5.921) showed that there is difference between and within completely different the various intelligence groups of the experimental group in their post-achievement test implying that the concept mapping strategy has had a differential impact on students belonging to different intelligence groups. Similarly, the F value obtained for concept
attainment test was found significant implying that there is difference within and between the scholars of different intelligence in their concept attainment ability. However, there was no difference found either between or inside the different grades of scholars in their performance of process skills. There was no difference determined between girls and boys in their achievement, method skills, and concept attainment and in their attitude towards concept mapping.

Cox et al. (1998) in their study investigated the construction of professional knowledge of pre-service teachers and teacher learning about literacy education. In this study concept maps were used to reveal important changes in the knowledge base of pre-service teachers. It was found that pre-service teachers in a school constructed richer, more professional and more complete concept maps (relating more literacy teaching and subject matter ideas together with logically appropriate connectors) than the university – based group with fewer hours in the elementary school.

James and Peter (1998) in their study described learning to teach culturally diverse learners for charting change in pre-service teachers thinking about effective teaching. Concept maps and surveys were used to assess the effects of multicultural education course on pre-service teachers cognition. It was found that Group B student conceptualization of effective teaching increased after the course, but other indicators showed that they did not activate reorganize their re-conceptualization. Group A student exhibited the opposite pattern. Each group emphasized a distinct view of teaching.

John and John (1998) in their study described the use of concept mapping in teaching complex notions in geography and discussed the nature and characteristics of concept mapping in three experimental exercises, and student responses in evaluations. Findings concluded that the concept mapping techniques increased the student achievement. They emphasized the continuing potential of this technique.

Mehta and Henderson (1998) in their study investigated by exploring notions of schooling by using concept maps for a high school integrated curriculum programme assessment. In their study, the concept mapping, a student-driven assessment tool, was used to compare student attitudes toward conventional school and the Community Environmental Leadership programme (CELP) in an integrated out-door semester for 11th graders that developed community skills, environmental awareness,
leadership, and responsibility. Although pre-CELP concept maps reflected cross-spectrum negatively, post-CELP maps reflected a sense of promise and empowerment.

Rye and Rubba (1998) in their study investigated explored the concept map as an interview tool to facilitate the externalization of student understandings about global atmospheric change. They found the effectiveness of two different types of interviews, one that embedded a concept map and other that did not embed a concept map in order to elicit post-instructional understanding. This study had focused on students understanding of chlorofluorocarbons and their role in global atmospheric change. Data was collected from 8th-grade physical science students and their teacher using open-ended interviews. Findings indicated as the interview that embedded a concept mapping process did not affect statistically significant in the externalization of student’s conceptual understandings.

Schacter et al. (1998) in their study explored the feasibility of a web-based assessment of problem solving. This study explored the automated data collection, scoring, and reporting of children’s complex problem-solving processes and performance in web-based information. Problem solving was studied using realistic problem in realistic contexts demanding multiple cognitive processes in the domain of environmental science. Sixty-nine middle school and high school students completed pre-test and post-test concept maps, a relevant book marking measure. Student performance from pre-test to post test for concept mapping scores did improve, but more exploratory information seeking behavior did not predict higher scores. Extracting relevant information from the web resulted in higher final concept mapping scores, but high scores on data cognition did not predict high scores on the relevant book marks and final concept maps. There were no significant results for the use of feedback contributing to higher final concept mapping performance or a greater number of relevant book marks.

Stanley et al. (1998) in their study investigated using concept maps to measure the conceptual change in pre-service teachers enrolled in multicultural education/special education course. Concept maps were used to trace the conceptual change in 30 pre-service teachers enrolled in an introductory multicultural/special education course at Michigan State University. Results indicated significant quantitative and qualitative
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differences between pre and post-measures. Student constructed post-concept maps which were more specific, and were more integrated.

Butler (2001) explored the pre service music teacher’s conceptions of teaching effectiveness, microteaching experiences and teaching performance. He investigated about music education concept maps that were focused on teacher effectiveness. In this study students created the concept maps after two micro-teaching. The study included the quantitative and qualitative findings. The study finally concluded that combination of concept maps with microteaching was found to be beneficial.

Grow et al. (2001) in their study reported mathematics instruction in Korean primary schools, structure, processes and a linguistic analysis of questioning. A collaborative study of mathematics instruction in 1st and 5th grade students in Korea was done. Lesson consisted of sequences of highly organized, systematic patterns of instruction dominated by questions that included higher level procedural and conceptual question by teachers. Observations have implications for educators interested in why Asian students perform so well on mathematical tests.

Carroll and Timpson (2002) in their study described concept mapping as a tool for teaching and training. It was recommended that concept mapping will facilitate the learner to develop meta-cognitive skills and build educator responsive to instructional principles. Findings concluded that the experiential learning model, the educational instructional map and logic model were helpful as concept mapping tools for the casual course of instruction.

Nietfeld (2002) described concept maps as schema representation to assess pre-service teacher understanding of effective instruction. He found schema representation, an authentic summative assessment tool for assessing pre-service teacher’s mental modals for teaching. It required students to integrate and synthesize what that had learned in class and create a representation of how they planned to use their new knowledge in the classroom. They elaborated on the utility of concept mapping by allowing for more creative formals and by adding a personal dimension.

Thompson and Mintzes (2002) in their study explored the cognitive structure and the affective domain on knowing and feeling in biology. In their study found the structural complexity and propositional validity of knowledge and attitudes. Concept
mapping and Likert-type attitude inventory was used for assessment and the study involved two hundred and thirty eight participants from 5th, 8th and 11th grades and college level and senior citizens. They reported significant differences among subjects groups on knowledge structure variable and attitudes.

Brinkman (2003) described mind mapping as a tool in mathematics education and presented the technique of mind mapping and pointed out its special fitting as a pedagogical tool for mathematics education. In this study all applications of mind mapping in mathematics education together with their advantages and limitations were described positively.

Brown (2003) explained group approach to concept mapping in high school biology. Concept mapping was used as an instructional method in co-operative learning environments and investigated the effectiveness of concept mapping on student learning during a photo-synthesis and cellular respiration unit. There was a positive effect of concept mapping on the experimental group.

Coffey et al. (2003) in their study summarised the literature pertaining to the use of concept mapping techniques and technologies for education and performance support. They concluded that when concept mapping is used in an ongoing fashion, learners experience an educational event and then use of concept maps in a reflective way enhances the learning. There was an indication that learning effects were enhanced during the course of concept mapping when learners adopt an active, deep and questioning approach to the subject matter. Certainly, active, self engaging, transformational interaction was engendered by a teacher who challenges the learner to explain, justify and formulate question in the course of building a concept map.

Gahr (2003) described the use of concept mapping in the organic chemistry lab. This study integrated concept mapping into the chemistry laboratory and required students to construct a concept map for each experiment. In study it was found decrease in student questions concerning set up and procedure after the treatment through concept mapping.

Lim et al. (2003) in their study developed reflective and thinking skill by means of semantic mapping strategies in kinder garden teacher education. This study examined some of the effective out comes for teacher educators and student teachers resulting
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from use of semantic webbing / mapping as a strategies for facilitating reflective and critical thinking skills in kindergarten teacher education programme in Hong Kong. Interviews of a random sample of participants and as analysis of their mind-maps revealed a change in perspective and attitudes towards matter content and teaching curriculum.

Carnine and Carnine (2004) in their study found the interaction of reading skills and science content data during teaching the troubled secondary students. It represented an innovative approach to integrating the teaching of middle school science content and reading skills to increase levels of student success with content area textbooks. This approach featured rigorously chosen vocabulary word reading instruction, oral and silent reading and express instruction on comprehension methods, like retelling, concept mapping, and summarization. Six aspects of instruction on a style that were mentioned like identification and teaching of massive concepts, the systematic instruction of vocabulary, a review, and integration of core concept, the visual show of how core concept was integrated, method for core concept, and structured hand – on activities.

Koppang (2004) investigated curriculum mappingas building collaboration and communication. It had explored the application and use of curriculum mapping as a tool to assist teachers in communicating the content, skills, and assessment used in their classroom. Curriculum mapping assisted both special and general education teachers in meeting the needs of students in the classroom. This process of mapping was equally effective at the elementary and high school levels.

Preszler (2004) described the cooperative concept mapping for improving performance in undergraduate biology. It was found that many students failed to integrate biological knowledge into larger conceptual framework. The biological knowledge did not seem to be connected with concept in a manner that allowed them to develop explanation of phenomenon or to use their knowledge to support an argument. So student had retained less and did not apply scientific knowledge results in decline of scientific literacy. Effectiveness of methods was tested that might contribute to a solution to this crisis in science education. In this study it was concluded that the use of cooperative concept mapping to encourage students to incorporate biological information into larger conceptual modals.
Robinson et al. (2004) in their study reported using community asset mapping in human ecology. They found community asset mapping was one approach to community assessment. The assets, capacities and resources embedded in a community assessment led people to take responsibility for and ownership of rebuilding and renewing their community.

Mac Gregor and Lou (2005) investigated web-based learning i.e. how task scaffolding and web site design support knowledge acquisition. This research was designed to obtain a better understanding to how to enhance the pedagogical effectiveness of web quests and of how students interact with the various features inherent to informational website. A major objective was to examine the effect of providing instructional scaffolds to support 5th grade students web questioning experiences. The findings indicated that concept mapping templates coordinated with the research makes enhanced students free recall and application of acquired knowledge.

Cheung (2006) explored a constructivist approach to design computer supported concept mapping environment. The use of concept maps to support teaching and learning of various knowledge discipline with range from science to language subjects was investigated. Forty two in-service secondary school teachers studying a post graduate diploma in a local university were selected. This involved four weeks of the collaboration lesson planning and concept mapping activities. Mind-net enhance collaboration among participant. However it is still early to know how the participants interact with such has environment, what cognitive and social factors are conducive to effective knowledge construction. It was suggested that further research on examining the entire process of knowledge construction is necessary.

Coffman and Riggs (2006) in their study discussed about the virtual vee map over an internet inquiry. These maps proved successful in promoting students in the areas of inquiry and data analysis using resources and data available in the internet. A post survey found that a majority a student’s enjoyed collecting and interpreting the data to find an answer to their own inquiry question.

Irvine et al. (2006) in their study investigated the concept mapping to enhance student learning in a financial accounting subject. They concluded that concept maps can assists accounting students in developing positive attitude to lifelong learning and
in becoming self directed learners by enabling them to integrate new knowledge into the framework of their existing conceptual understanding i.e. by concept mapping.

**Maloney and Simon (2006)** in their study explored experimented mapping on children’s discussions of evidence in science to assess collaboration and argumentation. They reported that the development of children’s skills of interpreting and evaluation evidence in science. This study was conducted in the UK, involved four collaborative decision-making activities to stimulate group discussion, each carried out with 5 groups of four children ranges between ten to eleven years of age. Research showed how the children evaluated evidence for possible choices and the rejection of alternative conclusions. A mapping technique was developed to analyze the discussion and identify different levels of argumentation. The researchers concluded that suitable collaborative activities that focused on the discussion of evidence could be developed to exercise children’s ability to argue effectively in making decisions.

**Wehry and Goudy (2006)** concluded that concept Mapping in secondary school arithmetic may be a developing arithmetic intervention designed to extend the chance of success in pure mathematics for sixth, seventh and eighth-grade students from low-income status. The intervention uses concept mapping to strengthen teacher understanding of the connections among mathematical ideas and to bring significant learning of connected ideas to their classrooms. This study details the progress of one cluster of seventeen lecturers as they learn to use Concept mapping tools to attach ideas in designing instruction.

**Asan (2007)** investigated the use of concept mapping in science class of fifth grade students. The study concluded that concept maps can effectively promote learning of students and thus, can be added to the teaching strategies of science teacher. The map contributes to student success, faster a long term change in thinking, and contributes to changing students learning strategies. The maps support both constructivist teaching and learning approach and may have wider applicability to the work world as well.

**Coffey (2007)** in his study explored a meta-cognitive tool for courseware development, maintenance, and reuse. The use of concept maps as meta–cognitive tools that help people to think about thinking. This work describes a network which
enable meta–cognitive tool. Based upon extension to concept maps that can be used to help course designers visualize and plan course organizations. This tool permits the user to create a novel type of course description based on the idea of an advance organizer. Course arrangements created by this method do not have the arbitrary linear sequences of topics typically found in traditional course at the college level.

**Moore (2007)** revealed concept acquisition and confidence using a spatial probability measure instrument. In this study it was found that instructional strategies for teaching concept had no relation with learners level of confidence and attitude in their knowledge based upon exposure to these instructional treatments.

**Chang and Chen (2008)** in their study investigated the learning through computer based concept mapping with scaffolding aid. They concluded that proposed concept mapping system can serve as a useful learning strategy. In this study construct on-scaffold version provided students with a semi-structure by which the students may learn well in short or medium term.

**Hay et al. (2008)** in their study investigated the role of concept mapping in higher education. They conclude that the use of concept mapping method can add significantly to the quality of university teaching. They also added that concept mapping makes learning visible. It is a lens through which the quality of learning can be determined. Teacher can use it to promote meaningful learning among their students.

**Pepper et al. (2008)** in their study investigated the effect of concept mapping on pre-service teachers reflective practices when making pedagogical decisions. They concluded that there was no difference in lesson plan quality among students using concept maps to plan instructional lessons and those not using concept maps. The method and timeline in which pre-service teachers were introduced to concept mapping in the treatment group had positive effect in the outcome of their study.

**Singh (2008)** in his study described the implication of dialogue mapping as evaluation tool in learning technology. This study has found that dialogue map was helpful in clarifying mazy thoughts to capture the objective of activity with less intervention. Discussing the linkage of the map with others group members helped student-teachers integrating their thoughts after repeatedly generated dialogue maps several
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times. Students and teachers agreed that the relationship among concepts were like bridges to connect and combine different levels of ideas and to make teaching-learning process smooth. There was substantial correlation between concept mapping ability of students and their performance in dialogic thinking exists. The study concluded that dialogue mapping is useful in integrating student’s thinking and make learning meaningful.

**Grestner and Bonger (2009)** in their study investigated the concept map structure and teaching methods in science teaching-learning process. They concluded that teaching approaches had effect on concept map structure but not on students’ longer-term learning success. Students of the teacher-centered approach produced more net structured than those students who participated in hands-on instruction. Subsequent analyses showed in total more net structures for female groups. The intervention of gender and number of nets per concept map showed significant effects on students, longer-term learning success.

**Kevin (2009)** investigated the impact of concept mapping to enhance the reading comprehension of science texts. During this study, he investigated how well seventy four, sixth grade science students described text structures from a nine hundred textbook chapter on soil conservation, given an idea map model with four super ordinate terms and twenty four unsorted ideas. Finding concluded with no vital variations were noted within the mapping performance of scholars at totally different reading levels. It was also noted in study that two-third of students indicated that they enjoyed concept mapping and would like to read and map instead of simply read without mapping. Students conjointly expressed a robust preference for mapping in pairs or small teams compared to make the concept maps alone. Multiple recommendations were provided for improving the relational thinking of students tasked with concept mapping informative science texts.

**Kumar (2009)** investigated the relative effectiveness of concept mapping and concept attainment model of instruction to study habits, styles of learning and thinking. Kumar concluded on the basis of the analysis of variance and t-test that students taught through concept mapping and concept attainment model as instructional strategy gained more in acquisition of science concepts than through conventional method. Thus, concept mapping and concept attainment model proved
superior instructional strategies to conventional method of instructional strategy in acquisition of science concepts. Students taught through concept mapping and concept attainment model did not differ significantly in acquisition of science concepts. Student having good study habits can learn more with concept mapping method of teaching. The possession good and poor study habit by students does not have any impact when taught through concept attainment model of teaching method. Study habits shows positive results for concept mapping and concept attainment model and between concept mapping and conventional method.

**Kwon and Cifuentes (2009)** in their study investigated the comparative impact of an individual basis created versus collaboratively created computer primarily based concept maps on middle school science concept learning. One hundred sixty one students completed the whole study. Previous science performance scores were used to assure equivalence of student groups. Students were allotted to three clusters/groups. First is the self -chosen study strategy cluster/group, secondly a personal concept mapping cluster /group, and a cooperative pair concept mapping cluster/ group. Collaboratively and on an individual basis constructing computer-primarily based concept maps had equally positive effects in seventh grade middle school science concept learning as measured on a comprehension test. However, the students who collaboratively created concept maps created considerably higher quality concept maps than those who on an individual basis created concept maps indicating deeper abstract understanding.

**Sabine and Franzx (2009)** in their study explored concept map structure and teaching methods in science. This study restricted the application of concept mapping to the teaching and learning of a science topic with middle school students in Germany. The main analysis questions were: - Do totally different teaching approaches have an effect on concept map structure or students’ learning success? ; is that the structure of concept maps influenced by gender? ; is that the concept maps structure a reliable indicator of students’ learning success. Sample of hundred and forty nine high achieving fifth grade students from four German secondary schools participated within the study. The common age of participant was five to ten years. Gender distribution was balanced. Students made concept maps operating in small, single sex groups. In style and methods, there have been two teaching approaches used, one
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primarily based upon teacher centred instruction and other consisting of student centred learning. Each was followed by an concept mapping phase. Student teams hold either one or the opposite teaching approach. In the study, they defined three different potential sorts of thought map structure i.e. spokes chains and nets. Constant quantity tests, like ANOVA, a method multivariate analysis and t-test style were used to establish any variations in gender, teaching approach, the range of nets per thought map and their interactions. Findings of the study state that sort of teaching approach had effect on concept map structure however not on students’ long term learning success; students of the teacher centred approach made additional internet structures than students who participated within the hands on instruction. Sequent analyses showed in total additional internet structure for feminine teams, the interaction of gender and range of nets per concept map showed a big impact on students’ long term learning success.

Tzu–Chien (2009) revealed in identifying senior high school students misconceptions about statistical correlation and their possible causes in an exploratory study using concept mapping with interviews. In the study it is found that correlation is an essential concept in statistics however students may hold misconceptions about correlation, even after receiving instruction. This study aimed to elucidate the misconceptions control by senior secondary school students regarding correlation, using the tool of concept mapping at the side of interviewing; the attainable causes of those misconceptions and the effectiveness, advantages, and limitations to adopted concept mapping using an interviewing technique for distinguishing student misconceptions. Twenty five grades 12 students who had received tuition on correlation were the subjects of this study. Concept mapping through interviewing was used to collect and analyze data in order to identify the subjects’ misconceptions, and their possible causes. Findings of the study are as follows: -Firstly, seven misconceptions about correlation were detected. Of these seven misconceptions, five were newly discovered by this study, while the order two are similar to those found by previous studies. Each of the seven misconceptions was held by 20%-68% of the subjects, showing their prevalence and significances. Secondly four major factors related to the development of misconceptions about correlation were identified which are learning materials, language, daily life experiences, and existing mathematical concept. Thirdly the concept mapping through the interviewing technique adopted in
this study was effective in detecting misconceptions about statistic, especially in revealing new misconceptions, and it was also helpful in exploring their possible causes.

Yavuz (2009) in his study explored paper based and computer based concept mapping and its effect on computer anxiety, computer achievement and computer attitude. This study was purposed to match the results of paper based and computer based concept mappings on computer hardware achievement, computer anxiety and computer attitude of the eight grade middle school students. The students were arbitrarily allotted to three teams and were given instruction on computer hardware. The teaching strategies used for every team were the conventional, paper based construct mapping and computer based concept mapping. At the end of a four week instruction, post-tests were administrated to assess computer hardware achievement, computer anxiety and computer attitude of the students. The findings indicate that paper based and computer based concept mapping methods turn out higher results than the conventional strategy. However, the results of paper based and computer based concept mapping methods weren't considerably totally different.

Buldu and Buldu (2010) in their study investigated the usefulness of concept mapping as a formative assessment in teacher education programs in UAE and evaluated the student teachers’ satisfaction with concept mapping. The results revealed that concept maps were informative for teacher educators and have the potential to improve student teachers’ learning and contribute to their awareness of learning process.

Pie–lin et al. (2010) in their study explored the effects of a computer assisted concept mapping learning strategy on EFL college students’ English reading comprehension. The purpose of this research was to investigate the effects of a computer assisted concept mapping learning strategy on EFL college learners’ English reading comprehension. The research question were; firstly what was influence of the computer assisted concept mapping learning strategy on different learners’ English reading comprehension? Secondly did the computer assisted concept mapping learning strategy effect learners’ use of other English reading strategies? One hundred ninety four freshmen who were enrolled in the English course were divided into low level and high level groups according to their English proficiency. A
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computer assisted concept mapping learning strategy was introduced to the learners in the experimental class to improve their reading ability. Through two way ANOVA analyses, it was found that the computer assisted concept mapping learning strategy has greater reading benefit for the low-level group than for the high level group. From findings of the study it is found that the independent sample t-test analysis indicated that the computer assisted concept mapping learning strategy enhanced learners’ use of other English reading strategies like reviewing, listing and enforcing.

Aggarwal (2012) investigated the effectiveness of computer based concept mapping in the acquisition of concept of chemistry in respect to attitude towards science. In the study it is concluded that students instructed through computer based concept mapping were found to have achieved significantly high in the acquisition of elements of chemistry than those students who were instructed through traditional method of teaching. Thus, computer based concept mapping proved better instructional strategy over traditional method in the acquisition of concepts in chemistry. Gender proved as an insignificant factor in the acquisition of concepts of chemistry. Attitude towards science was found to be considerably affected the mean achievement scores of students in the acquisition of concepts of chemistry. Students with the high attitude towards science achieved considerably more than students with low attitude toward science. The study additionally concluded that there is no important interactional impact of instructional strategy and gender was found on the achievement of students within the acquisition of the concepts of chemistry. Students having high attitude towards science moreover as low attitude towards science achieved higher when instructed through computer based concept mapping. Therefore the study concludes that there was no important impact of instructional strategy, gender, and attitude towards science on the action of students within the acquisition of concepts of chemistry

Saeedi et al. (2013) in their study compared effectiveness of methods of presentation and providing concept maps on reading comprehension. They concluded that presentation of pre-prepared concept maps significantly improve comprehension, compared to map generation. But paper-pencil and computer passed concept mapping compared to the control group were not statistically significant. They also concluded that the best way for use of concept maps is teacher-generated concept maps with texts.
Farzane et al. (2014) in their study concluded that concept mapping as educational method was better than lecture-based traditional method on education for evidence based educated medical topic via CAT’s. Twenty eight male and forty eight females were participated in this study. Total score among experimental group was higher than control group (78.2% vs. 72.5%, p < 0.001). Subgroup analysis revealed significant differences between scores of students in the experimental group and scores of students in the control group in the diagnostic section of questions (81.0% vs. 71.5%, P < 0.001). The scores of students in the experimental group were also significantly higher than control group in physiopathology section of questions. No statistically significant difference was discovered between two groups in scores of answers to treatment section of questions. The study concluded that the field of EBM, simplicity of learning by concept mapping is an opportunity which may help medical students to learn and criticize better concepts.

Marinkovic and Gimnazija (2014) in their study concluded that Maps enable students to perceive the concepts and relationships among them; the maps visualize, organize and distinguish concepts by their importance; maps develops mathematical literacy; maps connect a new knowledge with the old one; maps evaluate learning process; maps expand their knowledge; apply mapping method to other contents; become more active; get better results by working in groups or pairs; develop their communication skills through the presentation of conceptual maps and discussion. Maps allow teachers to teach students how to learn with understanding; provide comprehensive view of the lesson; organize teaching material; visualize the teaching process; introduce new concepts and link them with the known; decompose complex ideas; check the level of understanding; identify weak points; explore the reasons for misunderstanding among students; encourage student activities; connect interdisciplinary. The study also concludes that the disadvantages of the concept mapping i.e. use of limited size paper (if we restrict ourselves to A4), duration of a lesson (45 min); disadvantages related to the content of lessons with a lot of new or similar concepts; Lessons that have linear structure; Mapping cannot be used at any time (for different reasons), but we can use already made maps.

Chia and Chen (2015) in their study identified three categories of concept mapping i.e. isolated concept maps, departmental concept maps and integrated concept maps. It
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appears that problem based learning can help students to engage in integrated concept mapping and achieve a more integrated knowledge structure. The findings also revealed that the effect of problem based learning on the acquisition and integration of knowledge was robust. In order to solve the problems in problem based learning, students connect descriptive knowledge with procedural knowledge and create more details and cross links in the knowledge of structure. The finding of this study suggest that educators aiming to enhance their students’ knowledge structures should incorporate problem based learning and concept mapping in the curriculum.

Paul and Bernard (2016) in their study concluded that secondary school teachers perceive concept maps as a useful and effective assessment tool. Teachers also concurred that the use of concept maps is good way of assessing learner retention of learned concepts they also concluded that concept maps provides a quick snap shot of learners prior knowledge before engaging them in teaching and learning process. In this study teacher expressed discontentment over the use of concept maps as possible replacement to traditional examination and concluded that concept maps was valuable for formative rather than summative assessment.

OVERVIEW:

Teaching through concept mapping as one of the instructional strategy for experimental groups plays vital role in research work. Experimental groups taught through concept mapping performed higher in comparison to control group on the achievement tests and the students of experimental group shows positive attitude toward concept mapping (Manjula, 1990). The use of concept mapping in teaching complex notions in geography increases the students understanding (John and john, 1998). Concept maps were also used to reveal important changes in the knowledge bases of pre-service teachers (Cox et al, 1998) and conceptual changes was measured in pre-service teachers by using concept maps in special education courses (Satanley et al, 1998). Teaching through concept maps with aid to microteaching were also found beneficial (Butler, 2001). Concept maps as teaching tool facilitate the learner to develop meta-cognitive skills (Carroll and Timpson, 2002). Concept mapping as an instructional method gave positive effect on experimental group in cooperative learning (Brown, 2003). Use of concept mapping in organic chemistry laboratory by explaining each experiment with the help of concept maps decreases the questions
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Concerning setup and procedure (Gahr, 2003). The use of concept mapping techniques and technology for education and performance was positively supported (Caffey et al, 2003). Construction of concept mapping in cooperative learning improves the students’ ability to access answers for challenging questions in biology (Preszler, 2004). Concept mapping also assists accounting students in developing positive attitude to lifelong learning (Irvine et al, 2006). Concept mapping in middle school mathematics is a developing mathematics instruction which is designed to increase the likelihood in different indexes of mathematics (Wehry and Goundy, 2006). Concept map effectively promotes the learning of students in science classes and can be added to teaching learning strategies (Asan, 2007). Teachers can use concept mapping to promote meaningful learning among their students by using concept mapping as one of the teaching strategy in teaching-learning process (Hay et al, 2008).

Based on above studies and the studies conducted by Pepper et al (2008), Singh (2008), Grestner and Bonger (2009), Kwon and Cifuentes (2009), Kevin (2009), Kumar (2009), Tzu–Chien et al (2009), Yavuz (2009), Sabine and franzx (2009), Pie–lin et al (2010), Liu et al (2010), Buldu and Buldu (2010), Aggarwal (2012), Saeedi et al (2013), Farzane et al (2014), Marinković and Gimnazija (2014), Chia and Chen (2015), and Paul and Bernard (2016) concludes that concept mapping shows positive results in teaching learning process as compared to traditional method of teaching. It has also seen that teaching students through concept mapping result in positive attitude and increases the study habit towards their subject in which concept maps are used. Concept mapping also contributes awareness not only to students but also to teachers in the process. Thus as the result of all studies, concept mapping proves superior instructional strategy in different subjects and shows significant effect on students’ learning process.

2.3.0 STUDIES RELATED TO CONCEPT MAPPING AND ACHIEVEMENT

Saritas and Akdemir (2000) identified the factors affecting the mathematics achievement of students through collecting opinion of mathematics department students. Results revealed that instructional strategies and methods, teacher competence in mathematics education and motivation or concentration were the three
most influential factors that should be considered in the design. The result also highlights the need to customize instruction to optimize the performance of each individual student. Study also concludes that instructional designers need to develop flexible teaching and learning based on awareness of students experience and background, subject matter and instructional communications and technology.

Chularut and DeBakers (2003) in their study investigated the influence of a particular learning strategy i.e. concept mapping, on learning from text among students for whom English is not a first language. It was concluded that the concept mapping would not only have a positive impact on students but would affect self-regulation and self-efficacy as well.

Regensburg et al. (2004) focused on one amongst the theoretical classification regarding emotions that are directly associated with learning and achievement in mathematics. In the study, emotions are classified according to their valence i.e. positive vs. negative and their levels of activation. In testing the idea of this model, it had been investigated regarding the students’ enjoyment, anxiety, anger and tedium experienced before, throughout and after the completion of a mathematics test. The study concludes that the academic emotion in mathematics is directly associated with learning and achievement.

Heinze et al. (2005) in their study focused on students mathematics achievement and their interest in mathematics as well as on the relation between these two constructs. The study concluded from the result that the classroom level and, thus, probably the instructions has an influence on the development of achievement in reasoning and proof. Teachers should rely on a sound knowledge base for solving proof tasks, but they should be able to generate proving strategies and to pursue then by adequate mathematical methods. In particular last two aspects were obtained primarily within the mathematics classroom. The study also gives the clear difference between the classroom as for as their achievement and their interest and motivation are concerned. The study also concludes that no significant correlation between these variable could be identified.

Pankratius (2005) in his study, concluded that the positive effect of concept mapping on science achievement. The researcher also concluded that mapping concepts prior to, during, and subsequent to instruction led to greater achievement.
Caldwell et al. (2006) in their study concluded that the introduce of concept mapping as a component of teaching and learning strategy increases the achievement and interest of the participating students in learning about mathematics and its applications.

Boujaoude and Altieh (2007) in their study examines whether or not the construction of concept maps by students improves their achievement and ability to solve higher order questions in chemistry; to investigate the differential effect of treatment by gender and achievement level and to explore the relationship between performance on concept maps and chemistry achievement. Findings of the study concluded that there were significant correlation between students scores on higher level convergence and concept map scores and no differential effect of treatment on gender.

Chiou (2008) concluded that adopting concept mapping strategy will considerably improve students’ learning action compared to using a traditional method of teaching and most of the students were happy with construct mapping in a complicated accounting course. The study additionally concluded that concept mapping may facilitate to grasp, integrate and clarify accounting concepts and enhance their interests in learning accounts.

Namasaka (2009) concluded the positive effect of concept and Vee mapping strategy on students’ achievement and motivation in biology in mixed provincial secondary schools in Uasin Gishu district, Kenya. The study was quasi-experimental in nature Research based on the Solomon four group designs was used. All the students in secondary school in Uasin Gishu district constituted the target population. Four schools were samples, randomly assigned to experimental and control group. The research instruments used to collect data included the Biology Achievement Test and students’ Motivation Questionnaires. The data was analyzed using one-way ANOVA and t-test. Hypotheses were tested at alpha and are equal to 0.05 level of significance. Findings of the study show that students taught using CVMS had higher motivation and achievement than student taught using the traditional method. The study also concluded that students’ gender did affect achievement in biology where females performed better than male students. It is therefore concluded that CVMS is an effective approach in improving students’ performance in biology in secondary
schools as well as reducing the gender disparity in achievement.

Nnamdi et al. (2010) examined the effect of concept mapping and problem-solving teaching strategies on achievement in biology among Nigerian secondary school students. Their study was quasi-experimental pre-test treatment design. One hundred and thirteen students randomly selected from three mixed secondary schools from Delta North Senatorial District of Delta state, Nigeria. The experimental group was taught selected topics in Genetics using concept mapping and problem-solving strategies while the control group was taught using the conventional method. The study concluded that the experimental group performed significantly better in Genetics than control group and that gender does not affect students’ achievement in biology.

Schaal (2010) in his study concluded that concept maps use as well as the sum of motivational variables significantly influence the achievement, both indicating strong effect sizes. Result also reveals different achievement levels for low and high intensity concept map users and concept map influence the learning outcomes within the domain of human biology.

Sharma (2010) concluded that students taught through concept mapping acquired and retained more concepts of environmental awareness. Results also indicated that instructional strategies, achievement motivation, and cognitive style did not interact significantly to show variation in the acquisition of concepts of study.

Nnamdi et al. (2010) examined the impact of concept mapping and problem-solving teaching methods on achievement in biology among Nigerian secondary school students. Their study was quasi-experimental in nature. One hundred and thirteen students were haphazardly chosen from three mixed secondary schools from Delta North senatorial District of Delta state, Nigeria. The experimental group was instructed chosen topics in genetics using concept mapping and problem-solving ways whereas the control group was taught using the traditional method. The results of the study showed that the experimental group performed significantly higher in genetics than the control group and that gender doesn’t have an effect on students’ achievement in biology.
Rani (2011) in her study concluded that there is significant effect on instructional strategies i.e. concept mapping and conventional mapping on science among IX grade students. The study also concludes that: (a) There is no significant difference between science achievements of students with high and low-test anxiety. (b) There is no significant difference between science achievements of students with high and low self-efficacy. (c) There is no significant interaction between instructional strategy (concept mapping and conventional mapping) and test anxiety with regard to science achievement among IX grade students. (d) There is no significant science achievement among boys and girls of IX grade; no significant interaction between instructional strategy concept mapping/conventional method and gender on science achievement; no significant in test anxiety among boys and girls and no significant in self-efficacy among boys and girls.

Kaur (2012) in her study concluded that: (a) Group taught through concept mapping exhibit better performance as compared with conventional method. Therefore, concept mapping has a positive effect on achievement in mathematics. (b) There is significant difference in achievement of both groups in relation to high, average, and low level of intelligence. (c) There is insignificant difference in the mean gain scores of boys and girls when taught with the help of concept mapping thus concluded that the boys and girls get equal benefit from teaching through concept mapping.

Udeani and Okafor (2012) in their study investigated the comparative effectiveness of the informative and concept mapping instructional strategy of presenting middle school biology concepts to slow learners. One hundred and twenty four biology slow learners were identified and at random allotted to the expository group of sixty two students and concept mapping group of sixty two students and instructed the concept of photosynthesis. The groups were post-tested after two weeks of teaching for any important variations in biology achievement. Analysis of post-test scores indicated that the group taught by concept mapping instructional strategy performed considerably higher than their expository group counterparts.

Miandoab et al. (2012) in their study investigated the effect of concept mapping instruction on students’ learning performance in a history course. The study consisted of forty three high school male students of third grade. They were divided
into two groups i.e. concept map instructional group and control group. Four weeks of experimental instruction were given to the experimental group. Students’ progresses were examined by pre-test and post test measurements. The experimental results showed that subjects in the experimental group performed significantly better than control group.

Sharma et al. (2013) in their study concluded that post-test achievement scores of the students of the control group were significantly higher than their pre-test achievement score. They also found from their study that post-test achievement scores of the students of the experimental group were higher than their pre-test achievement scores. Significant difference between the mean scores of post-test for the achievement test administered to the control group and experimental group both at .005 and 0.01 levels was found. This difference between the mean scores of the students of the two groups are quite significant showing the effectiveness of the learning through concept maps over lecture method and proving that concept maps play a positive role in the enhancement of learning basic concepts of science. The result of the study revealed that the experimental group performed better than the control group in all achievement areas.

Kumar (2014) in his study revealed the impact of teaching through concept mapping in Social Studies. The result of the study revealed that mean scores of post-tests of elementary school students having educated parent higher than those having uneducated parents, it indicates that teaching through concept mapping has the significant effect on the achievement in social studies. This means that there is a significant difference between post-tests among elementary school students belonging to high and low socio-economic status parents on the achievement in social studies after teaching through concept mapping.

Chawala and Singh (2015) in their study investigated the effect of teaching through concept mapping on the achievement in chemistry among girls. The sample of the study consisted of fifty nine girls in experimental group and fifty nine girls in controlled groups of IX class from two government school of Ludhiana district. The experimental group was exposed to concept mapping method and the controlled group was exposed to the traditional method of teaching i.e. lecture and discussion for twenty-five days. Mixed group intelligence test was used to match the groups.
Achievement test in chemistry (developed and standardized by the investigator) were used as a tool for data collection. The result of the t-test analysis of the gain scores showed the achievement in the chemistry of the girls taught by the concept mapping was significantly more ($p>0.045$) as compared to girls taught with the traditional method.

Ogonnaya et al. (2016) in their study investigated that the effect of concept mapping on students achievement in basic science. The study was based on quasi-experimental design. There were one hundred and twenty two students from two secondary schools drawn from the population through a simple random sampling. One school was used for treatment and therefore the different school was used for control. The treatment group was instructed basic science with concept mapping approach whereas the other group was instructed with the normal technique of teaching. Three research questions and three null hypotheses guided the study. Mean variance and therefore the analysis of co-variance (ANCOVA) was used to analyze the data. The result of the study concluded that the concept mapping increases the student's achievement in basic sciences than the traditional method of teaching. Concept mapping boosts the achievement in each male and female student. Additionally, to the results of the study, there's no interaction between gender and teaching methods on students achievement in basic science.

**OVERVIEW:**

The instructional strategies, teacher competence in subject and motivation are three most influential factors that affect the achievement of the learner (Saritus and Akdemir, 2000). The use of concept mapping as instructional strategy have positive impact on students and affects self regulation and self efficacy as well (Chularat and DeBakers, 2003). Concept mapping had positive effect on science achievement. Concept mapping prior to instructions, during instructions and subsequent to instructions leads to greater achievement (Pankratius, 2005). Concept mapping as a component of teaching and learning strategy increases the achievement in mathematics (Caldwell et al, 2006)

(2012), Sharma et al (2013), Kumar (2014), Chawala and Singh (2015) and Ogannaya et al (2016) found that the concept mapping shows significant effect on achievement of students in different subjects. The studies also concludes that introduce of concept mapping as a component of teaching and learning strategy increases the achievement of students in their learning process as comparative to the process of teaching learning through traditional method.

2.4.0 STUDIES RELATED TO CONCEPT MAPPING AND CREATIVITY

Riley et al. (2004) in their study investigated the use of ICT based concept mapping techniques on creativity in literacy tasks. They concluded that pupils using concept mapping intervention significantly improve their non-verbal reasoning age-standardized scores over a control group with higher baseline who scores remains constant. Evidence linking this with using ICT-based concept mapping remains inconclusive. Correlation studies shows that writing achievement and creativity are linked and that writing achievement and concept mapping connectivity are linked. However there is no conclusive evidence for linking connectivity and creativity.

Illa (2006) in their study investigated the effect of concept mapping on the students’ creativity in secondary school Physics. It is investigated that the effect of concept mapping strategy on students’ creativity. The study was quasi-experimental in nature. A sample of one hundred respondents in four schools took part in the study. Physics creative test and concept map assessment-test were used to assess the students’ scientific creativity level and to evaluate the quality of the concept maps developed by the students. Result of the study showed that the students who used the concept mapping strategy obtained higher scores in the physics creative test than those who did not.

Hsu and Chang (2011) investigated the connection between computer-based concept mapping and creative performance. They investigated that concept mapping helps students produce digital films. The results of the content analysis and knowledgeable evaluations showed that computer-based concept mapping advantages students’ artistic and thinking skills. Students learn to use the code, think about and construct design structure, solve design issues, clarify ideas and use it to provide work, so increasing their imaging, visualizing, and dimensional thinking
skills. The results of the study show that the appliance of computer-based concept mapping received approval for students; Students’ computer based concept mapping performance will directly associate with their video production performance and students computer based concept mapping performance effectively predict their creative performance.

Simper (2014) investigated the undergraduate education students, twenty eight in number, who were randomly assigned to either concept map planning or text planning for the production of digital photo stories. The highest scoring photo stories were novel, interesting, clear, and able to be understood. The older participants scored higher for each of the dimensions, yet the concept map group was younger than the comparison group. Using age and concept map experience as covariates, a multivariate effect was found, and the concept map group produced photo stories with significantly higher clarity. These results suggest that the use of concept maps for planning aids aspects of creative development, and results in clearer creative communication.

Vijaykumari and Kavithamole (2014) in their study focused to investigate the effect of mind mapping on Mathematical creativity. The study conducted on a sample of hundred students with fifty students each in the experimental and control groups established that Mind mapping is highly effective in developing mathematical creativity among higher secondary school students of Kerala, both for male and female students.

Auta (2015) in his study investigated the comparative effects of concept mapping and inquiry methods of teaching on the academic achievement and creativity of Colleges of Education physics students in the North-East Nigeria. The study was a pre-test post-test experimental match group design. The population of the study consisted of two hundred and forty-seven physics students from seven state Colleges of Education in the North-East Zone. Two out of the seven colleges were sampled using simple random sampling technique by flipping a coin, the two colleges were designated experimental group 1 (E1), and experimental group 2, (E2). Intact class were used for the study. The two groups were subjected to a treatment for six weeks each. Thirty-three students were used in experimental group (E1) and thirty-four were used in experimental group 2 (E2). Physics Achievement Test was used to measure their
academic achievement while Ibadan Creativity Assessment Scale (ICAS) was used to measure their creativity. Two research questions and a corresponding two null hypotheses were raised with a view to finding out if there was any significant difference in the academic achievement and creativity of the students taught physics concepts using concept mapping and inquiry strategies of teaching respectively. The first hypothesis was tested using t-test statistic while the second hypothesis was tested using two-ways analysis of variance. Both hypotheses were tested at $P \leq 0.05$ level of significance. The findings of the study showed that there was no significant difference between both groups in their academic achievement after treatment. The study concluded that (i) There is no significant difference between the post-test mean scores of the experimental group E1 taught physics concepts using concept mapping strategy and experimental group E2 taught the same concepts using inquiry teaching strategy. And (ii) there is no significant difference between the creativity traits of fluency, flexibility, originality and motivation after the post-test of the experimental group E1 taught physics concepts using concept mapping strategy and experimental group E2 taught the same concepts using inquiry strategy of teaching.

Reeve and Kirby (2016) investigated the result of concept mapping on creativity in picture series. They investigated the utilization of concept mapping to support the event of creativity in picture series. Hypothesizing during this study is that the skill taught to support organization would improve creativity or not. Concept maps are applied to story development beneath the assumption that the creative development of narrative components needs organization. Beneath graduate education, students were assigned to either concept maps or text based planning groups for the assembly of picture series. Creativity was operationalised using dimensions of novelty, interest, clarity and skill to grasp. A variable result of designing technique was found for these dimensions favouring the concept map group, due largely to greater clarity in picture series. Clarity in picture stories odds to their utility as creative products. This study represents beginning towards empirical assessing concept maps for creative purpose.

OVERVIEW:

The students taught through concept mapping obtain higher scores in their creative tests with respect to those who did not (Ili, 2006). Computer based concept mapping also laid positive effect on their creative performance (Hsu and Chang,
2.5.0 STUDIES RELATED TO MATHEMATICS ANXIETY

Sahin (2008) in his study investigated the mathematics anxiety among IV and V grade Turkish elementary school students. Study concluded that students’ mathematics anxiety differed significantly according to gender and achievement level in mathematics, whether they liked their mathematics teacher or not. Female students reported significantly higher mathematics anxiety than males. Students who liked mathematics class and those who liked their mathematics teacher had low anxiety. However results did not show any significant difference in students’ mathematics anxiety with respect to their grade level and gender stereotype about success in mathematics.

Karimi and Venkatesam (2009) investigated mathematics performance, mathematics anxiety, and academic hardiness in school students. The study was concluded with the result that larger difference in mathematics anxiety is important; whereas no significant difference is detected between male and female students in mathematics performance and academic hardiness. It is also concluded that performance of the students in mathematics is often perceived by mathematics anxiety and female students scored higher on the variable, however, this relation has not observed with academics hardiness.

Patrick (2010) in their study investigated the learning statistics using maps and its effects on anxiety and performance. In the study it is concluded that anxiety prediction for this study was that the use of concept mapping would significantly decreases the overall statistics anxiety of the students in concept map group and that these students would have less statistics anxiety over the semester that the students in control group. The result does not support this hypothesis. In this study the academic performance of the concept map group remained relatively stable and similar to the
control group throughout the course of semester. However significant difference was found between the proficient concept map users and the control participants on the computational scores, significant difference was found between the concept map users and control participants on the conceptual scores and total scores.

Erdogan et al (2011) in their study investigated the prediction of high school students’ mathematics anxiety by their achievement motivation and social comparison. In the study they examined the relationship between the predictor variables as students’ achievement motivation and social comparison and the dependent variables, mathematics anxiety. The study concluded that by multiple linear regression analysis that achievement motivation and social comparison together are significant predictors of high school students’ mathematics anxiety.

Devine et al. (2012) in his study investigated the gender difference in mathematics anxiety and relation to mathematics performance, controlling test anxiety. They concluded that secondary school children experience mathematics anxiety, they controlled for test anxiety, which is typically not controlled in mathematics anxiety. In the study girls showed higher levels of mathematics anxiety than boys and high levels of mathematics anxiety were related to poorer levels of mathematics performance. The study also showed no gender difference in mathematics performance, despite girls reporting higher levels of mathematics anxiety.

Zakaria et al. (2012) investigated mathematics anxiety and achievement among middle school students. They concluded that middle school students’ mathematics anxiety level in Selangor, Malaysia is at a moderate level. The study found that there was no significant difference in mathematics anxiety levels of students according to gender. The study conjointly showed the significant difference between students’ mathematics achievement based on their arithmetic anxiety levels. Students who are high achievers have the lower level of anxiety whereas low achieving mathematics students have high levels of anxiety. This can be as a result of high achievers have a strong understanding of mathematics and have a lot of confidence than low achievers.

Ramirez et al. (2013) investigated mathematics anxiety, memory and math achievement in early school. They explored whether or not mathematics anxiety relates to young children math achievement. Sixty nine boys and eighty four girls got
Review of Related Literature

a measure of mathematics achievement and working memory. They found a negative relationship between mathematics anxiety and mathematics achievement for children who were higher but lower in working memory. High working memory individuals tend to rely on working memory intensive solution strategies, likely disrupted when working memory capacity is co-opted by mathematics anxiety.

Chang and Beilock (2016) in their study gave suggestions for future studies that future studies may enhance our understanding of mathematics anxiety-mathematics performance association by identifying various contextual factors that mediate or moderate this relation and may also develop effective interventions by targeting highly mathematics-anxious individuals as well as their parents and teachers. Further, multiple levels of analysis across genetic, psycho-physiological, behavioral, and self-report assessments across populations with diverse socio-cultural backgrounds are needed to delineate the specificity of mathematics anxiety and the extent to which it is associated with mathematics performance. Lastly, development of longitudinal studies would be critical in understanding the ontogeny of mathematics anxiety, how it affects mathematics performance across development, the nature of the (causal) link between mathematics anxiety-math performance, and what kinds of interventions may be the most beneficial in the long run.

OVERVIEW:

Students who liked mathematics class and mathematics teacher have low mathematics anxiety (Sahin, 2008). The performance of the students in mathematics can be perceived by mathematics anxiety but there is no significant difference detected between boys and girls (Karimi and Venkatesm, 2009). The use of concept mapping as instructional strategy decreases the overall anxiety of the students (Patrik, 2010). Students who are high achievers have low anxiety and the students who are low achievers have high levels of anxiety (Zakaria et al, 2012)

Based on above studies and the studies conducted by Ramirez et al (2013) and Chag & Beilock (2016) founds that female students reported with high math anxiety and students who likes mathematics class and mathematics teacher has low math anxiety. Studies also showed that there is no gender difference in the mathematics performance. It is also found that performance of the students in mathematics can be perceived by math anxiety i.e. higher the anxiety in mathematics poorer is the performance and lesser the mathematics anxiety, better is the
2.6.0 STUDIES RELATED TO CONCEPT MAPPING AND ANXIETY, MATHEMATICS ANXIETY AND MATHEMATICS ACHIEVEMENT, MATH ANXIETY AND MATHEMATICAL CREATIVITY.

Olugbemiro et al (1990) in their study investigated the result of concept mapping on students’ anxiety and achievement in biology. It was concluded that the utilization of concept mapping is useful in meaningful learning in science classrooms. This study also concluded that the use of concept mapping strategy reduces anxiety and thereby enhances achievement in biology. Fifty one students i.e. thirty male students and twenty one female senior secondary, tenth class students participated in the experimental study. The study concluded that concept mapping is significantly more effective than the traditional method of teaching in enhancing learning in biology. The study also concluded that concept mapping strategy reduces students’ anxiety towards the learning of biology. A significant reduction of anxiety was noticed for male students.

Wither (1998) in his longitudinal study over five years provides the elaborate relationship between mathematics anxiety and mathematics achievement. It starts from the already well documented indirect correlation between mathematics anxiety achievement and seeks to ascertain three hypotheses. Firstly the mathematics anxiety causes an impairment of mathematics achievement. Secondly the dearth of mathematics achievement occurs anxiety in mathematics and thirdly that there is an underlying reason for the first two. The results of this study were a complete surprise and also the first hypothesis was rejected. The study concluded that reduction in mathematics anxiety could be a laudable goal in itself however it doesn't bring with it an improvement in achievement and this study is comfortable to warrant the expenditure of cash and efforts on such programmes. So this study raises a big question mark over the belief that mathematics anxiety could be a reason for poor achievement in mathematics.

Prakash (2000) studied the relationship between anxiety and mathematical creativity. The hypothesis was that there is significant relationship between the anxiety and mathematical creativity. The sample comprised four hundred students (boys and girls) of VII class who were studying in government/private senior
secondary schools of rural-urban areas in Chandigarh. The sample was selected by stratified random sampling method. Comprehensive Anxiety Scale by Sihna and Moghe Test of Creativity in Mathematics were used for data collection. The data were analyzed by correlation technique. Mathematical Creativity was found to be insignificantly co-related with anxiety.

Johny (2008) studied the relationship between mathematics anxiety and mathematical creativity. The study conducted by the investigator on the five hundred secondary students of Kerala (South India). The data were analyzed with Pearson’s product moment coefficient of correlation. The relation between anxiety in mathematics and mathematical creativity was found to be real and low but negative.

Maloney et al. (2015) in their study explored how parents’ anxiety about mathematics related to their children’s math achievement. The goal of the study was to better understand why some students perform worse in mathematics than other subjects. In the study it is tested whether parents’ mathematics anxiety predicts their children’s mathematics achievement across the school year. It was found that when parents are more math anxious, their children learn significantly less math over the school year and have more mathematics anxiety by the school year’s end-but only if math-anxious parents report providing frequent help with mathematics homework. Notably, when parents reported helping with mathematics homework less often, children’s mathematics achievement and attitudes were not related to parents’ mathematics anxiety. Parents’ mathematics anxiety did not predict a child’s reading achievement, which suggests that the effects of parents’ mathematics anxiety are specific to children’s mathematics achievement. These findings provide evidence of a mechanism for intergenerational transmission of low mathematics achievement and high mathematics anxiety.

Puteh and Khalin (2016) in their study identified the mathematics anxiety and its relationship with the achievement of students in Perak Tengah district, Malaysia. The design of the study is using the quantitative method and the data was collected by using a questionnaire of Student Math Anxiety Scale (SKMP). The results of the study showed that the level of mathematics anxiety of the students was at moderate level with $M = 2.55$, $SD = 0.72$. Analysis of the t-test results for gender show that there is no significant difference with $t = -0.889$, $p <0.05$ between the level of mathematics anxiety of female students compared to the male students.
Ramirez et al. (2016) in their study concluded that the relation between mathematics anxiety and mathematics problem solving strategies is strongest in children with the highest working memory capacity. Ironically, children who have the highest cognitive capacity avoid using advanced problem solving strategies when they are high in mathematics anxiety and, as a result, underperform in mathematics compared with their lower working memory peers.

OVERVIEW:

The relationship between mathematics anxiety and mathematical creativity is real and low but negative (Parkash 2000; Johny, 2008). Those students which have low mathematics anxiety have high mathematics achievement and students with high mathematics anxiety have low mathematics achievement (Maloney et al, 2015; Puteh and Khalin, 2016). The effect of concept mapping is also seen on anxiety. Teaching through concept mapping as one of the teaching strategy reduces the anxiety and thereby enhances the achievement (Olugbemiro, 1990).

Prakash (2000), Johny (2008), and Fetterly (2010) investigated relationship between mathematics anxiety and mathematical creativity be real and low but negative. Haylock (1987) investigated the relationship between anxiety towards Mathematics, test anxiety and Mathematical Creativity. Anxiety towards Mathematics and test anxiety were assessed by means of questionnaire based on items from the Mathematics Attitude Inventory developed by the National Science Project at the University of Minnesota from Wallach and Kogan’s (1965) work. Mathematical Creativity was assessed with Divergent Production (DP) scores and Overcoming Fixation in Mathematics (OF) scores to different types of test developed by the investigator. Findings of the studies were: (1) There was inverse relationship between anxiety towards Mathematics and Mathematical Creativity, (2) There was negative correlation between test anxiety and Mathematical Creativity in case of the very high attaining group.

But the result of the longitudinal study conducted by the Whiter (1998) was surprising that reduction of anxiety in mathematics is a laudable goal in itself but it does not bring with an improvement in achievement. This study leads to a big question over the assumption that mathematics anxiety is a cause of poor achievement in mathematics.
Thus based on above studies and studies conducted by Haylock (1987), Prakash (2000), Johny (2008), and Fetterly (2010), Ramirez et al (2016), it is found that mathematical creativity is insignificantly correlated with math anxiety and that there is negative relation between math anxiety and mathematical creativity. The students with high math anxiety shows less creative performance and students with low math anxiety have better creative performance in mathematics.

2.7.0 RATIONALE OF THE STUDY

Concept mapping has been widely recommended in teaching of different subjects in different countries like Germany, India, Japan, Kenya, Korea, Malaysia, Nigeria, Turkish, United Arab Emirates and UK. As compared to these countries very less work has been done in India. There are number of studies, which support the idea, that use of concept mapping can extend and enrich students’ learning in different subject like in Basic Science, Geography, Special Education, Biology, Chemistry, Physics, English, in Higher Education and only some studies are seen in mathematics. Most of the work is done in science subjects and very less work is done in Mathematics. These studies in different subjects highlights the effect of concept mapping on achievement, cognitive skills, attitude of students, and its effectiveness across gender (Caldwell and Rubaee, 2006 and Kaur, 2012). Illa (2006) studied the effect of concept mapping on students’ creativity. No study has been found in which effect of concept mapping in mathematics is seen on mathematical creativity of students. Commonly students have anxiety in different subjects. To overcome the anxiety different instructional strategies were used and only the effect of concept mapping on students’ anxiety and achievement in biology (Olugbemiro et al, 1990) is seen, but no study has been accounted showing the effect of concept mapping in relation to math anxiety.

With this, it can be concluded that teaching through concept mapping is a new teaching strategy in mathematics and is to be adopted by mathematics teachers in India especially in government institutions. Very small amount of work had been carried out in India covering population of Chandigarh in study habits and styles of learning and thinking, environmental awareness and science (Kumar, 2009; Sharma,2010; and Rani, 2011)), covering population of Amritsar (Punjab) [Kaur
Review of Related Literature

(2012), and covering population of Ludhiana(Punjab) (Chawala and Singh ,2015). However, there is no study in which effect of concept mapping in mathematics on achievement and mathematical creativity in relation to anxiety in mathematics has been seen. Therefore, the conduct of the present study to know the effect of concept mapping in mathematics is justified. It will reveal the effect of concept mapping in mathematics on achievement and creativity of the students. Thus by filling the gaps in research evidences of concept mapping in mathematics.

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