CHAPTER 2: REVIEW OF RELATED LITERATURE

2.1. INTRODUCTION

A literature review is important for describing how proposed research is related to prior research in terms of findings. It shows the originality of research, its relevance as and the gap in the literature that the research intends to address. For that reason, this chapter discusses the conceptual understanding of mathematics and the history of Art Integrated Learning. This section further outlines the literature on the perceived benefits of Art Integrated Learning as well as the supposed impact of Art Integrated Learning. Moreover, this chapter reviews some literature on the experiences of learners who have been exposed to Art Integrated Learning and incorporates essential feedback from teachers.

2.2. CONCEPTUAL UNDERSTANDING OF MATHEMATICS

Conceptual understanding refers to an integrated and functional grasp of mathematical ideas. Students with conceptual understanding know more than isolated facts and methods. They understand why a mathematical idea is important and the kinds of contexts in which is it useful. They have organized their knowledge into a coherent whole, which enables them to learn new ideas by connecting those ideas to what they already know. Conceptual understanding also supports retention. Because facts and methods learned with understanding are connected, they are easier to remember and use, and they can be reconstructed when forgotten. If students understand a method, they are unlikely to remember it incorrectly. They monitor what they remember and try to figure out whether it makes sense. They may attempt to explain the method to themselves and correct it if necessary. Although teachers often look for evidence of conceptual understanding in students' ability to verbalize connections among concepts and representations, conceptual understanding need not be explicit. Students often understand before they can verbalize that understanding.

Conceptual understanding frequently results in students having less to learn because they can see the deeper similarities between superficially unrelated situations. Their understanding has been encapsulated into compact clusters

of interrelated facts and principles. The contents of a given cluster may be summarized by a short sentence or phrase like "properties of multiplication," which is sufficient for use in many situations. If necessary, however, the cluster can be unpacked if the student needs to explain a principle, wants to reflect on a concept, or is learning new ideas. Often, the structure of students' understanding is hierarchical, with simpler clusters of ideas packed into larger, more complex ones. It connects arithmetic to geometry and later in schooling serves as a link to more advanced mathematics.

The knowledge that has been learned with understanding provides the basis for generating new knowledge and for solving new and unfamiliar problems. When students have acquired conceptual understanding in an area of mathematics, they see the connections among concepts and procedures and can give arguments to explain why some facts are consequences of others. They gain confidence, which then provides a base from which they can move to another level of understanding. The knowledge of mathematics is also imperative for uniting geometry and Mathematics that are studied by all learners in secondary school in Secondary School (Lassa, 2012).

2.3 CHALLENGES WITH MATHEMATICS

Many traditional school-based mathematical word problems often disregard and challenge students' sense-making and only help serve to distance students from the real world, and the usefulness and value of mathematics. It is critical therefore in the teaching of numeracy and mathematics that a key value in mathematics is about its relationship with real-world things whereas word problems often do the opposite. In the aspect of teachers, the main factors indicated by students as their challenges and obstructions in learning mathematics are teacher behaviors, practices, and characteristics. For example, students feel worried when their teachers teach too fast and have unpleasant characteristics. As a consequence, students are afraid to ask for assistance when they are experiencing problems understanding certain lessons. The situation becomes worse when students cannot complete the homework given by the teachers.

Researchers such as Orhun (2002) studied the difficulties faced by students in using mathematics when solving problems. Orhun found that the students did not develop the concepts of mathematics. They made some mistakes and the teacher's active method and memorising methods enhanced students' knowledge of mathematics only for a moment. This proves to be problematic because students do not retain knowledge eventually. He further explained how the method used (teacher-active) limited the students' knowledge, and how it affected their memory span. This study notes a gap, drawing from Brown and Orhun's findings, in the pedagogy or teaching method teachers use to assure students' in-depth understanding and memory retention of knowledge. Hence, the researcher believes that approaches such as Art Integrated Learning may enhance conceptual understanding, including memory retention, making connections, and assure in-depth understanding of mathematics.

The results from the study showed that the use of manipulatives in teaching and learning mathematics played a positive role in learners' understanding of mathematics at the Grade 10 level. The results further showed that using manipulatives was an important mediating tool in the development of the conceptual and procedural understanding of mathematical concepts.

The researcher in this study also looked into Tuna & Kacar (2013) who investigated the effect of the 5E learning cycle model, based on the constructivist approach, which is used for teaching mathematics in Grade 10 of elementary mathematics education, on students' academic achievement and the performance of their mathematics knowledge. Participants of the study are Grade 10 pupils registered for the spring semester of 2010-2011 at Anatolian High School in Kastamoun. The students were divided into two equal groups - (a) a control and (b) an experimental group. Students in the experimental group took the course about mathematics from the researcher in an environment where the art integrated learning models based on the constructivist approach were used. The students in the control group took the same course from their mathematics teacher in an environment where the activities of official mathematics were used. The performance of the experimental group was higher than the control group.

2.4. INTERTWINED STRANDS OF PROFICIENCY

Schools of thought such as Kilpatrick et al. (2001:116) developed five Strands of Mathematical Proficiency to capture the successful learning and understanding of mathematics, namely:

- Conceptual understanding – comprehension of mathematical concepts, operations, and relations.
- Procedural fluency – skill in carrying out procedures flexibly, accurately, efficiently, and appropriately.
- Strategic competence – ability to formulate, represent, and solve mathematical problems.
- Adaptive reasoning – capacity for logical thought, reflection, explanation, and justification.
- Productive disposition – habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's efficacy.

These strands depend on each other; they are interwoven in the development of proficiency in mathematics (Kilpatrick et al., 2001).

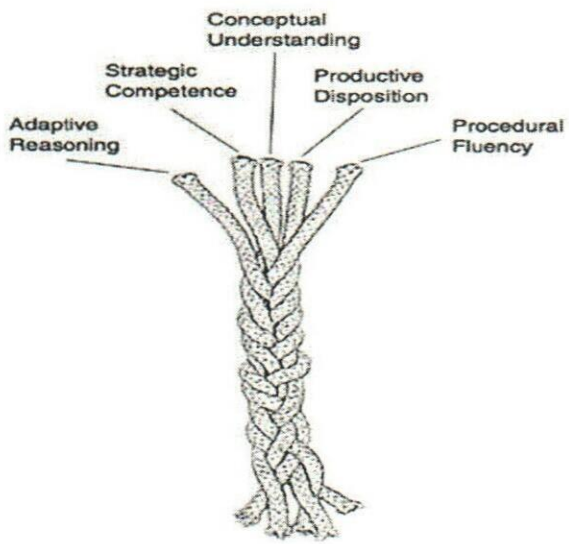

Figure 1: Intertwined strands of proficiency

This study adopted the conceptual understanding from the intertwined strands of mathematical proficiency by Kilpatrick et. al (2001). The study aimed to discuss mainly the comprehension of mathematical concepts, operations, and relations. Conceptual understanding is one of five intertwined strands of mathematical proficiency chosen to capture what it means for anyone to learn mathematics successfully (Kilpatrick, *et al.,* 2001:115). Learners with conceptual understanding know more than isolated facts and methods because facts and methods learned with understanding are connected, easier to remember and use, and can be reconstructed when forgotten (Kilpatrick *et al.,* 2001).

The success indicators for conceptual understanding of mathematics should be when students can respond correctly to trigonometric tasks that involve (a) general solution, and (b) basic ratio and reduction formulae since they demand higher-order thinking skills. The learners should be able to make connections of mathematical topics to solve trigonometric problems. For example, with general solution problems, learners should be able to correctly factorise (Mathematics) and apply basic ratios in connection with functions and graphs (Pythagoras). The latter is supported by Kilpatrick, et. al when they say learners with conceptual understanding will know more than isolated facts and methods because facts and methods learned with understanding are connected and easy to reconstruct and remember.

2.5 ART INTEGRATED LEARNING

Few studies conducted among students who were undertaking aspects of mathematics found that there were additional findings that suggested that Art Integrated Learning was instrumental to students' achievement. One study found that students who were enrolled in pre-Mathematics and used Art Integrated Learning were not only capable of achieving higher than the control group, but they were more likely to remember the information that they were taught in the long-term. In addition, there is a body of knowledge on the effects of Art Integrated Learning among middle school mathematics learners in 34 schools during the semester. The findings from this study are

consistent with other results that show that Art Integrated Learning has a positive effect on student achievement (NISHTHA). The finding showed that learners who worked in art integrated learning groupings were significantly advantaged in terms of their scores as opposed to those in control groups who responded to the same tests. Additionally, NISHTHA observed a higher level of scoring among middle school learners who were enrolled in general mathematics in Art Integrated Learning groups compared to those who received the instruction of learning individually. Also, Dr. Ashok Arora & Dr. Lovely Puri observed similar findings in their study and reported that there were significantly higher improvements among middle school learners who took mathematics under the Art Integrated Learning strategy compared to those who did mathematics as individuals.

The body of literature above shows the academic advantages that are attained through the employment of Art Integrated Learning approaches in mathematics AIL classrooms. Despite this, the depth of the body of knowledge centred on achievement in mathematics at middle schools is shallow when compared to the number of studies at elementary grade levels.

The studies on the impact of Art Integrated Learning have also pursued other variables besides that of achievement. The Art Integrated Learning approach has been studied in the context of its correlation to other beneficial psychosocial or psychological results. One of these results is the quality of interpersonal relationships that develop during group work (Dr. Ashok Arora & Dr. Lovely Puri). Art Integrated Learning induces the necessary team experience that may, in the long run, be crucial to tackle learners' challenges in learning the intricate aspects of mathematics, for instance.

Thus, Art Integrated Learning instills the necessary social skills that are in any case relevant to the wider learning environment. Furthermore, aspects such as adolescence can interfere with students' proficiency in, otherwise, challenging courses such as mathematics. Learners who struggle with

mathematics can begin to cope in ascendance by the interpersonal relationship opportunities that are presented in Art Integrated Learning (CBSE).

It is interesting to note that group work addresses this conflict provided the groups are small enough for individual recognition. Art Integrated Learning has also been linked to increases in self-esteem, attendance, time on task, enjoyment of school and AIL classes, and motivation to learn as well as a decrease in dependence on the teacher (Ms. Veena Gandhi Principal, Nigam Pratibha Vidhyalya New Chaukhandi New Delhi-110018). Perhaps one of the most important benefits of Art Integrated Learning has been more positive intergroup relations. Improved race relations, as well as increased acceptance of mainstreamed children, have frequently been reported (Ms. Veena Gandhi Principal, Nigam Pratibha Vidhyalya New Chaukhandi New Delhi-110018).

Scholarly work has been able to identify the exposure to the social, interpersonal, and psychological advantages of Art Integrated Learning as crucial to learning mathematics (Dr. Arora). Learners and teachers in these mathematics AIL classes have reported that the advantages of learning mathematics within art integrated learning approach settings were the acts of collaborating, intra-learner help and assistance, the interpersonal nature of it as well as the benefit of active participation.

However, these drawbacks are comparatively benign to the results that have found significant benefits in learning mathematics using Art Integrated Learning and the psychological as well as social advantages. Some scholars tread between the lines such as Slavin and Karweit (1984), who argue that the capacity of students to respond to mathematics instruction in a group setting, as well as the individual setup, are instrumental to the effective understanding of mathematics.

2.6 THEORETICAL GROUNDINGS OF ART INTEGRATED LEARNING

Art Integrated Learning is grounded in the belief that learning is most effective when learners are actively involved in sharing ideas and working art

integrated learning to complete academic tasks (NISHTHA). Furthermore, Art Integrated Learning in a mathematics AIL classroom involves social accountability, positive interdependence, individual accountability, and groups' accountability (AIL Guidelines).

AIL utilizes the possibilities of Visual (painting, photography, print-making, stage-art, clay-modeling, sculpture, applied art and craft) as well as Performing arts (dance, vocal music, instrumental music, theatre, puppetry, mime, storytelling, martial arts, magic performance, cinema, etc). In AIL, we work with the arts at the centre of the curriculum. The abstract concepts of the subject will be explored using different art forms.

Art Integrated Learning in mathematics instruction can also be described as the process with which students work together to accomplish a common goal under the guidance of their teacher further state that Art Integrated Learning involves students working in teams or groups on problems or projects under conditions that assure both positive interdependence and individual accountability.

2.7 IMPORTANCE OF ART INTEGRATED LEARNING

AIL was envisaged as pedagogy applicable to all levels of school education to develop the target areas of cognitive, socio-emotional, and psychomotor domains of the learner. At multiple levels of the teaching-learning process, Art integrated learning has opened spaces for the existence of learning that is both inter-disciplinary and holistic.

NCERT investigated the effects of Art Integrated Learning on students' achievement and problem-solving skills. The study of intact groups compares students' mathematics achievement and problem-solving skills. Art Integrated Learning method was used to teach the experimental section while the traditional lecture method was used to teach problem-solving. The study found that students instructed with the Art Integrated Learning method had a favorable response towards group work, and the use of the Art Integrated Learning method was a better alternative to the traditional instructional method.

Students' interaction and "talk" (Vygotsky's Constructivism) provide opportunities for students to think about and process the information. Time for "talking" and/or "writing" is needed to help students make sense of what they hear before attempting to "take in" more information. Art Integrated Learning promotes higher levels of achievement, greater depth of thought, improved attendance, and encourages innovation in both teaching and student involvement.

2.8 ADVANTAGES OF ART INTEGRATED LEARNING

Nobel Laureate Rabindranath Tagore pioneered the idea of a relationship between arts and learning: many of his thoughts are captured in a book titled 'Art- The Basis of Education' by his student Devi Prasad (1998). Extensive research in the field has established that utilizing visual and performing arts in the teaching-learning process encourages creativity, develops problem-solving abilities, and improves the ability to handle mental imagery, as well as an understanding for using spaces creatively. This leads to the holistic learning and development of children. The recommendations of the National Curriculum Framework (2005), state that art education at all stages enables students to fully appreciate and experience the beauty of the universe and helps in their healthy mental development. [National Curriculum Framework, NCERT, 2005] The details for using art as a basis for learning have been described in the Position Paper on National Focus Group on Arts, Music, Dance and Theatre (page 7-8). The paper also stresses the inclusion of art education in the curriculum of school education as a compulsory subject up to class X.

The effects of Art Integrated Learning on student achievement and attitudes in a secondary mathematics AIL classroom were investigated by Dr. Ashok Arora, Principal, and Dr. Lovely Puri, Head PSTE, DIET Rajinder Nagar, SCERT Delhi. Students in the Art Integrated Learning group had increasingly higher test scores than students in the comparison group and significantly outscored the comparison group on the third chapter test. Most students indicated that they liked working in groups and appreciated getting help from one another, especially for learning difficult concepts.

Supplementary results Prof. Krishan Kumar, the former director of, NCERT examined the effects of Art Integrated Learning on the academic achievement, AIL classroom behavior, and attitude of students in mathematics. The effects of Art Integrated Learning show the following: (a) a positive correlation between Art Integrated Learning and increased test scores; (b) with the proper interventions, Art Integrated Learning can help students learn how to be members of an Art Integrated Learning community; (c) an Art Integrated Learning environment can be beneficial to students who have previously had bad experiences with the subject, and (d) there are a variety of ways that Art Integrated Learning can be used in the AIL classroom. He further Claims that art integrated learning leads to success in the general mathematics AIL classroom.

This complements some of the views of scholars such as Dr. Arora and Dr. Puri (2013) who found that well-structured methods such as Art Integrated Learning produced more positive effect sizes than those evaluating, other instruction practices such as the use of innovative curriculum textbooks or the use of technology in reading and mathematics.

NCERT has subsequently conducted capacity-building programs on AIL in 15 states and union territories by the year 2017. AIL has successfully been introduced as a pedagogy of experiential and joyful learning in its ongoing initiative of block-level research in five regions with the respective Regional Institutes of Education (RIEs).

2.9 ART INTEGRATED LEARNING IN A AIL CLASSROOM SETUP

The classroom is the space that becomes a fertile ground for learning if utilized and managed appropriately. Given below are some suggestions for effective classroom management:

✓ Flexible seating arrangement which provides space for activities with free movement of children and teachers. For better efficacy of AIL, it is recommended that the traditional seating arrangement (rows and columns) should be discouraged and arrangements such as sitting in a U-shape, semi-

circle, etc. should be encouraged to create space for activities and presentations.

✓ Teachers/facilitators should move across the classroom space while interacting with the children. This will help the teacher reach and facilitate every child in the classroom.

In looking at the issue of Art Integrated Learning within the AIL classroom environment, The National Seminar on Art Integrated Learning was held in December 2012 by DEAA, NCERT reported on a best-evidence synthesis of studies across both elementary and secondary schools that compared Art Integrated Learning to control group studying the same material. The study concluded that Art Integrated Learning could be an effective strategy for increasing student achievement.

It was interesting to observe that studies by Puri and Arora, (2013) found that Art Integrated Learning compared to competitive and individualistic learning had very strong effects on a range of dependent variables such as achievement, socialisation, motivation, and self-development.

The results showed that art integrated learning was more effective than interpersonal competition and individualistic efforts. Interestingly, the results were consistent across all subject areas (language arts, reading, mathematics, science, social studies, and physical education) for all age groups, and all tasks involving conceptual understanding, problem-solving, categorizing, and reasoning.

2.10 BENEFITS OF ART INTEGRATED LEARNING

Art Integrated Learning is widely recognized as a pedagogical practice that promotes socialization and learning among students from pre-school through to tertiary level across different subject domains (AIL Guidelines). It involves working together to achieve common goals or complete group task-goals and the task they may not complete by themselves. Art Integrated Learning encourages students to discuss, debate, disagree, and ultimately teach one another to master academic material.

It is the most successful approach incorporated with two key elements i.e. group goal and individual accountability to help students enhance academic achievement. Dr. Arora further Claims that in Art Integrated Learning groups are rewarded based on the individual learning of all group members.

Group goals and individual accountability motivate students to give explanations and take one another's learning seriously, instead of simply giving answers. The success of one or more students helps others to succeed too and promotes the principles of shared leadership and responsibility (Penick & Alan, 1995). The above benefits confirm that Art Integrated Learning is an important teaching and learning strategy.

Figure 2: Benefits of Art Integrated Learning (Mcgraw - Hill, 1977).

2.11 THEORETICAL FRAMEWORK

Constructivism was chosen as the theoretical framework for this study because it emphasizes the active role of students in building and making sense of knowledge. The constructivism approach applies to Art Integrated Learning in enhancing conceptual understanding of mathematics. Constructivism is an epistemology in which AIL aims that humans construct knowledge and meaning from their own experiences (AIL Guidelines). Constructivists believe that learning should take place in realistic and authentic settings and that knowledge is constructed from experience.

For Idris and Chan (2017), the constructivist method of instruction recognises the importance of the learner in the learning process and believes that learners should build their understanding of concepts through self-discovery. Therefore, knowledge is not obtained passively but is actively and continuously adapted by structuring and re-structuring information and experiences as the learner develops to a higher level of understanding (Idris & Chan, 2017).

2.12 CONCLUSION

This chapter discussed the reviewed literature on the conceptual understanding of mathematics and the history of Art Integrated Learning as well as the tenets or principles that underpin Art Integrated Learning and the vital success factors to Art Integrated Learning in mathematics. The literature on the perceived benefits of Art Integrated Learning was deliberated and a critical highlight of the perceived impact of Art Integrated Learning was outlined. This section also reviewed some literature on the experiences of learners who have been exposed to Art Integrated Learning and some essential feedback from teachers was incorporated. The next section discusses the methodology used to gather data for this study.