Chapter 3

REVIEW OF RELATED LITERATURE

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**Introduction**

Review of related literature is an essential ingredient in the research process that can articulate and support claims about the knowledge in the field of investigation. It concentrates on previous empirical evidence and serves as a foundation for forming research questions which operationalise the objective of the proposed research subsequently focus on the research hypotheses. Mertens, (2010) reports that review of literature establishes historical perspective on the intended research, provides a vision of the need for additional research and enables the researcher to develop a conceptual framework for the research. He also recommends that literature review should be an ongoing process and the results of the review should be integrated into the body of report at appropriate points, especially in the discussion and conclusion. The investigator can use review as a substantive and methodological rationalization of his/her study.

In the present chapter, an attempt has been made to review the research works related to the present study that have been done in India and abroad. The evolved findings and extracts have also been systematically debated and discussed.

The studies have been reviewed are classified into the following sections:

- **3.1 Studies on Reflective learning.**
- **3.2 Studies on Mathematics learning.**
- **3.3 Studies on Reflective journaling.**
- **3.4 Studies on Problem based learning.**
- **3.5 Studies on visual tools for learning with special emphasis to Thinking maps.**

**3.1 Studies on Reflective Learning**

Reflective learning is designed to give learners the opportunity to be philosophical of their learning endeavors; that is to consider, discuss and
argue issues, from their own perspectives. It helps students to refine and strengthen their high level thinking skills and abilities through self assessment. It also gives students opportunities to think about how they answered a question, made a decision or strategized the solution procedure.

In order to capture a conceptualized fashion of the designations of reflective learning practices and to discern the experiential stance, the investigator reviewed a select number of research works in this domain. They are briefly described in the following part.

Chen et al. (2011) attempted to explore whether learners’ reflection levels can be improved if teaching strategies are adapted to fit with learners’ thinking styles in an online learning environment. Three teaching strategies namely constructive, guiding and inductive were designed to match with the thinking styles. An online reflection learning system was subsequently developed to reflect this scenario. The results revealed that the reflection levels of the fit group had outperformed the non-fit group.

Gilstrap (2008) conducted a study to investigate the influence of independent variables on students’ critical reflection scores in a library instruction programme. A student sample enrolled in English composition II courses, participated in a four session library instruction curriculum. Brookfield’s Critical Incident Questionnaire was used as the main instrument to collect critical reflection data, and the sparks – Langer et al. framework for Reflective thinking was used as a scoring instrument. Multiple regression analysis was conducted on 4 major theoretical constructs namely, academic achievement, semester, gender and age; and 6 theoretical assumptions namely, year in school, previous library instruction transfer of student, librarian, day of week, and time of day. It was found that academic achievement, gender, semester and year in school is predictors of critical reflection.
Phan (2006) discusses two separate studies conducted over a 12 month period in mathematics and curriculum studies examining the relationship between students’ epistemological beliefs, learning approaches, reflective thinking and academic performance.

**Study 1** examined first year mathematics student’s learning approaches – deep and surface; the four stages of reflective thinking – habitual action, understanding, reflection, critical reflection, and academic performance. A linear structural analysis indicated that a surface learning approach predicted habitual action and a deep learning approach predicted understanding and critical reflection. Deep learning approach, habitual action, and critical reflection also predicted academic performance.

**Study 2** involved third year curriculum studies students and used path analysis to show that deep learning approaches, epistemological beliefs and reflective thinking predicted academic performance. Results indicated that deep learning approaches also predicted habitual action and reflection. Furthermore, epistemological beliefs influenced learning approach, as well as the four stages of reflective thinking.

Song et al. (2005) conducted a study to explore the underlying factors of the instructional methods which support reflective thinking. The participants of the study were 141 middle school students in Canada. They suggested three factors that a sample of young adolescents perceived as helpful in prompting reflective thinking as:

a) Reflective learning environment  
b) Reflective teaching methods  
c) Reflective scaffolding tools  

Exploratory factor analysis was used here. One way ANOVA showed that the most helpful factor was the reflective learning environment, with the
most helpful elements being freedom and collaboration. The study also suggested that neither sex has superior higher order thinking skills in perceiving the helpfulness of reflective thinking.

Smith and Jack (2005) conducted a study to ascertain whether students found reflection to be a meaningful activity, whether there are perceived benefits associated with reflective practice and whether it is a valid process on which to assess the outcomes of a course. A focus group interview and a web discussion board were used for data collection. Findings revealed that reflective writing is considered as a key component of portfolio assessment. It is also concluded in the study that the students identified that reflection had a positive impact on the practice and they were more able to embrace the process in a meaningful way.

Martin, & Bulpitt (2005) reported a participatory action research project that examined the development of reflection from the perspective of the student. The study explored the experience of reflection and the meaning students attribute to these experiences. The students undertaking a Diploma in pastoral counseling in 2002 were to participate in the study. The findings of the study suggests that the educators should concern themselves more with the development of a reflective environment than teaching students how to reflect. This might account for the slow adoption of reflection within education. The implications of the study for education are concluded as:

a) Reflection is not always a positive experience for students. It cannot always be turned on and off at will and can be disturbing.

b) Reflection is a much broader experience involving feeling, instincts and spirituality than purely a rational thinking process.

Norton, Owens, and Clark (2004) reported a study to bring first year students’ understandings of themselves as learners together with the
expectations of their academic subjects, on an initiative using Meyer’s (2000a) Reflections on Learning Inventory (RoLI). This research took place in a University college in the north west of England. The findings from this study suggested one-to-one discussion of an individual learning profile is useful as a first step in raising levels of meta learning awareness in first year undergraduates. The study also pointed out that the tutors might be able to make predictions about how a student will perform academically, based on a combined interpretation of the RoLI profile together with an analysis of their reflective writing about their learning approach.

Connor, Hyde, and Treacy (2003) conducted a qualitative study that set out to explore nurse teachers’ perceptions and experiences of using reflection. The study was conducted among diploma nursing students in the Republic of Ireland. Eleven nurse teachers were interviewed intensively: Two major themes identified were:

a) Reflection and reflective practices as a way of reviewing clinical experiences.

b) Reflection and reflective practice as a way of valuing, developing and professionalizing nursing practice knowledge.

A number of participants alluded to the potential for reflective practice to uncover the hidden wealth of knowledge in every day nursing practice.

Harrison, et al. (2003) examined how reflective learning can be promoted and developed explicitly within the disciplines of Geography, earth and environmental sciences (GEES). From the analysis of the questionnaire survey the project team identified four themes regarding the relevance of reflective learning of GEES disciplines. They were:

a) The implicit or explicit promotion of reflective learning

b) Reflection as a skill
c) The value of the opportunity to reflect and

d) Reflection and student development

The project findings concluded how the inclusion of reflective learning exercises and activities is at an embryonic stage in many UG GEES departments/schools and hence as educators, we should provide opportunities to promote and deepen reflection and overcome any obstacles that hinder reflective learning.

Lyon, and Brew (2003) empirically examined students’ experiences of teaching and learning during their surgical studies in operating theatre. A multi method interpretive case study strategy focused on students’ experiences in one Australian University was used. The researcher described the operating theatre as a complex and highly charged workplace and outlines the challenges for students’ learning and examines the strategies students use to learn in this context. The investigator identified three domains in which the students successfully manage their learning. They are (1) the physical environment and the emotional impact of surgery as work (2) educational tasks and learning objectives and (3) the social relations of working in the operating theatre. The paper highlighted the differences in how students reflect on their experiences to turn them into learning.

Bean, and Stevens (2002) conducted a study to research the dimensions of teacher reflection. The main purpose of the study was to explore the role of scaffold reflection with pre-service and in-service teachers in the context of two literary courses in education (university courses) in the southwestern United States. Using constant comparative and critical discourse analysis, the pre-service and in-service teachers’ online and written reflections were analysed for reflections of and challenges to various education – oriented discourses. Results show that
scaffolding helped the students to formulate and articulate their personal belief system but did not substantively help them to challenge larger discourses of teaching, learning and students.

Stockhausen, & Kawashima (2002) conducted a study to establish how Japanese nurses respond to the introduction and use of reflective practice. Ethnography was identified as the appropriate methodology. By conducting focus group discussions to probe specific issues from an identified cultural population revealed two categories of reflection namely, cultural reflection and perturbed reflection. The findings indicate that as students are introduced to the new concept of reflective practice the experience is influenced by prior cultural and educational experiences. As students encounter reflective practice it causes apprehension as they respond to the newness of the concepts and create reconstructed meaning of their professional, personal, cultural and educational experiences. The experience of being introduced to reflective practice highlights the need for educators to consider student’s cultural and prior educational experiences when teaching students from different cultures.

Knowles et al. (2001) reported a brief discussion of two procedural frameworks, action research and reflective practice. They seek to develop and assess reflective skills through a structured development programme. The participants were B.Sc (Hons) coaching science students in UK. 5 staged processes using qualitative methodology was used for the study, which explored perceptions of the ‘reflective episode’, a reflective skills development programme and associated psychological skills of reflection (stages 1-4). A final stage explores the researchers’ perceptions of this research process. Periodic assessment of coaches’ level of reflection demonstrates a shift in reflection between early stage and post placement stage. The investigation highlights
psychological processes that underpinned participant development of reflective skills. The findings of the present study have implications for programmes of study that include reflective practice as a teaching and learning strategy. Reflective skills, placement characteristics and confidence related factors are discussed in relation to these stage changes.

Lee, and Loughram (2000) in their study explored how student teachers’ reflection can be enhanced through a school-based teaching programme. Six student teachers taking the pre-service teacher training at the faculty of education, Australia were selected to be the subjects of the study while they were involved in a nine week school-based teaching practicum. The methodology employed was an interview video-interview cycle which involved pre-lesson interviews, post lesson-interviews and viewing video. A model based on Schon’s framing and reframing was used to recognize student-teachers’ reflection. The major findings were:

a) Reflection was prompted by issues or concerns which changed over time
b) Reflection was characterized by the nature of reframing which occurred overtime.
c) Pre-service teachers’ reflection was facilitated by the specific nature of a school based teaching programme.

Implications of the study included:

a) The extended teaching practicum allows pre-service teachers to articulate better perspectives of ‘seeing’ their pedagogical practice;
b) School based teaching programmes of this form need to be carefully considered in teacher education programmes.
c) By learning from, and learning through pedagogical experiences, pre service teachers may gain professional growth in pedagogy.

Kember et al. (2000) developed and tested a four scale questionnaire to determine whether students engage in reflective thinking, if so to what extent in professional preparation courses. The four scales or constructs measured are habitual action, understanding, reflection and critical reflection. The final version of the questionnaire was completed by 303 students from eight classes of the health sciences faculty of a university in Hong Kong. The psychometric properties of the instrument have been established by the use of confirmatory factor analysis. The reliability of each scale was shown to be satisfactory by the use of Cronbach alpha. It is argued that the scales should be valid because they were derived from a well-established literature on the nature of reflective thinking. Further evidence for the reliability of the instrument comes from the way that the mean of each scale significantly distinguished between PG and UG students.

The above studies posit the ways in which reflection embarks into the varied domains of educational system and how it works among its stakeholders. Some of the studies accentuated the development of a reflective environment in classroom ensuing the slow adoption of reflection within the realm of teaching and learning to revitalize the entire system. The studies also point towards the impediments and constraints to be overcome and opportunities to be provided for promoting deeper reflection. It can be concluded that reflective practices cause apprehension, and create a reconstructed meaning of the experiences. Reflection involves feelings, instincts and spirituality than purely a rational thinking process.

3.2 Studies on Mathematics Learning

Mathematics offers students a great opportunity to express themselves creatively and is increasingly a prerequisite for full participation in our
modern society. Scintillating mathematics learners are the ones who could understand the concept, learn the procedures with meaning, solve problems using efficient strategies, defend and justify their reasoning and find mathematical investigations challenging and engaging. For this, students require active engagement in conscious reflection on their own mental processes and structures which is a metacognitive skill, by which being aware of what one knows and does. It is the absence of reflective activities of planning, coordinating, monitoring and assessing solution process which has interpreted as a likely cause for lack of success in mathematics learning. In this context, the investigator collected and scanned some of the related research works and summarized below.

Santagata et al. (2011) conducted a study to investigate the effectiveness of professional development programme on teacher knowledge and practices on student learning: Measures included fidelity of implementation, teacher knowledge and practice and student mathematics learning. The result shows that an effect was found on mathematics learning for students whose teachers reached a certain level of mathematics content knowledge.

Kersting et al. (2010) explored in their study the relationship between teacher knowledge and student learning in the area of mathematics by developing and evaluating an innovative approach to assessing teacher knowledge. The approach is based on teachers’ analyses of classroom video clips. The quality of teacher’s analysis, coded using an objective rubric are shown to be valid and reliable. The study concluded that there is a positive relationship between teacher knowledge and student learning.

Leonard et al. (2010) conducted some case studies in the context of mathematics education and claimed that culturally relevant instruction
(CRP) coupled with teaching for social justice (SJP) can motivate marginalized students to learn mathematics. In the article they,

a) Explored the theoretical frameworks underlying CRP and SJP.

b) Presented illustrative cases of mathematics teaching that revealed the possibilities and challenges associated with these pedagogical approaches.

c) Offer to the field of teacher education recommendations related to the successful use of CRP and SJP within today’s classroom.

They concluded that learning rigorous content and developing a strong mathematics identity are critical to achieving mathematics success. Teaching mathematics using CRP and SRP can motivate students from diverse backgrounds to use mathematics as a tool to accomplish their own ends.

Williams, and Sreed (2009) in their action research project examined the effect of mathematics journaling on mathematic problem solving skills of second graders. The conclusions revealed that mathematics Journaling is an effective strategy to improve and enhance the understanding of mathematical problem solving skills.

Samuelsson (2008) examined the effect of three different structured methods, traditional, independent and problem solving, of teaching arithmetic. The results showed that:

a) There are no significant differences between teaching methods when assessing arithmetic skills

b) Students’ progress in quantitative concepts is significantly better if teachers teach traditionally or with a problem-based curriculum.
c) Pupils would be more benefited in developing self regulating learning skills if they are taught through traditional or problem solving curriculum.

d) Traditional and problem solving are more effective for students’ self concept

Aristokils, Nicolaou, and Philippou (2007) examined the relation among efficacy in problem posing, problem-posing ability, and mathematics achievement. Quantitative data were collected from 176 fifth and sixth grade students, and interview data from six students selected on the basis of hierarchical cluster analysis. It was found that:

a) Students, perceived efficacy to construct problems was found to be a strong predictor of the respective performance as well as general mathematic achievement.

b) A strong correlation between ability in problem posing and general mathematics performance exists.

c) Problem posing ability is greater in informal tasks.

Findings provide support to earlier studies indicating the predictive power of context-specific efficacy beliefs.

Breyfogle (2005) conducted a study with a purpose to explore the teachers’ experiences with respect to his reflections and classroom practice while trying to create inquiry-based mathematical discourse. Data included videotaped classroom observations, audiotapes focused reflection sessions. The identification of the varied reflective states exhibited by the teacher suggests a more complex relationship between reflection and changing teachers’ practice than previously thought. The result reveals that the interaction of teacher’s reflective activities and reflective states contribute to various kinds of teacher change in the classroom.
Salinas (2004) conducted a study to find out the effects of reflective note books on perceptions of learning and mathematics anxiety. Twenty eight prospective teachers enrolled in a mathematics course participated in regular writing activities in reflective notebooks. Students’ writings and data collected from interviews and surveys were used for analysis. Results revealed that students appeared to develop new ways of thinking about mathematics, to realize their contribution to the learning community and to begin to evaluate them more effectively.

McDuffie (2004) conducted a case study to examine the reflective practices of two elementary pre service teachers during their student teaching internship with the framework for a ‘deliberate practitioner’. The investigator studied pre-service teachers’ thinking with regard to reflective processes and how they use their pedagogical content knowledge in their practices. Findings indicate that the pre service teachers use their pedagogical content knowledge in anticipating problematic events, and in reflecting on problematic events in instruction. Limits in pedagogical content knowledge and lack of confidence impede pre service teacher’s reflection in the act of teaching. They were more like to reflect on their practices outside of the act of teaching.

Fraser, and Spinner (2002) Compared fifth grade students in two constructivist mathematics classes with fifth grade students in four traditional mathematics classes. Pre and post testing- including conceptual map testing (Novak in Fraser & Spinner, 2002) and the test of Mathematics –Related Attitudes – indicated that the Constructivist Class Banking System (CBS) program students had dramatic results in their (1) understanding of mathematics concepts, (2) attitudes towards mathematics and (3) perceptions of the classroom environment. Data also showed that higher cognitive achievement was found consistently in the experimental group as compared to the control groups.
Chapter 3

The literature on mathematics education reveals that a constructivist environment with due focus on metacognitive skills yield higher academic performance and better mathematical dispositions. Certain observations claim that for invigorating mathematics learning space students should have the opportunity to discover by themselves a way to reach the solution to the problem. Hence teachers have to challenge and encourage the students toward independent search for various paths to the solution, develop intuitions and creativity, convergent and divergent thought as well as to acquire the ability to plan and evaluate which could be possible through engagement in conscious reflection by the learners. It can be concluded from some studies that reflective exhibits of learning, problem posing and problem solving activities and conceptual mapping encourage reflective practices pursuing better mathematics competencies.

3.3 Studies on Reflective Journaling

Journal writing is commonly used in the academic world as a positive tool to encourage reflection and learning. The pedagogical potential of this technique includes: student responsibility for learning, active engagement in reflective process, student centered approach, natural speech characteristics and shaping the knowledge as learners see fit. But the instructional tactics offered in our classrooms are far from these dynamics of potential learning. In this scenario, the investigator has made an effort to trace out some of the research reports in close proximity with these phenomena.

Dyment et al. (2011) reviewed 11 research articles that examine the level of reflection found in student journals in higher education across a range of disciplines. The review reveals that there is little or no consistency in the research community around the mechanisms and process of assessing levels of reflection in student journals and the quality
of reflection found in student journals varies considerably across studies. Only two of the 11 studies found a high percentage of student’s journals were highly reflective.

In 1999 Kember and his colleagues devised a coding scheme based on the work of Mezirow, to identify and assess levels of reflective thinking in student’s written journals. Bell et al. (2010) evaluated the usefulness of this coding scheme in a business education context. The findings reveal that Kember et al. (1999) coding scheme with refinements is useful as a reliable method for identifying and assessing students’ reflections in written journals. The study also concluded ‘that reflective learning journals can be used in a business education context to provide insights in to what business students reflect upon and how students can be supported in their development of reflective skills. They added the categories process reflection – internal and process reflection- others to the coding scheme as refinement.

Otienoh (2009) conducted a qualitative study of a hermeneutic phenomenological nature. Semi structured interviews were the sole method of data collection. The Miles and Huberman approach of qualitative data analysis was utilized. Finding indicated that teachers encounter a number of challenges that inhibit them from reflecting through journaling. These ranges from lack of time, the structure of the programmes and the way reflective practice is introduced to them to teacher motivation and lack of structures to support the practice.

Hong (2008) carried out a research project on students of the bachelor of nursing programme, international medical university with the objectives:

a) To explore the student’s views of reflective practice
   - To identify factors that have motivated the students to practice reflection and writing reflective journals
To identify factors that could have impeded the students in reflective practice.

To elicit ways that could further motivate reflective practice in students.

Data were collected using questionnaires and focus group interviews. Findings revealed that the students viewed reflective practice as a form of learning that provided them with an opportunity to express themselves, and keep a record of their learning experiences for reflection. Factors that motivated them included feedback and guidance from their preceptors, and having group discussions. Factors that inhibited the reflective practice included not sure of what need to be entered in the reflective journals, language and time constraints as well as personal attitude. It is suggested that guidance and feedback from preceptors, and having more sample reflective journals would motivate them in reflective practice.

Degago (2007) investigated the value of writing reflective journals for student teachers during practicum placement. The author invited 10 pre-service education degree teachers to write a weekly reflective journal throughout their four weeks practicum teaching. It was concluded that the student teachers benefited immensely from their experiences of writing reflective journals for the purpose of reflecting on their practical experiences. They reported that the activity helped them improve their teaching experiences and deepen their understanding of the complexities involved in learning to teach. The study has implications on the role of reflective journal as a means of engaging teacher candidates in reflective teaching, a recently emerging notion in the education of teachers in Ethiopia.

Connell and Dyment (2006) reported a study involving eight university faculties who teach courses with outdoor field components in the areas of
outdoor recreation, experiential education, or outdoor education. A mixed methods approach was used that included 32 item quantitative questionnaire and a focus group discussion. The researchers presented three thrust areas to the participants to reflect. They are 1) current practices of journal writing (types of journals, types of entries, process of journal writing) (2) perceptions of journal writing (rationale, quality, evaluation) and (3) recommendations to maximize the potential of journal writing. The faculty who participated in the study appreciated the pedagogical potential to journal writing to encourage reflection and learning. They were, however, cautious about certain aspects of the journaling process and offered numerous suggestions for improving the journaling experience. The findings also set the stage for more ambitious explorations for the role of journaling in higher education.

Thorpe (2004) recognized in his study that reflective learning journals are significant tool in promoting active learning among nursing students. The subjects of the study were 52 nursing undergraduates enrolled in nursing management course in Canada. In this study he discussed the application of two models of reflection to a set of reflective learning journals and offered some recommendations for educators, researchers and students. The major findings indicated the students may be categorized according to Kember et al (1999) as, non – reflectors, that is, lack of evidence of deliberate appraisal, reflectors ,that is, demonstrate insight through analysis, discrimination and evaluation, and critical reflectors, that is, indicate a transformation from initial perspective.

Rothwell and Ghelipter (2003) critically evaluated the design and delivery of a suit of management skills modules, combined as an integrating theme throughout the programme of study among management degree students in an international collaboration between Israel and U.K. The study was focused particularly on reflective learning and a range of
strategies that have been used to encourage students to be critical and reflective learners, principally through the use of reflective diaries. Reflective diaries were used both as a learning vehicle and a module assessment tool. It is suggested that reflective learning can best be encouraged by active participation, by drawing all students into classroom discussion.

Giovannelli (2003) demonstrated in his study that reflective disposition toward teaching was related to effective teaching especially in the domains of instructional behaviour, classroom organization and teacher expectation. Reflective disposition consisted of six components: the composite of reflective disposition and the composite of effective teaching, reflection on what teachers should know and be able to do, reflection on teaching, reflection on learning, reflection on the relationship between teaching and learning and reflection on what it would be like to be a teacher in the classroom. Data used to test the hypothesis were composed of reflective disposition scores earned by teacher candidates and effective teaching scores of teacher candidates by their field instructors. The study was conducted in University of Illinois at Chicago among elementary education undergraduate teacher candidates.

Kaminski (2003) reported in his quantitative study through the use of journals students rifled on their experiences in number sense programme and on various aspects related to the teaching and learning of mathematics. 85 students of pre service teacher education course in Australia were the participants of the study. From the analysis of the data three themes emerged: (i) Student teachers’ learning experiences in number sense exploration (ii) Student teachers’ planning for, and teaching of mathematics, and (iii) Changes in student teachers’ views and in their attitudes to teaching mathematics, which assisted in contextualizing student teachers’ reflections on aspects of the learning and teaching of mathematics.
It is suggested that using reflective journals may have assisted student teachers in interrelating their mathematical knowledge, experiences and understanding. Also it is suggested that the changes in student teachers’ views, attitudes and approaches were facilitated by an environment which supported questioning, evaluating and reflecting upon experiences in mathematics learning.

Langer (2003) reported the use of learning journals as vehicles for encouraging critical reflections among non-traditional students and compares variances with studies among traditional students. The study was conducted at Columbia University’s computer technology programme in continuing education. Result suggests that non-traditional students are more skeptical than traditional students about using learning journals and more likely to use them as study tools. An implication of this study is that student perception and skepticism of the assignment can affect the objective of developing reflective thinking. This implication stressed the need to account for student perception in studies on learning journals and critical reflection.

Williams et al. (2003) conducted a study to describe physical therapy students’ perceptions of their learning during a clinical placement and promote their reflective thinking. The study was conducted during a 6 week clinical placement of physical therapy programme in Canada. Fifty six students kept journals and reflected on at least one learning event per week in their clinical placement. Four educators evaluated the level of reflection in their journal entries of students and six themes were identified: (i) process of making clinical decisions (ii) complexity and richness of interactions with patients (iii) effects of the practice environment on learning and patient care (iv) acquisition of clinical and administrative skills (v) value of clinical experiences (vi) acknowledgement and evaluation of
different learning methods. Result showed that through journal writing students demonstrated integration of academic and clinical learning, recognized the value of their clinical experiences and achieved a high level of reflective thinking ability.

Bain et al. (2002) explored the role and importance of journal feedback in developing student’s reflective skills. The subjects of the study were 35 pre-service education students at two universities in Australia. Students received individual feedback on each journal entry that focused on either the level of reflection attained in their writing or the particular issues that their entries addressed. Within these groups, the type of feedback provided was further varied according to the level of questioning and challenge with which students were confronted. Although students in all conditions reported positive aspects of the feedback they received, feedback that focused on the level of reflection attained was more effective in bringing about improvement in journal writing than feedback that focused on teaching issues. Such feedback, combined with issue-related questions and comments designed to challenge the student and encourage consideration of alternative perspectives, would appear to offer the most effective strategy for enhancing the effectiveness of journal writing as a learning tool.

Grant (2001) described the ways in which pre-service elementary teachers in a literacy methods course in U. S. A. reflected upon their experiences tutoring children in reading and writing. The results show that those tutors who were most effective at creating and implementing successful reading instruction looked at their experiences in profoundly different ways than their classmates. Their journals showed that the journals of the outstanding tutors differed from the others in three ways: (a) the quality and quantity of cognitive effort they put into teaching and
reflecting about teaching (b) their tolerance of ambiguity and (c) the complex ways in which they understood the relationship between emotions and learning. The study also suggests some specific skills that future teachers can be taught that could improve the quality of their teaching; (a) asking more, as well as more in depth questions about their experience and (b) risk taking, and self evaluation.

Hoban (2000) explained in his study how pre – service teachers used a reflective framework to study the relationship between teaching and learning in a 13 week science method course in Australia. After each class the students had to reflect on their experiences to study the relationship between teaching and their learning. There were three phases which glided students in using a reflective journal; (i) analysis of experience (ii) synthesis of reflections (iii) theorizing to identify a metaphor as a representation of a relationship between teaching and learning. Students were then requested to deduce implications for their future role as classroom teachers although the pre service students claimed that using the framework was the hardest task they had attempted at university. They gained insights in to how they learned which had implications for how they planned to teach.

Stefani et al. (2000) presented a case study of developing a student – centered approach to reflective learning through a partnership arrangement between disciplinary based academic staff and educational development staff members. Two stages were involved in the study – initial stage using a learning cycle approach to reflection and the second with pre – prepared project management log book. This case study has reinforced the importance of formative feedback to student learning. The study suggests that development of the project management log books enhanced learning and reflection on learning and from students response it is revealed that
students could recognize the value and importance of reflection, when contextualized to a specific learning task.

Kember et al. (1999) proposed a scheme for estimating the quality of reflective thinking in students’ writing in reflective journals using categories based on Mezirow’s work on reflective thinking. The research was conducted in Hongkong. In an initial test of the scheme, reasonable levels of agreement were obtained from eight judges. Disagreements over coding resulted from differing interpretations of the significance of what students had written rather than from a lack of precision in the guidelines for coding categories. A second test, using student’s reflective papers, showed acceptable levels of reliability between four assessors. The method is recommended for both assessing students and evaluating courses in programs which aim to develop reflective thinking. The framework of coding categories established validity.

Morrison (1996) investigated the development of reflective practice through the keeping of a learning journal by full time and part time students on taught modular higher degree course in education. Two models for reflecting on personal, academic, professional and evaluative development are outlined, guidelines for the content of learning journals are indicated and their contributions to notions of student ‘empowerment’ recorded through a learning journal are evaluated in practice.

Two models of reflection outlined were: (i) reflection in action and reflection on action (ii) reflection, development and empowerment. The experience of keeping a journal has been running in the modular programme at the University of Durham’s School of Education in U.K.

The above research studies discussing the use of reflective journaling suggests that they offer many benefits including providing opportunity for
students to explore their learning, values, beliefs, assumptions and experience in greater depth; making explicit connections between theory to practice; stimulate critical thinking; breaking habitual ways of thinking; enhancing the development of reflective judgment; develop problem solving skills; encourage deep rather than surface learning and make connections between old and new knowledge. Research in this field suggests that many educational institutions require students to keep journals in a wide range of courses in different academic fields including literature, psychology, education and sociology.

3.4 Studies on Problem Based Learning

Problem based learning as an instructional approach offers learners with opportunities to explore wide range of information, to link the learning with their own needs as learners and to develop independence in inquiry. In PBL environment learners are expected to select learning issues from the immediate reality or virtual environments and draw out questions for investigation on their own. The main emphasis of PBL classes is given to the development of self directedness, which incorporates the ability to handle study tasks, monitor progress, make appropriate decisions in knowledge application and modify actions after independent critical reflection. Here the investigator attempted to collect report and analyze a few studies in close contiguity with the PBL phenomena to delineate the major pedagogic benchmarks.

This study conducted by Zhang et al. (2011) examined the strategies that experienced facilitators used to promote productive discussion among science teachers. Participants of the study included six facilitators and 35 in service teachers who participated in a professional development program that adopted a problem – based learning approach for teacher training. Data analysis showed that experienced facilitators employed a
variety of strategies, including questioning, revising, making connections, clarifying, reframing, summarizing, role playing, Meta talk and modeling. Analysis further revealed that teachers were able to make progress in participating in the problem based learning discourse in many ways.

Yeung (2010) in this study determines the impact of problem – based learning on a pre university geography class. Learning activities include problem analysis, information collection, and examination of concepts, oral presentations and group summaries in relation to current and perennial geographical issues of local and/or global concern. Assessment for learning and assessment of learning were done by the teacher, classmates and students themselves, Results showed that students could analyse problem statements and present their understanding systematically but varied considerably in organization, argument, and quality of thinking. To seek improvements, teachers should become more active facilitators while encouraging students to learn as problem solvers. Teacher training and school based support are needed for creating a collaborative inquiry – oriented atmosphere in the classroom. This study has been conducted in an action – research, case study format without any random sampling of subjects or the use of any experimental design for comparing students’ learning before and after the PBL activities.

Cotic and Zuljan (2009) advanced a problem based instruction model to find out whether the students who received problem based instruction, would display greater ability in solving difficult mathematical problems and greater attitude towards mathematics compared to the group receiving conventional instruction. They formulated the experimental factor- problem posing and solving as the key math- teaching activity- broadened the conventional mathematical problem by introducing in to it several other types of problems and strategies of their solving. The efficiency of
the model created was tested on a sample of 179 nine year old students. The study used causal – experimental method of pedagogic research. The findings were;

a) The students who were taught through the created model of problem – based instruction demonstrated greater knowledge especially in solving more difficult mathematical problems compared to the control group who were exposed to traditional method.

b) The students in both experimental group and control group had a positive attitude towards mathematics.

c) PBL has not decreased the student’s motivation for learning mathematics despite its difficulty, can be interpreted as the teachers in the EG knowing how to differentiate and individualise their learning.

In this study Simone (2008) examined the impact of problem – based learning on prospective teachers’ problem – solving abilities. Two classes of prospective teachers were included in this study. The experimental class used problem – based learning while the control group used a more traditional approach. The dependent measure was the participant’s analysis of a problem. The participants in problem – based learning were significantly better than the controls in constructing the central problem, elaborating the problem, relating their solutions to the problem, and using multiple resources. The results showed that in problem- based learning the synergy between theory and practice fosters prospective teachers problem solving especially their ability to define the problem, generate solutions, and use both practical and literature – based resources to support the solution.
Kumar and Natarajan (2007) examined the components of a theoretical problem – based learning framework adopted by a reform minded tertiary institution in Singapore. The goals of this framework are to enhance the ways in which students think and augment knowledge building within authentic problem solving contexts. Student’s reflections of their experiences in operating within the problem based learning environment are descriptively analysed to draw insights into the pedagogical implications of this framework. The research methodology adopted for this purpose is essentially constructivist-interpretative and a descriptive analysis involving analytic induction was employed in the analysis phase. A significant number of students commented in the collaborative dimensions of learning embedded within this PBL system: it improved their social, interactional and public communication skills. It was also found that by learning disciplinary content matter through the instructional strategy of solving real – life or simulated problem, the development of higher order skills such as critical evaluation and information processing develops in students.

Song et al. (2006) studied about the instructional factors that may prompt reflective thinking in learners in PBL environments and whether these factors differ based on age or developmental stage. The participants of the study were 122 middle school students from three public schools and 749 college students attending introductory statistics course from north eastern research university in United States. The results indicated that the middle school students perceive the learning environment factor as more important to prompting their thinking, while college students perceive the scaffolding method factor as more important. While the elements clustered into two factors, most college students disagreed with their helpfulness in prompting reflective thinking, a finding opposite to that obtained for middle-school students. Different patterns were also
found between learners’ perceptions of the most helpful elements within each factor. Based on these results, suggestions are given for designing developments and age appropriate PBL learning environment that support reflective thinking.

Sungur & Tekkaya (2006) investigated the effectiveness of PBL and traditional instructional approaches on various facets of student’s self regulated learning including motivation and learning strategies. Instruction to the control group with teacher centered, text book oriented traditional instruction and experimental group with PBL, in which students worked with ill structured problems. Results revealed that PBL students had higher levels of intrinsic goal orientation, task value, use of elaborative learning strategies, critical thinking metacognitive self regulation, effort regulation and peer learning compared with control group students.

Neo and Neo (2005) examined how learning in multimedia could be enhanced through the use of problem – based learning. Students in a second year course in the faculty of creative multimedia (FCM) were assigned the problem – based multimedia project. This study investigated the structuring of the student learning process, the impact of the problem – based learning environment on student learning and the important skills such as creative and critical thinking, team work, communication, collaborative and problem solving skills that arose as the result of the intervention. The interrelationships between the teacher, students and technology in this learning mode were also established. The result obtained was positive and satisfactory.

Yeung et al. (2003) explored the match between student’s learning issues and the learning objectives that have been set by teaching staff with respect to the problem design in problem – based learning strategy adopted. The findings indicated that students recognize 79.9% of the learning objective with a significant improvement as the semester
progresses. There was also evidence to suggest that students move towards independent learning as a result of problem based learning.

Basile et al. (2003) in their study explored problem based learning as a dimension that adds context and framework to coaching and reflection. The process for problem – based learning is described as a healthy environment for reflection, discussion and problem solving. Result illustrated how teacher candidates move from micro – reflection to self reflection to macro reflection as they engage in a year – long teacher education program in a professional development school. Implications from the study suggested that problem based learning is a valid process for the enculturation of teacher candidate to schools and to the profession of teaching.

Koszalka et al. (2001) explored learners perceptions of design factors found in PBL classrooms prompting reflective thinking. A survey questionnaire for measuring the perceived factors related to reflective thinking in PBL was administered among 3 different middle schools in rural Pennsylvania and data collected was analysed using factor analysis. The study found that the students perceived three factors as most important in supporting their reflection in PBL lessons. They are:

a) Learning environment.
   - Having freedom in class,
   - Working with partners,
   - Working with an ill structured task,
   - Having time to think,
   - Drawing pictures.

b) Teacher.
   - Teacher explanations,
   - Teacher questions,
   - Authentic task.
c) Scaffolding tools.
   - Answering questions,
   - Writing about answers.

Implications for designing PBL and reflective activities are also discussed in the study.

The above mentioned studies provide illuminating insights into the development and implementation of PBL programme unconfined by discipline boundaries. The collaborative dimension of learning embedded within the PBL system encourages an interactive approach to learning and has a strong reputation for enhancing student motivation toward learning tasks, provides unconstrained environment by means of student empowerment, encourages reflection, critical thinking and creative thinking. It is also revealed from the observation that PBL students had higher level of intrinsic goal orientation, task value and use of elaborative learning strategies.

3.5 Studies on Visual tools for Learning with Special Emphasis to Thinking Maps

   Visual tools as non-linguistic symbol system provide new pathways for learners to think at higher levels and thereby transform static information into active knowledge. The informational context evolved through this metacognitive tool links mental and emotional associations to create and communicate rich patterns of thinking. The major categories of visual tools are brainstorming webs, graphic organizers and conceptual mapping. A learner may begin a learning activity by using graphic organizers, shift to brainstorming webs and finally use a conceptual map to focus. Thinking maps as a visual transformational language is the synthesis of all these categories and can be effectively implemented in our mathematics classes. The investigator went through certain prominent
research works related to these domains to crystallize a mental frame of the investigation in this regard.

Gerstner and Bogner (2010) monitored the cognitive and motivational effects within different educational instruction schemes namely

a) Teacher – centered versus hands – on instructor
b) Hands – on instruction with and without concept mapping:

They used a pre – test, post – test, retention test design both to detect students short – term learning success and long term learning success and to document their decrease rates of newly acquired knowledge. They monitored intrinsic motivation also. Results showed that concept mapping as a knowledge consolidation phase positively affected short – term increase in knowledge. The teacher centered approach provided higher short term learning success, where as hands – on instruction resulted in relatively lower decrease rates scores of interest, perceived competence and perceived choice were very high in all the instructional schemes.

Leaciby et al. (2010) in their study tested the hypothesis that student learning in an introductory financial accounting course increases; as measured by examination scores, when traditional methods of instruction are supplemented by concept mapping activities. The result of the study showed no significant evidence supporting the stated hypothesis. They conducted a survey to the experimental group which showed that

a) The concept mapping provides a positive student experience and is a useful learning tool.

b) Better students indicate a preference for mapping software rather than creating maps manually.
Karakuyu (2010) conducted a study with an aim to investigate the effect of student’s concept mapping on their physics achievement and attitudes toward physics lesson. Pre test post test non equivalent group design was selected for the study. Results of the study showed that

a) There were no significant differences in the attitude and achievement between control group and experimental group

b) Concept mapping group of students were observed to have a tendency of more positive attitude than their counterparts.

c) Concept map instruction was more effective than traditional instruction in improving physics achievement.

In one of their studies; Wang et al., (2008) have found that the conversion of abstracted short texts into concept maps could stimulate individual reflection and generate new knowledge and provide scope for viewing knowledge from another angle.

Young and Lauren (2009) investigated the comparative effects of individually constructed and collaboratively constructed computer based concept mapping on middle school science concept learning. It was found that the students who collaboratively constructed concept maps created significantly higher quality concept maps than those who individually constructed concept maps indicating deeper understanding,

Chiou (2009) examined whether concept mapping strategy CMING can be useful in helping students to improve their learning performance in a business and economic statistics course, a single factor between subjects experimental design with three participant groups namely, collaborative concept mapping (CCMING), versus individual concept mapping (ICMING) versus traditional textbook exercises (TTE) was employed. The experimental results suggested that
a) Adopting CMING strategy can significantly improve student learning achievement in statistics, compared to TTE.

b) Adopting CCMING improve student achievement even more than using ICMING.

c) Most of the students were satisfied with using CMING to learn statistics.

Chiov (2008) examined in his study whether concept mapping can be used to help students to improve their learning achievement and interests. The study revealed two results:

a) Adopting a concept mapping strategy can significantly improve student’s learning achievement compared to traditional method.

b) Most of the students were satisfied with using concept mapping in an advanced accounting course as it can help them to understand, integrate and clarify accounting concepts and also to enhance their interests in learning accounting.

Asan (2007) conducted a research project to determine the effects of incorporating concept mapping on the achievement of fifth grade students in science class. The pupils in the experimental and control groups were exposed to the same teaching technique and were given the same test. The control group and the experimental group were given a traditional oral review and a review using concept mapping tool respectively. The result indicates that concept mapping has a noticeable impact on student achievement in science classes.

Samawi (2006) in this research study explored the effect of concept mapping, as a metacognitive teaching strategy on the critical thinking skills and dispositions of junior and senior live Baccalaureate nursing students. The second purpose of this pr test – post test quasi experimental
study was to evaluate the changes in student’s concept mapping skills over time. The findings revealed that

a) There was no relationship between critical thinking scores and disposition scores

b) The concept mapping strategy triggers critical thinking which guides the students to engage in meaningful learning.

c) There was no change in student’s concept mapping skills over time.

Zanting, Verloop and Vermunt (2003) in their study evaluated two instruments, the interview and concept map, for accessing practical knowledge in the context of teacher education. The analysis showed that concept mapping had elicited more reasons underlying teaching than interviewing. Both instruments can help student teachers to access practical knowledge qualitatively.

Lim et al. (2003) examined some of the affective outcomes for both teacher educators and student teachers resulting from the use of semantic webbing/mapping as a strategy for facilitating reflective and critical thinking skills in four components of the module, “Further studies in Kindergarten curriculum”, namely, Art, Language, Mathematics/Science, and Social studies conducted by the Hong Kong institute of education. The findings indicated that semantic mapping is a worthwhile strategy to employ in kindergarten teacher education. For student teachers, semantic maps were excellent as a medium for displaying a network of visual information. It is also a valuable tool for learning, planning and evaluation. It can serve as a mirror for the teacher-educator’s own reflective practice.

Leary (1999) investigated the effects of the Thinking maps programs, a series of graphic organizers, on the achievement of fourth grade students as measured by a standardized test. The investigator used a nonequivalent pre test-post test control group design. The sample consists of 78 elementary
students for both control and experimental group. Three fair-way ANOVAs were used for analysis. Interviews were conducted with four teachers to collect data on the treatment and control conditions. The analysis of the study indicated that there was no significant difference between the treatment and control on any of the variables included in the study. While the quantitative analyses could not validate the owner’s of thinking maps program claims by standardized tests, the researcher provides some insight into teachers’ and students’ reactions to using these graphic organizers as tools for improving classroom instruction.

The aforementioned studies explored the impact of visual transformational tools namely Concept mapping, Semantic mapping and Thinking maps on student learning and teaching in various disciplines. As very few studies have been conducted in the area of Thinking map strategy the investigator could not report more studies in this area. Some of the studies indicate that concept mapping provides positive student experience and is a useful learning tool which enhances, and stimulates reflections, generates new knowledge and provides scope for viewing knowledge from another angle. The mapping strategies have the potential to have very powerful role in promoting meaningful learning and providing teacher facilitation with a valuable insight into the mental models of learners and visualizations of learning arena portrayed by the maps.

The realizations that emanated from a thorough analysis of the research reviews set the stage for framing the present study of its kind and for developing the select reflective learning designs for enhancing reflective thinking levels and mathematics competencies at secondary level. The methodological approach adopted, the analysis and interpretations done and findings and conclusions derived are portrayed in the succeeding chapters.