CHAPTER III

REVIEW OF LITERATURE

3.0 Introduction
This chapter encompasses the review of research studies pertaining to constructivist(ic) approach in environmental education in four broader areas such as, constructivism, constructivist approaches in education, environmental education, and constructivist approach in environmental education. The review of the literature concludes with a summary of the literature review and the implications for the present study.

3.1 Research studies on constructivism
The review of literature in this section comprises fifty nine (59) studies on application of constructivism in the field of education. Here the review is presented in research focus, nature of researches, samples used and tools and techniques employed in a sequential manner. The studies of Wang (1998), Seguine (2002), related to impact of constructivist instructional context on quality of teaching. The studies of Lees (1998), Bijas (2007), Cook (2007), and Ross (2008) related to effect of constructivist teaching strategy, constructivist teaching on content understanding, learner construction of relevance of constructivist pedagogy to the content and effectiveness of constructivist instructional methods on students’ motivation.

related to use of constructivist strategies to promote conceptual understanding and science process skills.


CHAPTER III

of Paul Ernest's social constructivist philosophy of mathematics education, constructivist behavior among four science teachers.


3.1.1 Major findings from studies on constructivism
The major findings as per the main focus of the respective studies are as follows:

3.1.1.1 Researches on effectiveness of constructivism
Lees (1999) study found that no significant effect of a constructivist teaching strategy on students understanding. Ross (2008) study revealed that constructivist approaches were found to have a positive effect on both procedural and conceptual knowledge of student learning in middle school mathematics. Bijas (2007) study findings suggest constructivism informed pedagogy provides opportunities for students to construct relevance of the content by relating new learning to students’ personal experiences and prior knowledge. Herron (2000) study indicated that despite being given the same instructions, curriculum and materials, each teaching assistant conducted his laboratory section in a unique way and rarely conducted the complete laboratory in
the intended manner. It was evident that constructivist teaching methods were being learned. Ziegler (2000) study findings suggest that different dimensions of constructivist teaching, learning, and supervisory practices have differing effects on student achievement. The results confirm research supporting the positive effect of constructivist learning practices. Specifically, an emphasis on problem solving was positively related to student achievement in mathematics. The results of the study also suggest that school setting, mathematics certification, teaching experiences, gender and minority status are all factors related to the use of constructivist, teaching, learning and supervisory practices.

Delli (2005) study revealed that the participants reported that they valued reflective practices, constructivist based assignments and instruction. They stated that they learn best when they are involved in an inquiry – rich environment in which all classroom members are part of a learning community. Soanes (2007) study evolved in unexpected ways. The students viewed seatwork and whole group instruction as learning and resisted learning activities that were different from their notion of learning. Researcher was unable to substantially advance constructivist approaches to teaching and learning. Researcher analysed possible reasons for student resistance to these new pedagogical practices using the concepts of habitus and power. He also look at how a variety of social issues challenged the creation of a community of learners in the classroom. The findings from this study provide an in-depth analysis of an attempt to change students’ ideas about learning and the negotiations between students and teachers that are necessary to do so. Kerr (1999) study found that parents, teachers and students reported positive attitudes toward the change to constructivist mathematics. Data indicated that the shift to constructivist, standards based teaching and learning resulted in improvement in mathematics achievement. Dethlefs (2003) study found that, no specific dimensions of constructivist learning environment were consistently related to student achievement. However, several dimensions of constructivist learning environments emerged as significant predictors of student attitudes, including Personal Relevance, Shared Control, and Student Negotiation. The dimensions of Critical Voice and Uncertainty appeared to be less important in predicting student attitudes.
The results of Bilal (1994) study showed that although the constructivist approach was not statistically significantly different to the traditional approach on the paper and pencil knowledge test, the result of the clinical interview showed that the instructional treatment did have effects in other respects. The students in the constructivist group interviewed had acquired conceptual knowledge that are consistent with both the structure and concepts of physics, and used physics concepts more accurately to explain the new tasks.

White (2000) study indicated that, change in cognitive development, as measured by pre – test and post – test using GALT, was significant in the experimental group, but not in the control group. Neither group showed significant changes in attitudes toward science over the course of the semester. Both groups demonstrated gains in content knowledge, the gain by the experimental group was significantly greater than the gain with the control group. Gatlin (1999) study indicated that, significant difference was found on the science achievement post test where the students receiving the traditional pedagogy scored higher than the students taught by the constructivist pedagogy. However, the scores of students receiving constructivist – informed pedagogy showed slight increase on the delayed posttest, while the traditionally taught students’ scores decreased, thus the difference in the achievement of the two groups was diminished over time. Makanong (2000) study indicated no significant differences of mathematics problem solving processes and achievement between students in the two treatment groups. The qualitative data indicated that constructivist teaching was a promising approach capable of getting students more involved in learning mathematics. Students in this study who learned mathematics based on constructivist teaching tried harder, as measured by the interview task problems, than those who learned based on traditional teaching.

Berube (2002) study indicated that students who were taught by teachers with more traditional and mixed teaching styles performed better on the Higher – Order Skills comprehension measurement, while teachers with constructivist teaching styles actually had the lowest scoring students. Also, the interaction of ethnicity and teacher type was significant, indicating that Higher – Order Skills scores were influenced by that interaction, with Caucasians scoring the highest when taught by teachers with mixed teaching styles. Wesche (2002) study indicated that both the groups were
statistically equivalent on both the computational and conceptual subscales on the pretest, but the behaviorist group significantly outperformed the constructivist group on both subscales on both the immediate and delayed posttests. These results strongly favor a behaviorist approach in teaching the area of a triangle to fifth graders. Combined with the research literature, this unexpected outcome indicates that theorists and practitioners may need to adopt and eclectic approach to their teaching methodology, in which some topics may be taught more effectively from a behaviorist viewpoint and others from a constructivist perspective. Pettitt (2008) study indicated that, overall, the mathematics achievement of the treatment group was not significantly higher than that of the comparison group. It was concluded that the adoption of a constructivist methodology does not negatively impact test scores.

Soeharto (1999) study demonstrated that students in the treatment group reported a significantly higher use of constructivist ideas by their teachers than students in the control group. Results of analysis of covariance techniques showed that there were significant differences between the treatment and control groups, specifically among those classes of students which were taught by teachers who had graduated from high school level preparation programs. Significant differences were also found between the treatment and control groups among those students who were taught by high school graduated teachers. Majdalani (1994) study found that positive correlations observed were between their understanding of number sense and their attitudes. Liang (1999) study revealed that constructivist curriculum model using hands-on, inquiry-based, cooperative learning was more effective in promoting conceptual understanding and positive attitudes toward science learning for those with lower past science performance. The PIPS approach left more room for self-reflection on the development of understanding of science concepts in contrast to the lecture-lab type teaching. A similar study conducted by Smith (2000) indicated that the participation in constructivist classroom does positively affect pre-service teachers’ attitude toward mathematics teaching and learning as well as beliefs about the classroom environment.

Akar (2003) Findings show that post-test scores were not statistically different between the experimental and the control groups. However, a significant difference was found in the retention scores in favour of the experimental group. The conceptual
change the learners went through was evident in their metaphorical images which tend to change from a more controlling image to images that depict leadership, sensitivity to individual differences, and student learning. Descriptive findings indicate that retention was fostered through constructivist activities that mainly included reflective writing, critical thinking, and problem solving. Factors such as active learning, meaningful and enjoyable learning environment, and the attitudes of instructors had a positive impact on student learning. Nevertheless, the load of reflective diary writing and portfolio preparation tasks, and collaborative work could be overwhelming and discouraging and these impacted negatively on learners’ attitudes towards the course.

Akcay (2007) study findings include the following: (a) Pre service science teachers showed significantly growth over the semester in their perceptions concerning STS / Constructivism, beliefs about science teaching and learning, and attitudes toward science and technology, and their implications for society. These significant changes were not affected by gender nor grade (elementary Vs secondary) level. (b) Pre service science teachers showed statistically significant growth toward an STS / Constructivist philosophy of science teaching and learning in terms of student actions in the classroom, as well as their increased understanding of science processes and content. (c) An STS / Constructivist approach provides student – centered learning environments that are relevant, motivational, and meaningful for pre service science teachers. Further, it encourages them to interact and to participate more actively in science classrooms.

White (2008) study results showed a significant increase in content knowledge, for the education students, on the geology content knowledge assessment (GCKA). However, none of the students improved on their development of the graphic timelines over the course of the study. The improvement was demonstrated by students at the two lower levels. At these stages it is perceived that there are correct answers to questions and solutions to problems. These findings indicate the need to assess students as to their intellectual levels in order to develop effective teaching strategies to improve learning at all levels in the educational process. Jimarez (2006) study found that the use of constructivist strategies promotes conceptual understanding of science concepts and development of science process skills and a change of attitude towards science.
3.1.1.2 Studies related to students
Quaintance (2006) study found that students’ beliefs about learning and teaching changed in much the same way as in previous studies. The students developed an appreciation for constructivist practice, realized the importance of student-centered environments, came to value collaborative learning and social interaction, and moved away from the view that learning is acquiring facts towards a view that learning is constructing knowledge. Students’ attitudes towards the course remained stable over the semester, with some exceptions. The students indicated the course content was interesting and relevant; they felt comfortable sharing their thoughts; they disliked the lack of deadlines for the assignments; they were lukewarm about the discussion boards and online journals, and the class discussions, particularly hearing classmates’ perspectives, were important for their learning. Student reactions that emerged as the semester progressed included concerns about inappropriate student behavior and confusion about the expectations for student performance.

Olson (1999) study revealed that the assessment of conceptual change through interviews conducted two months after the unit, and many items on the concept maps had decayed from students’ memories. Concept maps were insufficient to indicate the depth of students’ understanding. Low and high achievement students focused on the method of instruction rather than specific activities. Brown (2010) study indicated that students' perceptions were that all seven areas of a constructivist learning environment were present in their learning communities but to varying degrees. The students' perceptions were all positive and indicated that they were more aware of collaborative inquiry, the opportunity to construct knowledge, and to reflect on prior experiences in their learning community classes. French (2008) study revealed that those gifted students who feel adequately supported by those in their environment will be less likely to indicate a preference for working alone, compared to those who do not feel supported. Butts (2009) study interviews revealed that the participants were able to relate the educational material which they prepared using technology to the project being developed. No participants saw the instructor as a presenter of facts.

3.1.1.3 Research studies related to teachers
The study conducted by Owen (1994) revealed that when the teacher was observed to pose problems at the beginning of as well as throughout, lessons and provided a safe,
risk-free environment, the students were eager and willing to talk about their thinking or how they came to solve a problem. Results from the study suggest that a teacher must develop a safe secure environment if constructivism is to be fostered. The findings of Coppola (2000) were relevant to educational leaders and policymakers who want to promote quality use of computers in schools and want to create environments in which teachers can develop their teaching. On the structural level, teachers had time in the day to devote to learning and reflection, office space, designated computers, access for students, a stable technological infrastructure, and technical support on demand. On the cultural level, the norms of school and community emphasized learning, autonomy and independence, innovation, and accountability for quality. Overall the culture functioned well because it was coherent, appropriate for the local context, and consistent over time. Within this environment, faculty learned constructivist teaching with computers through a process that included commitment to learning how to do so, formulating pedagogical problems, exposure to new ideas, creating new curriculum, trying ideas in the classroom, reflecting on their work, and refining the practice.

Dias (2001) study revealed that, Commitment to teaching and supportive relationships at the school helped the first year teachers negotiate satisfying role in inquiry teaching. It is also mentioned that, constructivist theory represented a narrowing of the gap between educational theory and practice. Schiller (2001) study found that, the teachers study group created a non-threatening forum for reflection, support, and sharing as each teacher learned that they were not alone in the struggles and challenges they experienced in negotiating constructivism. Hunter (2003) study revealed that the teachers’ use of constructivist pedagogy was consistent across all aspects of their practice, they used meta cognitive and purposeful teaching strategies, and they were leaders in their profession. Paradoxically, the teachers understood the importance of teaching with technology, but exhibited limited knowledge of how to incorporate the Internet into their teaching. Teachers also experienced time constraints, a conflict between their constructivist philosophy and expectations placed upon them, and the need for information literacy skills curricula and technical support.
Savasci (2007) study findings revealed that teachers generally reported that they held constructivist teaching and learning beliefs. However, they had difficulty in incorporating their beliefs into classroom practice. Only one teacher could implement his beliefs related to constructivist teaching and learning into classroom practice; as such, his expressed beliefs were consistent with his observed classroom practice. Personal Relevance and Student Negotiation were the most frequently preferred constructivist components and Critical Voice was the most perceived constructivist component in science classrooms. Shared control was one of the least preferred and was the least frequently perceived and implemented constructivist component in science classrooms. Whole-class activities were frequently observed in all science classrooms. However, teachers working in the private middle school tended to spend more class time in group work than those working in the public high school. On the other hand, teachers working in the public high school tended to allocate more class time to individual work than those in the private middle school. The teachers working in the private middle school tended to use more student-centered activities in their classrooms. Teachers working in the public high school tended to use more teacher-centered activities in their classrooms. School type (private versus public) and grade level influential factors that affected teacher practice.

Kingsley (2008) study the researcher discovered four major steps in a dance between teacher and students that developed literacy skills in a caring environment by nurturing self-esteem and self-regulation in learners. The teacher designed a peer tutoring program with first grade students in which literacy skills instruction was embedded within an authentic context that responded to second language learners with learning challenges. The teacher’s roles as director, philosopher, enabler and connector were explored and a mirror image of students and teacher were provided through a narrative tracing of three focus students. Besides describing the literacy practices of the teacher, this study uncovered a spiritual dimension of the teacher’s role in that she began from the sacred space of teaching from the heart. Using gentle judgment and praise she built self-esteem by reflecting back to her students an image of competent, intelligent, human beings.

The study of Ibrahim (2002), on the impact of the Guided Constructivist teaching method on students’ misconceptions about concepts of Newtonian physics reveals that in teaching learning process greater conceptual learning is fostered when
teachers use constructivist based interactivity teaching strategies to train students to link everyday experience in the real physical world to formal school concepts. Ji (2003) study findings indicated that: (a) the teacher’s characteristics play a major role in determining the nature of her pedagogical beliefs, practices and her willingness to change toward a more constructivist teacher; (b) the masters program has significantly influenced the change in her pedagogical beliefs and practices into constructivist model of teaching and learning. (c) When Web – based technology is involved in the teacher’s curriculum, it is more likely that the teacher engages in the role of active designer of her class and curriculum, and provides the students more meaningful ‘real – life’ experience of learning environment.

Berger (2000) study determined that participants did incorporate skills and knowledge from Opening the Gate (staff development through constructivist orientation) into their daily practice. Hierlmeier (1999) study indicate that teachers made adjustments to their pedagogical thinking focusing more on several constructivist principles: personal relevance and learning styles, student initiative, daily discrepancy resolution, and appreciation for primary sources. The findings also revealed teachers prevailing effort to replicate their own preferred learning environment as fundamental to pedagogical decisions and planning for their students. Many of the teachers’ efforts to change the learning environment on campus were thwarted by lack of school vision for experiential learning lack of staff collegiality, and teachers’ limited ability to network community resources. Star (2006) study results showed that the majority of teachers (70%) report that they use constructivist practices in their classrooms. Results also revealed that teachers use constructivist practices mostly during the presentation of new information. Results also reveal that middle school science teachers use constructivist practices more than the secondary school science teachers.

Brown (2007) study found that although the principal, who initiated application of constructivist strategies retired, constructivist strategies remain in use. The changes that occur with change in leadership, as predicted in the Tri – Partite Theory, were managed at South wood by an internal replanning process of establishing PLCs. This study lends credence to the importance of professional learning communities as a constructivist change strategy, which finessed the entropy
organizations face with leadership changes by establishing PLCs as a socialization process. Saunders (2010) study revealed that, no significant differences between teachers who implement constructivist practices and those who do not with regard to their beliefs and perceptions. There was no significant difference found between teachers who implement constructivist practices and those who do not with regard to their scientific knowledge mean rating, or their constructivist practices rating ($p > .05$).

Liptak (2000) found that changes in teacher – principal relationship and leadership role of the principal happened when the teacher and principal believed the constructivism. Lew (2001) study results indicate that the new teachers were largely early constructivist teachers. Constructivist teaching approaches were used during student teaching. Socialization and induction processes had minimal effects. Both observed practices and beliefs about teaching and learning were student – centered; after declines in years one and two, constructivist behaviors improved by the third year of teaching. Students of the new teachers perceived their lessons as being more interesting, more relevant to them, and that they had more autonomy about instruction than reported by students in other programs. Their perceptions better matched those of students taught by more experienced teachers, who were identified as expert constructivists. Another study by Seguine (2002) found that constructivist teachers fostered strong relationships with their students and taught beyond the prescribed curriculum to ensure meaningful student learning. These constructivist teachers enacted their practice with or without administrative support and desired professional development that addressed their needs and promoted an – active learning environment.

3.1.1.4 Studies related to school education

Wang (1999) study revealed that although bringing many constructivist ideas into their internship, three out of four these pre service teachers were unable to retain all these ideas or articulate them into their practice. Instead, they developed some ideas that were contradictory to their program’s expectations. The pre service teachers actually moved closer to their collaborating teachers at both conceptual and practical levels. The ideas they shared with their collaborating teachers were able to be retained and practiced in their teaching. The ideas they failed to share with their collaborating
teachers disappeared or were not enacted in their practice. The new ideas they
developed in their internship were often those their collaborating teachers held and
practiced. The expectations both pre service and collaborating teachers had for their
roles in the internship, had a strong impact on what they were able to do in their
collaboration. The kind of collaboration they developed, in turn, contributed to the
chances for the quality of these pre service teachers’ learning. The culture of teaching
in each school was different and not always supportive of their constructivist ideas.
Wilding-Martin (2009) study brought the idea of Paul Ernest. Ernest sees learning as
the social construction of knowledge through conversation. Therefore, he believes that
mathematics education should foster knowledge construction through active
engagement and student interaction. In addition, he claims that mathematics education
should contribute to the development of democratic citizens who are able to critically
evaluate political and social claims that are based on mathematical arguments.

3.1.1.5 Studies related to teacher education

McGlynn (2002) study revealed that firstly, most faculty – educators teach as they
were taught, developing constructivist pedagogy requires a process of activity
reflection, and dialogue for authentic change to occur. Learning is not the result of the
process; learning is the process. Secondly, planned change is successful when
outcomes are identified, and conditions and resources are in place, which support the
phases of the change. Third, disequilibrium promotes learning. In order to risk
change, faculty – educators require an environment that is voluntary, non –
evaluative, and collaborative. Forth, a theory – to – practice, learner – centered
approach requires new skill sets and they reveal gaps in basic traditional teaching
techniques. Next, participating in constructivist pedagogy is uncommon for a majority
for a majority of students. The role of the learner in a constructivist classroom
requires articulation and forming by the faculty – educator. Finally, change is a non –
continuous, complex learning process that requires establishment of a collegial,
trusting relationship between participants.

Curley (2000) exploratory case study indicated that constructivist supervision
facilitated reflectivity in some student teachers and not in others. Difficulties in
implementing constructivist supervision are a promising beginning for the
development of a constructivist orientation to the supervision of student teachers.
Trundle (2000) study results indicate that without the instruction most elementary pre-service teachers were very likely to hold alternative conceptions of the cause of moon phases. Also, participants who had the inquiry-based instruction were much more likely to hold a scientific conceptual understanding shortly after instruction, and many continued to hold scientific understanding months later. Michalec (1999) study indicates that with respect to the program studied, the theory/practice divide was non-existent. Pre service teachers in the program learned how to teach in both constructivist and teacher centered style of teaching at both the university and public schools. The site of learning to teach had a lesser impact on which style of teaching pre service teachers learned than did the kind of pedagogical relationship they formed with more experienced practitioners.

Howson (1999) study (case studies) revealed the evidence that, difference in the ways the pre-service teachers communicates their understanding and process make constructivist theory their own. They work to interpret their own realities in the classroom as their prior beliefs and knowledge are challenged. Constructivist concepts are implemented with some successes and some disappointments showing fluctuation in growth during their experiences. Gallagher (2005) findings from this case study included a deeper understanding of science, technology and engineering reported by the majority of the pre service teacher participants. In addition, pre service teachers gained and reported more advanced strategies for problem solving, communicating, and working within a course that used a constructivist framework for learning. Results from this study suggest that engineering can provide a valuable context for pre service teacher preparation that involves learning and teaching of science, technology, and problem solving. Gill (2005) study findings indicates that using the teacher educators’ real-world experiences in the elementary school classroom provides pre service teachers with an up-close and personal view of education that validates the authenticity of the teacher educator. Palas (2002) study the mentors were found to embrace a non-linear, multi-directional view of learning in which learners made choices and decisions and in which teachers valued their autonomy to structure classroom time in ways that supported beliefs about active child centered learning. Finally a theme emerged depicting the struggle participant mentors felt as their student teachers entered the teaching field. Mentors were concerned that these novice teachers might encounter administration or school cultures with expectations for large
amounts of time spent explicitly drilling and remediating for high stakes standardized tests. Mentors expressed concern about whether their student teachers would find opportunities to follow through on teaching practices they had experienced in their student teaching. A key finding was the need for shared language to describe beliefs about the learning process. Eick (2000) study revealed that, three major factors consistently influencing use of constructivist practices: (a) personal history informing beliefs and practices, (b) content and pedagogical understanding, and (c) cooperating teacher interpretation of the curriculum and associated pacing regime.

3.1.1.6 Studies related to suggestive format
Thompson (2005) study reveals the importance of autonomy and interplay between the accountability movement, misunderstandings of child developmental and societal pressure. For the participating teachers in this study, the current educational environment limits teacher autonomy and constructivist practices. In addition, when teacher backgrounds are not specific to early childhood education, their autonomy, and therefore, their use of constructivist practices, is further limited. It is recommended that teacher education programs facilitate teacher autonomy by helping pre-service and in-service teachers to articulate and defend their beliefs. Finally, when teachers are given more autonomy and use more constructivist practices, this could act as a catalyst for change in the wider culture. Terry (2002) study findings first describes the characteristics of constructivism as they exist in the classroom under study. Secondly, elements that contribute to the construction of an atmosphere of trust within the constructivist classroom have been explored. Through analysis, caring, respect, communication and cooperation have been identified as four basic elements in the development of trust. Thirdly, these elements are shown to require conditions of honesty, acceptance, commitment, and responsiveness devoted to the relationship. When these elements and conditions are fully integrated, a significant level of trust should exist that will support the forces of diversity, conflict, risk, and reflection.

Cook (2007) study findings were that teachers should provide students with constructivist lessons such as cooperative groups, problem based learning and inquiry question in which to learn content objectives. As social beings, students are more motivated to participate in activities that allow them to work with peers, contribute their own ideas, and relate topics of interest to their own realities. Keeping these ideas
in mind during lesson preparation will increase students’ motivation and achievement. Variation of instruction should include activities that reflect multiple intelligences and real world situations. The findings of Piazza (1994) ethnographic study were the reality of the constructivist classroom studies offers implications for emerging constructivists’ teachers in establishing environments which promote the construction of mathematical knowledge. A constructivist culture was found to be constructed as meaningful to the construction of knowledge. The educational goal of autonomy created cultural meaning for schooling experiences. Reform efforts supporting a constructivist approach to education require a re-conceptualization of education. Researching lived histories of emerging constructivist teachers may offer insight into the reform of teacher education, professional development, and teacher induction. Constructivist teachers are potential agents of educational change because they act autonomously. Griffard (2000) qualitative case study revealed numerous gaps in graphic decoding, indicating that both direct experience and explicit instruction are needed if students are to “learn how to learn with graphics,” especially those graphics central to understanding a computer simulation’s representations of structures, inputs, processes and outputs.

3.2 Researches on constructivist approaches

3.2.1 Researches on cooperative learning
The studies of Basili (1989), Ali (2003), McNair (2006), Gilbert (2008), Hines (2008), Morris (2008), Goyak (2009), Chester (2010), Conring (2010), Dong (2010), Donohue (2010), Morrison (2010), Niemi (2010), Purghart (2010) and Romero (2010) are related to cooperative groups incorporating conceptual change strategies, similarities and differences of cooperative learning in private versus public schools, effect of cooperative learning vs. traditional learning on students achievement, effect of cooperative learning on students achievement, small groups of fifth graders construct meaning of narrative and informational texts, systematic literature review on science outcomes associated with cooperative learning in secondary and early post-secondary science-classrooms, influence of the Big Five personality factors on behavioral indicators of children's cognitive and social development during small group collaborative discussions, to compare two different cooperative learning models in terms of their effects on student achievement, influence of verbal and nonverbal
behavior on power and status within small groups, teacher use of cooperative learning on student achievement, effects of small-group and traditional didactic instruction on student acquisition of facts and reasoning skills, influence of affect on cooperative productivity.


3.2.1.1 Major findings
Basili (1989) study’s transcriptions of verbal interaction revealed five of the eight groups audiotape had verbal behavior suggestive of all four conditions of the conceptual change process (e.g. dissatisfaction with preconceptions, and perceptions of intelligibility, plausibility and utility of new concepts). All the individuals, who had evinced all four conditions, achieved correct concepts on the posttest. Dong (2010)
study found that, Extroversion showed a big influence on how many speaking turns the students were able to get discussions. Conscientiousness demonstrated significant prediction on all the measures in the post discussion questionnaire which aims to evaluate how engaged the children were. Emotional Stability showed an interesting interaction effect, with gender on the number of talking turns the students made. Openness revealed a significant positive main effect on the students’ self-reports of the level of involvement in the discussions. Agreeableness showed significant negative impact on the students’ self-rating of how many negative emotions they experienced. Morris (2008) study results indicated that the identity of the student asking a question or requesting help in some form or another is a better predictor of whether he/she will receive help than the type of questions he/she asks. Nonverbal behavior was analyzed for social gestures, body language, and shifts in possession of tools. Each nonverbal act was coded as either "positive" (encouraging participation) or "negative" (discouraging participation); and, the researchers found that in groups in which there was unequal participation and less "help" provided among peers (according to the verbal analysis results) there tended to be more "negative" nonverbal behavior demonstrated than in groups in which "shared talk time" and "helping behavior" were common characteristics of the norm.

The combined results from the analyses of the verbal and nonverbal behavior of students within small groups were then reviewed through the conflict, power, status perspective of small group interactions in order to determine some common characteristics of high functioning (collaborative) and low functioning (non-collaborative) groups. Some common characteristics of the higher functioning groups include: few instances of conflict shared "talk time" and decision making, inclusive leadership, frequent use of encouraging social gestures and body language, and more sharing, of tools than seizing. Some shared traits among the lower functioning groups include: frequent occurrences of interpersonal conflict, a focus on process (rather than content), persuasive or alienating leadership, unequal participation and power, frequent use of discouraging social gestures and body language, and more seizing of tools than sharing.

Donohue (2010) study findings showed that affect played a decisive role in promoting cooperation and productivity and that its influence accumulated,
accentuating the positive or negative effect. Ali (2003) study results showed that overall the students in the Cooperative Learning with meta cognitive Scaffolding group significantly outperformed the students in the Cooperative Learning group who, in turn, significantly outperformed the students in the Traditional group in all (mathematics performance, mathematical reasoning, and meta cognitive knowledge) measures. Chester (2010) study found that significant relationship between cooperative learning dyads and physics achievement by high school minority students was found. By learning in small groups, students were able to help each other construct meaning and make sense of their learning. Conring (2010) study findings indicated a significant difference in the mathematical achievement of 2nd grade students taught using cooperative learning strategies when compared to the mathematical achievement of 2nd grade students taught using traditional teaching method. The use of cooperative learning strategies could increase math achievement, which may improve the likelihood of children being able to reason mathematically in real world situations.

The results of Romero (2010) meta-review indicate that cooperative learning improves student achievement in science. The overall mean effect size was .308, a medium effect. Moderator analyses on study participant characteristics gender and ability level were inconclusive based on the small number of studies in which data on these characteristics were disaggregated. If the intervention was structured in a particular fashion, the effect on student achievement was greater than that for an unstructured intervention. The intervention showed a greater effect on student achievement in biology classes than in other science disciplines. Studies performed using cluster randomized or quasi-experimental without subject matching methodologies showed a greater effect on student achievement in science than studies that used the quasi-experimental with subject matching methodology. Niemi (2010) study revealed that the learning using a structured dyad model resulted in significantly higher student achievement scores than learning using the Jigsaw II model. Purghart (2010) study revealed that students placed in the small-group instruction classrooms increased their learning in the social studies unit significantly more than those in the traditional classroom for factual recall and reasoning questions. Quantitative results showed no significant difference between the gains of high and low-achieving students. Gilbert (2008) study found that cooperative learning does not have a
significant impact on academic success. However, when considering academic progress among groups, there were differences amongst grade levels. Students in grades 3rd, 4th, and 5th posted considerably higher math scores in cooperative learning groups than 1st and 2nd grade students.

McNair (2006) study revealed that procedures employed by teachers during cooperative learning included the following: directly teaching the subject to students before beginning cooperative group learning, placing students in groups of four, closely monitoring students, assessing students, and rewarding students. Students reported sharing, taking turns, and helping one another as procedures used during cooperative learning. Cooperative learning was viewed as being valuable in the classroom. Competition was not considered a vital part of cooperative learning. A few teachers and administrators considered competition an important factor of cooperative learning during the interview process; however, competition was not observed being facilitated in the classroom during cooperative group learning. Morrison (2010) study revealed that (1) Fifth graders initiated and maintained meaningful talk of written text in peer-led settings with minimum teacher intervention; (2) They used numerous cognitive processes to generate talk as they engaged in discussion of texts; (3) They talked about narrative and informational texts in similar ways; (4) And they engaged in more lengthy discussions of informational text and provided more meaning making utterances for this text type compared to narrative text. Hines (2008) study results indicated that teachers' overall actual use of cooperative learning strategies was quite frequent and these strategies ranged from presenting and explaining, to modeling and intervening, to teaching the skills needed for students to work together. Goyak (2009) study results revealed significantly in the means in the cooperative learning group in four of the eight constructs within the CUCEI. Results within the WGCTA-FS disclosed no significant differences between the means of the two groups.

3.2.2 Researches on problem based learning
approach to teaching information literacy skills; effects of participation in a Problem-based learning (PBL) teacher education program; perception of PBL and attitude towards its adoption among teachers; effectiveness of PBL; students perspectives on PBL; student achievement in the problem-based learning classroom; relationship between tutors' pedagogical beliefs and their comfort and challenges with the facilitation of Problem-based Learning (PBL) tutorials; PBL to prepare school principals for teacher supervision in a constructivist classroom; impact of a metacognitive reflection component in a problem based learning unit; Effect of problem-based learning on critical thinking ability, effects of problem based learning (PBL) and traditional lecture instruction (TI) courses on critical thinking, knowledge and application of strength and conditioning.

Association Certified Strength and Conditioning Specialist (NSCA-CSCS) in knowledge and practice exams.

3.2.2.1 Major findings
Casey (2008) study found that the Problem Based Inquiry method can be used effectively as an indirect training evaluation method. This study demonstrated that PBI can increase transfer of training and increase training effectiveness, in most cases. Pease (2010) study results indicated students' superior mastery of the concept learned via PBL in terms of understanding, integration and application. It also indicated that collaboration is not an essential component of PBL, as revealed by a lack of a significant difference in students' performance across these two conditions. Performance in both conditions remained superior to that in the Lecture/discussion condition. Tims (2010) study results indicated that PBL may help ESL adult students improve, learn, and/or practice English because it promotes hands-on learning as well as the possibility of integrating the four language skills. However, the students' learning in needs should determine the type, length, and focus of the project activity, as well as the degree of active teacher involvement. Sanderson (2009) study revealed that, student course evaluations revealed student perceptions of PBL in which students found textbook usage, the use of PBL problems, and communication of strength and conditioning concepts with the group as she most beneficial PBL course components to learning strength and conditioning with peers as teachers as the least beneficial. PBL students also noted feelings of frustration, culture shock, and lack of time in learning course material. All PBL students were graduating seniors with no prior PBL experience. The instructor recorded observed critical thinking, application of knowledge, and positive and negative comments and class interactions in field notes. Students did not improve critical thinking, knowledge, and application in strength and conditioning better with PBL than TI. It is important to note PBL scores were not statistically less than TI suggesting that PBL was an equally effective pedagogical method.

McCaughan (2010) study results showed a statistically significant relationship between pedagogical beliefs and facilitation comfort with PBL facilitation techniques. Interview data corroborated these findings. Pilliner (2003) study found that majority of teachers were unaware of problem – based learning (PBL). Teachers who embrace a student – centered teaching preference are more likely to be aware of PBL. Little
more than half the teachers have a student – centered teaching philosophy, and less than half appreciate the student – centered teaching components of PBL. Teaching philosophy is related to the teachers’ age and inference for PBL teaching components. More female than male teachers embrace the student – centred components of PBL. The greatest perceived barriers to teacher implementation of PBL included, assessing and reporting student learning, a loosely structured, sometimes noisy learning environment, and system unwillingness to provide PBL support sources. Dobbs (2008) indicated that there was not a significant difference in student achievement between the PBL and traditional teaching methods. Diercks (2003) study results indicated in increase in the pre service teachers’ self – efficacy in teaching science. Krivel – Zacks (2003) investigation revealed that the majority of the groups involved agreed that PBL curriculum does have an effect on reasoning, interest, enthusiasm, and satisfaction of faculty and teacher education students. Majority of participant groups also were of the opinion that PBL and non – PBL curriculums provided equal knowledge of basic skills and principles, and professional preparation to the students.

Nelson (2008) study indicated several identified positive themes: the need for integration, the PBL process, professional growth, peer interaction, and leadership. Group dynamics and communication technologies were mentioned as negative aspects of the online (PBL) model. Additionally, participants indicated that the following issues represent challenges of learning technology integration through online PBL: group dynamics, scheduling and time issues, use of multiple disciplines, and pushing the boundaries of student learning. Mondschein (2008) research indicates that integrating PBL into curriculum focusing on information literacy facilitates the development of information competencies and promotes academic engagement among students. The findings of this research suggest that a first-year seminar incorporating PBL should consist of a sequenced curriculum including information competencies reflecting the five student learning outcomes. Burris (2009) study found, that students in the supervised study treatment group produced higher scores or critical thinking ability. While this difference was statistically different, there was no practical difference between the two groups. The supervised study treatment group outperformed the PBL group on content knowledge. The difference was both statistically and practically significant.
The overall findings of Seifert (2009) study fail to lend support for the intervention that was examined. The qualitative analysis results were not statistically significant between the two experimental groups and the control group. While the qualitative data sources provided some insights regarding how students learn, the data did not indicate that this type of metacognitive support greatly impacted student learning over the course of his study. Dempsey (2001) study revealed that the PBL project meets the criteria for a successful PBL (e.g. Promotes collaboration, mirrors real world, meets objectives, etc.). Participants’ journal entries provided rich insight and texture to the findings.

3.2.3 Researches on inquiry learning


3.2.3.1 Major Findings

Blain (2001) study revealed that, grade three students had significant improvements in inquiry ability and attitude toward school science as a function of their participation in mixed-age dyads completing inquiry-based science experiments with a high school physics partner. The social interaction between the ‘more capable other’ (Vygotsky,
1978) with the grade three student in the mixed-age problem solving team indicates a contributing factor in this improvement. Gabel (2001) study indicates that a scaffolded approach in all pedagogical aspects contributes in a successful performance from the students in designing their own scientific investigations. The study of Callard (2002) reveals that after engaging in the three instructional units based on an inquiry approach, all students did indeed demonstrate learning of not only the mathematical content expected in traditional eighth grade mathematics, but also demonstrated learning that went beyond these expectations in many instances.

Furtak (2006) study revealed large differences in the guidance teachers provided (in scientific inquiry teaching) to students during the unit. Teachers whose students showed lower gains in learning exhibited patterns of alternating between high and low levels of guidance. The teachers whose students showed higher gains had more mixed patterns of guidance. The results suggested that the teachers whose students had higher gains illustrated more instructionally responsive teaching, and took an active role to move students toward learning goals, whereas the lower-gain classes received little meaningful guidance from teachers. Measures of student learning indicated teacher effects. Reger (2007) study showed marked increase in and deeper levels of higher-order thinking for two of the students. The other boy and girl showed progress using the inquiry activities, but it was not as evident. The social dynamics of the group seemed to hinder one girl’s participation during some of the activities. The social interactions played a role in strengthening the exchange of ideas and thinking skills for the others. The teacher had a tremendous influence over the production of higher – level statements by modeling that level of thinking by questioning the students. Through the practice of answering a question with a question, the teacher gradually solicited more analytical thinking from the students. Slone (2007) study found that, prior to inquiry based instruction most of the sixth grade students were very likely to hold non-scientific conceptions of magnets and magnetic phenomena. After instruction fewer students held non – scientific conceptions and most students held at least some scientific understandings. A similar finding has also been noted by Trundle (2000) among pre-service teachers. Another study by Choi (2008) found that participant teachers constructed fairly positive beliefs and practical knowledge that promoted inquiry-instruction throughout the course.
Moreover, they improved their knowledge and skills of conducting inquiry in their own science lessons.

Kessner (2008) study results indicated a general improvement of students meeting mastery of the fifth-grade science state assessment when kits were implemented. Teacher fidelity and high implementation were validated with Student and Teacher Surveys. Jensen (2009) study results showed that within non-inquiry instruction, heterogeneous mean group scores were higher in both reasoning and achievement than homogeneous groups. In contrast, within inquiry instruction, homogeneous mean group scores were higher in both reasoning and achievement. Inquiry instruction, as a whole, significantly outperformed non-inquiry instruction in the development of reasoning ability. Within inquiry instruction, low-ability students had significantly greater reasoning gains when grouped homogeneously. Harris (2010) study found that both the experimental group and the control group significantly increased their mean scores from the pretests to the posttests. The amount of gain from the pretest to the posttest was significantly greater for the experimental group than the control group. The experimental group significantly outperformed the control group with regard to their mean number of items answered correctly on the life sciences test.

Katz (2010) study found that, students in the four classrooms viewed: (1) the conceptions of mathematics and mathematics instruction differently; (2) adaptive reasoning and thinking in the mathematics classrooms differently; and (3) the roles of teachers and students differently. There was greater distinction between the students' views in inquiry classrooms and students' views in the conventional classrooms. Weakley (2010) study found that statistically significant changes were observed in the use of spatial constructs and concepts by students in each of this course treatment that were compared. Students were also observed to apply spatial modes outside the classroom that represented the spatial thinking: within the new context of the University environment as they observed and described the landscape.

Horvath (2009) study showed that, six of the pre-service teachers did not demonstrate shifts in content of planning, teaching and reflecting on inquiry-based science. Three of the pre-service science teachers who shifted perspectives were chosen for further analysis. All 3 pre-service science teachers were found to have
constructed a more robust view of inquiry. Yet each pre-service science teacher also described experiencing and engaging with inquiry in relation to her own unique set of instructional contexts. Varma (2009) study indicate that when multiple inquiry-based experiences and instructional strategies, consistent with the National Science Education Standards, are integrated into a traditional elementary science methods course and reinforced through observations of classroom practice in the field, pre-service teachers develop an understanding of scientific inquiry and inquiry-based science instruction, develop an appreciation for the benefits of teaching and learning science in a constructivist environment, develop confidence to teach science and indicate intent to use inquiry-based science teaching strategies in their own classroom practice.

Slack (2008) study found that pre-service teachers’ experiences with Scientific Inquiry were that the experience increased their abilities to conduct inquiry, increased their understanding of how they might use Scientific Inquiry in their classroom, increased their understanding of why variables are used in experiments, and did not increase their physics content knowledge. Ruyter (2002) study indicated two main findings. First, the concept of scaffolding was broadened from an instructional strategy or remedial tool to consider curriculum as scaffolding. The second finding emerged from the data on the teachers’ planning process. The data reveal the complexity of the curriculum creation process and the essential role of teacher inquiry into her or his own pedagogical content knowledge in order to create curricula that are engaging and accessible to all learners. Another study conducted by Livingston (2005) found that, with the environment in place, the teacher can provide various problem situations that promote students’ active reflection. The dialogic structure of the teacher’s facilitation of student’s science knowledge is shown to utilize students’ presumptive statements to hone their construction of inductive or deductive arguments. Gejda (2006) study indicated that participants reported practicing the 5Es (engage, explore, explain, elaborate, and evaluate) in inquiry-based instruction in their secondary science classrooms. Time, resources, the need to cover material for mandatory assessments, the science topics of concepts being taught, and professional development on inquiry-based instruction were reported to be important considerations in participants’ decisions to practice inquiry-based instruction in their science classrooms. A majority of the secondary science teachers participating in this
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study indicated they had the time, access to resources and the professional development opportunities they needed to practice inquiry–based instruction in their secondary classrooms. Study participants ranked having the time to teach in an inquiry–based fashion and the need to cover material for mandated testing as the biggest obstacles to their practice of inquiry–based instruction in the secondary classroom.

Reid – Hector (2007) findings indicate that the Inquiry Based Learning Project primarily functioned to generate learning by facilitating the groups’ transition from a task-oriented team to a learning system. Collectively the IBLP facilitated team learning by creating a learning environment situated in a climate of trust, facilitated a balance between advocacy and inquiry; and served as a mechanism to bridge diversity relevant to educational background, team roles and gender. The IBLP helped the team to deal with dysfunctional patterns of communication and interpersonal conflict rooted in issues of gender diversity relative to power inequities and access. Hunsburger (2008) study found that to reconstruct one's role as an inquiry teacher requires more than a theoretical understanding of the approach but entails an iterative process of experimentation, reflection and reconstruction that is unique to and deeply personal for each teacher. The researcher also discovered that for the three teachers in my study the role of co-learner is integral to their identities and how they live their lives. He also find that the setting in which the implementation takes place has much to contribute to the process through providing a safe and supportive environment for making mistakes and taking risks.

Tzou (2008) study explored three questions (1) what is the nature of teachers’ support of inquiry practices? (2) How do teachers accomplish goals along multiple dimensions of inquiry?, and (3) What aspect of inquiry are in tension and how can we describe teachers’ practice in terms of the tradeoff spaces between elements of inquiry in tension?. It was found that the teachers provided support for inquiry along all three dimensions (cognitive, social, and linguistic), sometimes in ways in which the dimensions were in tension. Tosa (2009) study results shown that inspite of the variations in teachers' definitions of inquiry-based teaching, teachers in both countries strongly agree with the idea of inquiry-based teaching. However, little inquiry-based teaching was observed in either of the countries for different reasons. The data
indicate the Japanese teachers did not generally help students construct their own understanding of scientific concepts in spite of well-planned lesson structures and activity set-ups. On the other hand, the observational data indicates the American teachers often lacked meaningful science content in spite of their high level of pedagogical knowledge.

Regis (2010) study results indicate that collaboration influenced the content teachers planned to teach as they discussed Investigations-related issues, determined Grade-Level Expectations (GLEs) to be taught, and/or exchanged activities for teaching. Whether they collaborated through district-sponsored meetings, school-level planning, or by personal choice, teachers ultimately created lesson plans individually. Teachers who considered Investigations to be an effective curriculum that addressed the GLEs supplemented sparingly, while those who perceived "holes" in the curriculum supplemented extensively. Most teachers recorded minimal information in their lesson plan due to time constraints and a limited understanding of curriculum features. Sack (2010) study revealed that many of 4th grade teachers like teaching science, actively pursue ways of improving their science teaching skills, but do feel as if science is an area of deficiency for them. They reported that their teacher preparation programs did not have science content courses, as an area of concentration, and they feel as if additional content knowledge would be beneficial to enhancing their instructional methods. Many teachers reported attending different kinds of district and state level workshops to help them advance their pedagogical content knowledge around the state science standards, but few teachers reported participating in professional development workshops that would improve their science content, knowledge. Case study teachers support this claim as well; however these teachers did say that they were exposed to additional science content classes during their pre-service training. Student findings collected through a series of think-aloud interviews and classroom observations suggested that scaffolding and repetition are imperative to student learning and their development of scientific thinking skills. By giving students repeated exposure to the desired science content, they were able to show proficiency with the embedded inquiry task.
3.2.4 Researches on concept mapping


Abayomi (1988) used pre and post achievement tests and Group Embedded Figures Test. Carter (1999) used solicited personal documents including written proposition lists, concept maps, and examinations, were examined along with tape recorder conversations. Salata (1999) used survey and pre and post achievement tests. Snead (2000) used a conventional weather test and six performance assessment items test. Jackson (2006) used Equivalent forms of the Teaching Science Inventory (TSI) and Equivalent forms of the Science Lesson Planning (SLP) test. Conklin (2007) used concept map as pre writing and post writing assessment. Ku (2008) used student’s pre and post concept maps, the instructor’s concept maps, participant observations, semi-structured interviews with the students and the instructor, semi-structured interviews with the students via instant messaging, documentation of the student’s write ups, instructor’s handouts and lesson plans. Pickens (2008) used pre-post achievement tests. Campbell (2010) used meta analysis review. Somers (2010) used interviews, observations, and pre and post concept mapping.
3.2.4.1 Major findings

Abayomi (1988) study revealed that although there was no statistical significant difference between the two groups, the means of the posttest scores for the students in the concept–mapping group were higher than the means for the students in the outlining study guide group. There was no significant difference between achievement scores of field–dependent and field–independent students. Based on the one–on–one interviews, students responded favorable to the concept–mapping strategy. Salata (1999) found that achievement improved to a statistically significant an meaningful level when students were presented lectures using a concept map organizer. Achievement was higher when students were shown lecture using the concept map organizer as compared to the outline organizer. Conklin (2007) study revealed that concept mapping significantly improved the depth of content; however, no statistical significance was detected for organization. Students had a significantly positive change in attitude toward using concept mapping to plan a writing assessment, organize information, and think creatively. The findings indicated concept mapping had a positive effect on the students’ abilities to select concepts appropriate to respond to writing prompt, integrate facts into complete thoughts and ideas, and apply it in novel situations. Concept maps appeared to facilitate learning how to process information and transform it into expository writing. Sustained practice in designing concept maps may influence organization as well as content.

Campbell (2010) meta-analytical review results indicate that Novak’s concept maps are effective learning tools for enhancing and promoting achievement among students. Within the learning domains of Science, English/English as a Second Language, Education, and Electives, concept mapping improves achievement. However, within the learning domain of Math, concept mapping groups did not demonstrate improvement of achievement. Both computer-generated and non-computer-generated maps were slightly more effective. Snead (2000) study found that concept maps not made significant overall effects on student’s science achievement. Jackson (2006) study results indicate that, there were basically no relationships between the treatment and outcome measures. There were no significant differences between the three groups in their knowledge about how to teach science. The learners did learn how to teach science using inquiry. There is little evidence to support that concept mapping was more successful than the listing strategy in improving
preservice elementary teachers’ knowledge of teaching science using inquiry science instruction methods.

Carter (1999) study on collaborative concept mapping strategy revealed that most students paid only moderate attention to each other’s comments. Most commonly observed cooperative behaviors were seeking meaning, providing explanations, and completion of partner’s statements. The degree of pair symmetry did not consistently influence student interactions or cooperative behaviors. Students used easily memorized, but not necessarily accurate, answers. They had difficulty in focusing on abstract concept and in forming explicit relationships. They also had difficulty with the hierarchical nature of concept maps. Ku (2008) study findings suggested that the student generated pre-concept maps prior to the design and problem-solving activities revealed students’ utilization of their pre-existing knowledge, either from previous courses or from other design and problem solving activities to generate their pre–concept maps. The pre-concept maps also revealed preconceptions or misconceptions the student held in regard to the knowledge domain. The post–concept maps, observations, interviews, and write-ups/evaluations suggested that the students learned and developed technology concepts as a result of the design and problem solving activities through meaningful learning and through the problem solving process in a constructivist learning theory.

The study of Pickens (2008) revealed that when the participants developed their concept maps it became their model for thinking. As the participants created their model they developed a sense of ownership and empowerment of the knowledge. The participants further described that concept mapping required a higher level of thinking. Participants described that concept mapping helped them to critically think as it required them to research and investigate relationships. Somers (2010) study findings showed that concept map usage clarified students’ understanding of the organization and relationships within content area and that the process of creating the concept maps increased participants’ understanding of the selected content. The participants felt that the visual element of concept mapping was an important factor in improving content understanding. These participants saw benefit in using concept maps as planning tools and as instructional tools. They did not recognize the use of concept maps as assessment tools. When the participants
were able to find personal relevance in and through their concept maps they were better able to be reflective about the process. The experienced teachers discussed student understanding and skill development as the primary purpose of concept map usage, while they were able to use concept maps to accomplish multiple purposes in practice.

3.2.5 Researches on collaborative learning
3.2.5.1 Major findings

Cuneo (2008) study found that while collaboration resulted in a slight performance increase, the differences between the two groups were not significant. However, the survey indicated that students in the collaborative group felt more confident in their problem-solving ability, enjoyed the activity more, and had a more positive experience in completing the activity than the students who completed the activity individually. It was also found that students in the collaborative group felt slightly more pressured for time than the group working individually. Griffith (2010) study showed that, the Professional Learning Community was making significant progress towards its goals of increased collaboration and pedagogical knowledge, but there was insufficient evidence to determine if participants' science content knowledge improved. Caputo (2008) study found that among the three factors—students' attitudes towards collaboration in groups, faculty/student interaction, and faculty feedback—students' attitudes towards collaboration in groups had no significant relationship with students' learning while faculty/student interaction and faculty feedback had the most significant relationship with students' learning.

Perry (2008) study results showed that teachers who attended face-to-face CIGs and online CIGs felt less isolated within their building as measured by a repeated t test and the individual interviews. Also, the results showed that participants who experimented with improving writing strategies increased their self-efficacy-beliefs as measured by the repeated t test. Another study conducted by Armstrong (1999) reveals that, participants were able to observe their own learning experiences in terms of relationships formed in their respective groups. Their ability to see themselves learning from within these relationships contributed to their overall learning experience and learning outcomes.

Zinicola (2003) study finding was that all students learned as a result of 12 talk sessions as evidenced by pre- and post-conceptual change scores. Interactions that promoted learning involved students connecting their thoughts, rephrasing, and challenging ideas. The role structure was only used by students about 15% of the time, but it started the talk with a science focus, created awareness of scientific methods, and created an awareness of equitable member participation. Students offered more spontaneous, explanatory talk when the role structure was relaxed, but
did not engage in as much scientific writing. They said the role structure was important for helping them know what to do in the talk but they no longer needed it after a time. Gender bias, status, and early adolescent developmental factors influenced many of the group’s interactions.

Joscelyn (2010) study revealed that collaboration mitigated isolation and led to improved lessons and instruction; however, data collection superseded lesson development and the utilization of team time to solve problems of instructional practice. The data indicated that teacher roles and goals were unclear, for teams had multiple tasks to complete from standardized test preparation and delivering the curriculum to meeting yearly school and district goals. Jadallah (2010) study found that teacher and child moves that were not direct requests, but triggered children to react, were considered to have indirect effects and continued to have a delayed impact in subsequent turns. Teachers' strongest direct effect of immediate influence was in requests; for explanations, followed by requests for reasons and clarification, and finally by requests for evidence. Children's strongest indirect effect of immediate influence on each other was in responding to requests for reasons followed by responses to requests for clarification and explanation, and finally in responding to requests for evidence. Four properties of the systems of classroom talk were examined: dependence. (b) stationarity. (c) Homogeneity, and (d) reciprocity. Stationarity and homogeneity assumptions were not met indicating change over time and across groups. Certain discussion moves exhibited not only unidirectional patterns of interaction, but also bidirectional, in which not only teachers affected children but children affected teachers' as well.

Oakley (2001) found that, those teachers believed constructivist approach, began to de – emphasize test results and focus on student learning and understanding. Wissel (2008) study results indicate that positive and negative perceptions of the functionality of groups are not dependent on practicing the five key elements of collaboration as defined by Johnson and Johnson (1994), nor are they dependent on the absence of social compensation. When the key elements were practiced and there was little to no social compensation, the group members perceived their experiences to be positive and their-groups to be functional. However, when the key elements were not practiced, and social compensation did occur, the majority of group
members still perceived their experiences to be positive and their groups to be functional.

### 3.2.6 Researches on field trips

The study of Sugg (2008), Marshall (2010), Patterson (2010), Rebar (2010), related to environmental field experiences at a formal environmental education site; impact of an out-of-school science program on the science learning; to compare students' perceptions of the learning environment in a traditional science classroom and a field study classroom; evidence for teachers' field trip strategies. The studies of Marshall (2010) and Rebar (2010) were of qualitative in nature. The studies of Sugg (2008) and Patterson (2010) were of both qualitative and quantitative in nature. The studies of Marshall (2010) and Patterson (2010) have taken students as the sample in their studies. The study of Rebar (2010) used teachers as the sample. The study of Sugg (2008) used school principal and teachers as the sample. Sugg (2008) used survey and interviews. Marshall (2010) used semi-structured interviews. Patterson (2010) used surveys (modified version of the "What is happening in this Classroom Survey" (WIHIC) and the "Test of Science Related Attitudes" (TOSRA). Rebar (2010) used artifacts, surveys and interviews.

#### 3.2.6.1 Major findings

Sugg (2008) study found that while science teachers generally have positive opinions of field studies, awareness of the requirement to provide them is low and obstacles remain which prevent teachers from employing the method. Many science teachers are not providing opportunities for their students to experience science and environmental education instruction in natural settings. Half of the teachers and more than a third of the principals surveyed were not aware of the requirement to provide students with field investigations. The study generated quantitative and qualitative evidence demonstrating that teacher use of the field investigation method is strongly linked to the following factors: (a) teacher and principal awareness of the requirement; (b) administrator support; (c) funding for transportation to appropriate natural settings; (d) intra or interdepartmental competition for limited field trip opportunities: and (e) teacher training. The presence or absence of these factors has significant implications for policy and practice in science and environmental education. Marshall (2010) study findings indicate that qualitative differences in the
in-school science experiences of upper elementary children exposed to OST (out-of-school) settings and those not so exposed with respect to their conceptual understanding, epistemology of science, and formation of identity as science learners.

OST participants were more able to rapidly recall their in-school science experiences than not-OST participants. OST participants were also able to transfer their OST science knowledge to their in-school science experiences.

Patterson (2010) study results from Phase one showed that students prefer the classroom for investigation and prefer the field environment for enjoyment of science. Students that are low socio-economic class rank cooperation in the field higher than the Classroom and students that do not qualify for free or reduced lunch prefer the field environment for enjoyment of science. The qualitative data showed that students are physically engaged, develop a sense of place and learn skills in the field that reinforce concepts learned in the classroom. Rebar (2010) study findings reveal that teachers attempt to link the curriculum to the activities, resources, and content encountered on the trip using a variety of connections. However, these curriculum connections are characterized as products of opportunistic situations and reveal limited depth. Evidence further indicates that teachers treat the field visit as a background experience for their students rather than as an opportunity to introduce new concepts or do an activity that is integrated into the curriculum. Nevertheless, teachers included in this study were leading field trips that created countless learning opportunity for their students. Because training specific to field trips is rarely included in preservice programs, teachers were asked about influences on their field trip practice with specific focus on observed strategies.

Based upon the results of their studies researchers’ suggested varies aspects for further studies. Snead (2000) study suggests that the effect of concept mapping on students science achievement is not clear and therefore, researchers should continue to seek more data to either or reject the effectiveness of concept mapping. Dempsey (2001) study suggests that further research is needed regarding the placements of a PBL project in a course (initial or culminating activity) and the impact of various grouping arrangements on the problem solution. Hierlmeier (1999) study suggests that need for more pre – service and professional development opportunities that address the teacher – as – learner and teacher – as – reflective – researcher in praxis, within
the context of classroom, campus, and community. Choi (2008) study suggests that a follow-up study is needed to assess the participants’ implementation of inquiry-instruction in their classroom, and to examine whether the use of inquiry-instruction with their students makes a significant difference in students’ science learning. Rebar (2010) study suggests that field trip pedagogy be integrated into science methods courses required for preservice teachers. Niemi (2010) study suggests that promoting the use of cooperative learning in classrooms converting schools into learning communities.

3.3 Implication for the present study
From the review of the above studies following implications were drawn. The studies on constructivism were generally qualitative in nature, but not many studies conducted for student teachers at teacher education level, because, the sample of studies were of teachers, students and student teachers. Constructivist approaches like, Teacher guided discovery/inquiry, Problem Based Learning, concept mapping were generally used. It is found that constructivistic approach Provides risk free environment to the learner and teacher role as a facilitator helps learners own thinking which further lead to the sense of ownership among learner. This extends students interest, enthusiasm, and satisfaction towards learning. Through constructivist approach conceptual change occurs among the learner from non-scientific to scientific. Those teachers who believe in constructivism have positive influence on their teaching. The participation in constructivist classroom influences student teachers attitude towards classroom teaching, and learning. Use of constructivist approach positively influence change in principal role and relationship with teachers.

3.4 Researches on Environmental Education
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environmental education, impact of an experiential science program on students’ understanding of ecological science, differing concepts of human-environment interactions and the environmental problematique, misconception on environmental issues, improving environmental education instruction for better understanding, and ecological mindedness in the Ec(h)o of consumerism.

The studies of Lin (2000), Suneetha (2000), Dey (2008), Poddar (2009), Gul (2011), Kose (2011), Tuncay (2011) and Mosothwane (2000 ) related to undergraduate students’ attitudes towards environment; relationship between environmental moral reasoning patterns and environmental attitudes; primary and secondary school students’ misconceptions related to greenhouse effect; pre-service teachers’ conceptions of environmental education; the status of environmental education at the teacher preparation level; Supplementary Curricular Programme on Environmental Education; status, issues and prospectus of environmental education; Environmental Education in primary schools. The studies of Brown (1989), Gilbertson (1991), Rickinson (2001), Sharma (2004), Lane (2007), Manes (2007), Shin (2009), Meuth (2010), and Foster (2010) are related to status, foundation and development of environmental education; environmental literacy; implementation of environmental education; trash arts environmental education program; strategy for environment in Multi-Grade teaching, examine the nature and quality of current research evidence on students and their learning in environmental education.


3.4.1 Major findings
The major findings as per the main focus of the respective studies are as follows: Chacko (2002) study revealed that, there was significant difference between environmental literacy of teachers who received training in environmental education and teachers who did not receive any training in environmental education. Leftridg (1977) study revealed that, rural students were more perceptive of environmental issues than urban students. In her study Tomar (1998) found that the achievement of students on environmental aspect was found to improve, if there is a better school ecology, infrastructural facilities and they were utilized properly. Loman (1999) study revealed that, students’ understanding of key concepts related to ecology and students’ feelings about science in identified areas were of statistical significance. However, a review of the mean gains or losses showed relatively small change. Therefore, the results of this study were inconclusive.

Daniel (2006) found that, students’ conceptions of the environment did shift from a non-specific scene of the outdoors to one that was identifiably connected to their own lives and their own pueblo. There was no convincing evidence that the students’ ideas about science shifted, nor was it evident whether students made connections between western science and their traditional knowledge. It was evident that forming relationships with members of the community based on shared
understandings of the program’s purpose was a difficult process and that it takes time. Scott (2008) study revealed that, children chose the ways they interpreted and expressed their environmental knowledge, ethic of care, advocacy, and commitment to action. This development of each child’s self-expression resulted in motivational and powerful learning experiences that inspired and nurtured their connections to the earth. Gilbertson (1991) study indicated that, students were found to be more literature toward environmental issues than ecological principals. Student attending a residential type experience were more environmentally literature. There were no significant differences between the control groups and those who attended a field trip type experiences.

Meuth (2010) study results indicate that students have high levels of ecological knowledge but, convey only moderate feelings towards the environment. The students report that they are willing to engage in more pro-environmental behaviors than they actually report doing. They also display modest abilities to identify and analyze environmental issues as well as select appropriate action plans. Regarding the domains critical to environmental literacy, the mean scores for this sample fell within the high range for ecological knowledge; scores for affect, cognitive skills, and behavior all fell within the moderate range. For each grade level, the overall environmental literacy composite scores also fell within the moderate range. Horne (2010) study found that some of the stereotypes, particularly related to gender, revealed in prior research (Barman, 1999, Chambers, 1983) are evident among many elementary students. Male environmental scientists were drawn twice as often as female environmental scientists. Females were represented in more pictures of environmental caretakers than environmental scientists. Students overwhelmingly drew environmental scientists (98.1%) and environmental caretakers (76.5%) working alone. Wildlife was noticeably absent from most drawings (85%). Where wildlife was included, it was most often birds (6.9%) and fish (3.1%). More than one species was evident in only 2.5% of the pictures. Fifty percent of environmental caretakers were shown picking up trash from land. Actions such as reducing resource use occurred in only 13 out of 319 pictures (4.1%). Pictures of environmental caretakers sharing knowledge were even less common (2.5%). Almost 22% of females drew multiple individuals compared to 18.5% drawn by males. Females were more likely to show
individuals collaborating while males were more likely to show individuals working in opposition.

Kose (2011) study found that undergraduate students had positive attitudes toward the environment as regard to their gender and faculty types. It was emphasized that female students were more sensitive toward environment than male students. Gul (2011) study indicated that the students had fewer misconceptions than those specified in the literature related to “events depending on increasing of greenhouse effect”, events getting bigger greenhouse effect” and “events to reduce greenhouse effect”. Suneetha (2000) study found that experimental treatments using specially designed supplementary curricular programme have been found significantly more effective in developing basic understandings in environmental education and also developing a favourable attitude towards the environment in all the four selected schools. The study has demonstrated its effectiveness in terms of multi-disciplinary approach, substantiating the Infusion Technique for teaching of environmental education. Dey (2008) study indicated that boys and girls of government secondary schools have been found to have better environmental awareness, attitude in comparison to their counter parts. It was found that a significant and positive relationship between environmental awareness and environmental attitude among students. The perceptions of the teachers reveal that the status of environmental education is not much encouraging. A lot has to be done with respect to curricula, development of teaching-learning material, modes of transaction, co-curricular activities, and providing reinforcement for attainment of the objectives of environmental education.

Poddar (2009) study revealed that no significant difference was found in the Environmental Awareness of Male Teachers and Female Teachers. The Environmental Awareness of Urban School Teachers was found significantly higher than that of Rural School Teachers. The Environmental Attitude of Male Teachers was found significantly higher than that of Female Teachers. The Environmental Attitude of Urban Teachers and students was found significantly higher than that of Rural Teachers. The Environmental Achievement of Male Students was found significantly higher than that of Female Students. There was found to be a significantly positive correlation between Environmental Awareness and
Environmental Attitude of Teachers. The Environmental Awareness and attitude of Teachers has been found to have significant effect on the Environmental Achievement of the Students.

Foster (2010) study analysis reveals that learning is divided into a section concerning teacher-controlled environmental ethics and a section concerning student controlled physical environmental learning. The separation of the program into distinct parts creates two contrasting experiences within the program. As a result, creative attempts by students to connect the two sections through constructive learning techniques are thwarted by the program’s disjointed format. Despite the failure of the program to empower and legitimize student learning, this study describes the complexity and ingenuity of student-controlled learning and shows how it adds valuable dimensions to children’s environmental educational experiences. Mathison (2009) study try to explain that, pursuing the understanding of ecological mindedness involves a recovery and uncovering of and for the 'other,' not solely on an intellectual level, but emotional and 'spiritual' as well. This pulls forward the power of an echo to resonate and reverberate with related 'others' themes such as peace education, participatory democracy, global education, tolerance, difference, and indusivity—in other words, transformative education.

Charmatz (2008) study revealed that environmental action projects provide a context for students and teachers to learn interdisciplinary content knowledge, develop personal beliefs, and learn ways to take action in their communities. This pedagogy has the potential to increase cooperation, communication, and tensions within school communities. Students' participation in the development of environmental action projects may lead to feelings of empowerment or being able to make a difference in their community, as an individual or member of a group. Schultz (1955) study indicated that teachers will make more effective use of materials if they understand some basic concepts of ecology and have had field experiences. Manes (2007) study collected the data in two phases and included observations, interviews, surveys, and documents. The results showed that the participant teachers gained insights into ecological issues and confidence in their ability to teach these topics, but for the most part they were not successful with implementation. Shin (2009) study revealed that, teachers came to understand the importance, objectives, potential
topics, and teaching methods of early childhood environmental education. While implementing environmental education in their classrooms, teachers recognized possibilities for environmental education through connections with children's daily lives and previous activities conducted in their class-rooms. Teachers also identified that critical action research through group communication provided practical and useful knowledge of their educational practices. Teachers' improved pedagogical knowledge and awareness about EE increased their confidence to teach environmental education.

Brown (1989) study results indicated that 78.6% of the respondents felt that they were not adequately prepared to teach EE and in-service was not available in 70.9% of the schools. Lack of time to develop an EE program was the item most respondents indicated as inhibitive to EE curriculum development. Teacher interest was the element most influential in implanting EE into the elementary curriculum in the study sample but state mandate was the most influential element in the exemplary school. Schlottmann (2009) study argues that emphasis on "methods," such as critical thinking, reflection, and case-sensitivity, could greatly increase the ability of students to understand and respond to complex, changing and unprecedented environmental problems; an emphasis on cultivating student agency and competence in ethical thinking (the "methods" emphasis) is a more effective and justifiable aim than teaching that specific implicit ideas. Ko (2003) study found that Integrated Science teachers’ attitudes toward environmental education, skills of teaching environmental education, beliefs in the relevance of Integrated Science to environmental education, and intentions of teaching environmental education in Integrated Science classes were associated with their actual ways of teaching of environmental education. Teachers tended to teach more environmental education if they held more favorable attitudes toward environmental education, had more skills of teaching environmental education, believed more in the relevance of Integrated Science to environmental education, and would actually want to teach more environmental education in Integrated Science classes if there were fewer constraints. Sharma (2004) study revealed that 80% (20) teachers were not teaching environment every day, whereas the remaining 20% (5) teachers were teaching environment every day. But all the teachers strongly agreed that they were informed about how to teach about environment in multi-grade teaching.
Rickinson (2001) reviews on environmental education reveals that most of the studies are predominantly of quantitative, rather than qualitative, evidence, but this is changing as new foci (e.g. students’ perceptions of nature) emerge, bringing different methodological approaches and conceptual frames. It provides more information about students’ environmental knowledge and attitudes than about their educational experiences and preferences, and more about learning outcomes than learning processes. Robertson (1995) study indicated that student teachers conceptualizations of human–nature relationships traverse a range of eco-philosophical perspectives. Chang (1999) study indicated that pre service teachers moderately agreed that their actions to offer EE could bring desirable outcome in EE; they possess positive attitudes and perceptions regarding EE.

Empirical data collected in Irwin (1993) study revealed that, the colleges of education with respect to the understanding of concepts, aspects of environmental knowledge and opinions on selected environmental issues indicated that amongst both students and lectures, while there were important positive aspects, often culturally related, there were also significant problem areas. Similarly an evaluation of development and operation of the present college environmental education program, including an evaluation by student participants, indicated important strengths and weaknesses. Tuncay (2011) study revealed a significant positive correlation between eco-centric moral reasoning and environmental attitudes of pre-service science teachers’, whereas there was not a statistically significant relationship between neither of anthropocentric nor non-environmental moral reasoning and environmental attitudes.

Mosothwane (2000) study indicates that teacher trainees hold clear conceptions about environmental education. Furthermore, teachers’ conceptions about a subject influence their instructional planning and their delivery of subject matter. The pre-service teachers reported that colleges of education did not teach content and methods of teaching environmental education. Lin (2000) study findings revealed that, for nearly two decades, the number of Canadian teaching institutions offering environmental education courses to pre-service teachers has remained generally low and the level of priority granted nominal. The few institutions that do offer such courses tend to emphasize the traditional forms of environmental education – ecology,
conservation education, outdoor education, and biology. In addition, pre-service teachers continue to receive much of their environmental education training from faculty members who (1) possess degrees in education and biology and (b) have low levels of participation in environmental education projects and research. The low-standing status of environmental education at the pre-service teacher level will likely persist unless major barriers at different levels are addressed. These include hindrances found in institutional practices and organizations in faculties of education and at the instructional level. The two case study findings revealed that the personal beliefs, ideologies, and perspectives of environmental instructors have a powerful influence on how they structure and teach environmental education to pre-service teachers. As a result, pre-service training courses vary substantially among institutions within the country. Of the two courses examined, one predominantly prepared pre-service teachers to design teaching strategies that primarily cultivated an appreciation and sensitivity toward the environment facilitated student – centred activities that enhanced an environmental ethic, but lacked learning experiences focusing on “real” environmental problems related to social action strategies. Most significant was that critical perspective that addresses social, economic, moral and political issues appears to be generally missing in most environmental education courses for prospective teachers.

The findings of Bradford (1999) investigation indicated that rural Hondurans conceptualize their environment through the worldview lenses of survival and poverty, leading to sense of fatalism when confronting the complex and multifaceted problems associated with quality of life and environmental quality. Lewandowski (2002) study reveal that, even short experiences in a familiar setting may have a significant impact on individuals’ appreciation of and concern for the local environment. Hammond (1999) study indicates that, the continuing debate about the nature and conceptualization of environmental education as needless repetition of issues which have been satisfactorily resolved, important questions remain to be addressed by curriculum theory in this field. Lane (2007) study revealed that there are subtle differences in using the term integration and infusion, and some EE professionals would say there are subtle and insignificant differences. Because of this ambiguity, it is recommended that the term infusion be avoided and EE professionals focus on understanding and applying the integration approach to implementing EE.
The study also revealed that teachers insert environmental concepts and that this approach needs further investigation.

Tenam-Zemach (2008) study found that at the national and state levels, there was a lack of articulation of the goals of environmental sustainability or an ecological paradigm. With respect to the science textbook, a greater number of keywords were present; however, the context of many of these keywords did not align with the discourse of an ecological paradigm. Further, the environmental sustainability themes present in the textbook were limited to the last four chapters of the text. Kola-Olusanya (2009) study data reveal that despite the unavailability or near-absence of environmental studies and education within the formal school curriculum (particularly at the elementary and high school levels), the young adults rely on other locations for learning, such as the internet, environmental non-governmental organizations (ENGOs), television, and family. Based upon the results of their studies researchers’ suggested varies aspects for further studies. Leftridge (1977) study suggests that, concerted effort needs to be made in schools to implement environmental awareness activities into all disciplines and curriculum designers should seek innovative ways of incorporating environmental education from a multidisciplinary approach.

3.5 Implication for the present study
The training of environmental education and field experience helps teachers to have better environmental literacy and better conceptual understanding. Along with the environmentally literate teacher, if the schools have better infrastructural facilities it facilitate students’ achievements in environmental education. The conceptual understanding about environment among students is better when the subject is made connected to their own lives.

3.6 Researches on constructivism and environmental education


3.6.1 Major findings
The major findings as per the main focus of the respective studies are as follows: The study of Ramkumar (2003) revealed that, students expressed autonomy in learning through interactions with teachers and fellow peers, proposed hypothesis based on certain concepts to explain the occurrence of events during the context of scientific investigation, and showed willingness to change ideas in the light of evidence. Another study of Muller Dahlberg (1999) revealed that, the factors identified by students for their conceptual learning were teacher guidance, social interaction both in small group and in whole class discussion; authentic learning task, and strategic questioning the teacher used to activate their prior knowledge. In Christenson (2004)
found that, children were getting more opportunities to use critical thinking skills as various classroom activities were carried out to include multiple perspectives on environmental issues when the teachers collaboratively plan for controversial environmental issues. Another study conducted by Barnes (2002) revealed that, the way students think about, learn from, and solve real environmental problems were all constrained by the perspective tenets (including cultural tenets of role, status, and power) and envisioning processes. It was concluded that students need help from the community to go further in solving these real environmental problems.

Lord (1999) study revealed that, students in constructivist classes performed significantly better on exams, rated the course higher, and participated more in campus and regional environmental support efforts than students in traditional classes. Skidmore (2008) study results showed no statistically significant difference (using a test) between (a) posttest scores of students individually constructing maps compared to students who constructed in groups and (b) map quality from beginning to the end of the semester between the individual and group constructors. During the data analysis, all students collectively showed a significant improvement from pre- to posttest scores. Improved quality of maps constructed from the beginning to the end of the semester of all students was not supported quantitatively, but the qualitative analysis showed some overall improvement. Social change will come from providing accurate knowledge for students to use for decisions related to environmental problems and by creating more critical thinkers because of a variety of learning strategies in schools, as well as teachers’ increased use of concept mapping for improved student learning.

Wee (2008) study on social constructivist framework was utilized to steer data collection and to guide interpretation. Qualitative methods such as interviews, drawings and photograph journals were used to elicit children's ideas and field notes provided a rich description of the learning environment. It was found that, children in this study did not view humans as part of the environment. Land use was conceptualized as a human activity for human benefit, that is, children's conceptions of land use were framed by an anthropocentric worldview. Furthermore, children's conceptions of land use-related outcomes were negative and limited to large-scale, visible forms of environmental impacts. Environmental science instruction did not
change these ideas; in fact, they were reinforced by the school curriculum. In his research study Robertson (1995) argue for the place of eco-philosophical literature within environmental teacher education and for a constructivist based pedagogical approach which encourages students to explicate and critique their personal beliefs. The study of Thompson (2003) revealed that, intervention of lab based and utilized in – context, constructivist approaches positively influence participants’ abilities to retain science content knowledge and to affect their belief in themselves as teachers.

Wright (2006) study results showed that the constructivist – based curriculum was not a significant factor of influence, suggesting that regardless of which learning environment they were expose to, subjects experienced similar improvements to their environmental literacy across a sixteen – week semester. Given that the findings were contrary to expectations and counter – indicated by several other learning environment studies as well, a broader investigation as to why the two learning environments produced similar results is warranted. Crede (2009) study findings indicate that a nature immersion model of sustainability education is much more effective than a traditional pedagogical model. Nature immersion was cited by all seminar participants as the single most important factor in the overall success of the seminar and, therefore, student learning. The seminar experience was an important catalyst for the long-term benefit of changing attitudes, behaviors, and lifestyles toward more sustainable living. It motivated participants to take on leadership roles in sustainability and encouraged them to become better stewards of the planet. The experience also enhanced their social relationship and depend their sense of responsibility toward others.

Van Kannel – Ray (2005) philosophical study indicated that the tensions between constructivism and environmental sustainability are resolved in two ways. First, there are forms of constructivism that align in viable ways with the criteria critics argue are necessary for a sustainable environment and which derive from the seminal work of Vygotsky and the sociocultural constructivists. Social constructivism additionally aligns with environmental sustainability since it focuses on the shared experience of a culture and the dialogic nature of inquiry. Second, emerging from the literature of environmental sustainability are the guiding principles for a new pedagogy of communal constructivism. What separates the emerging process of
communal constructivism from sociocultural constructivism and what it gains from environmental sustainability is a moral compass. These guiding principles inform the idea of responsible embeddedness within a system of communities.

3.7 Implication for the present study
The constructivist based learning environment allows students autonomy in learning, proposing hypothesis for scientific investigation. Teacher guidance, social interaction, authentic learning task, and strategic questioning were important factors for conceptual learning. Through constructivist based pedagogical approach student express their personal beliefs and multiple perspectives on environmental issues, also perform well in their exams. Constructivist approaches positively influence participants’ abilities to retain science content knowledge and to affect their belief in themselves as teachers.

3.8 Overall implication
Constructivist approaches provides risk free environment for the learner in the classroom and teachers’ role as a facilitator further helps learners own thinking which lead to the sense of ownership. This helps students interest, enthusiasm, and satisfaction towards learning. The training of environmental education and field experience helps teachers to have better environmental literacy and better conceptual understanding. Along with the environmentally literate teacher, if the schools have better infrastructural facilities further facilitate students’ achievements in environmental education. Through constructivist based pedagogical approach student express their personal beliefs and multiple perspectives on environmental issues and perform well in their exams. From the review of related literature it is observed that there are very few studies conducted on constructivism and environmental education in teacher education. Further, pedagogical demands of environmental education go well with the constructivist methods. So it is necessary to conduct research on constructivist approach to environmental education at teacher education level in Indian context.