CHAPTER III

REVIEW OF RELATED LITERATURE

3.1 Studies related to Modern Instructional Strategies
3.2 Studies related to Web Based Learning
3.3 Studies related to Meaningful Engaged Learning
3.4 Studies related to Astronomy Education
REVIEW OF RELATED LITERATURE

The review of related literature involves the systematic identification, location and analysis of documents containing information related to the research problem. The major purpose of reviewing the literature is to determine what has already been done that relates to your problem. Another important function of the literature review is that it points out research strategies and specific procedures and measuring instruments that have and have not been found to be productive in investigating your problem. This information will help you to avoid other researchers’ mistakes and to profit from their experiences. It may suggest approaches and procedures previously not considered (Gay, 1999).

Since the present study was intended to develop Web Based Meaningful Engaged Learning Strategy for learning Astronomy at Secondary school level, the investigator mainly collected studies related to modern instructional strategies, Web Based Learning, Meaningful Engaged learning and Astronomy education. The studies collected are arranged under the following heads.

3.1 Studies related to Modern Instructional Strategies
3.2 Studies related to Web Based Learning
3.3 Studies related to Meaningful Engaged Learning
3.4 Studies related to Astronomy Education

3.1 Studies related to Modern Instructional Strategies

Gaikwad & Tankhiwale (2014) designed and evaluated an interactive E-learning module in Pharmocology for effectiveness, acceptability and feasibility, with the aim of promoting active learning. A quasi- experimental single group Pre test Post test study was conducted with Fourth- semester students of the second professionals course selected using the non probability convenience sampling method. It was found that the interactive E-learning module prepared was moderately effective and well perceived by the students.
In the study conducted by Fathima, Sasikumar & Roja (2014), some metacognitive intervention strategies were used to enhance the teaching competency of graduate teacher trainees. It was found that there was a continuous improvement in all the dimensions of teaching competency by means of the applied strategies.

Hosseini & Mohammed (2014) conducted an experimental study to find the possible effects of Competitive Team Based Learning (CTBL) versus Group Investigation (GI) method of Co-operative learning on the language proficiency of Iranian EFL intermediate students. Seventy homogenous Iranian intermediate students were selected as the sample. The results of the study indicated the advantage of CTBL over GI in terms of its effect on improving the target group’s language proficiency.

Ciarocco et al. (2013) in their study applied a multifaceted approach in teaching five experimental designs in a research methodology course. The sample consisted of 70 students enrolled in an experimental research methods course. It was reported that students gone through multifaceted approach showed greater efficacy in APA style writing, a higher perceived utility of research and statistics and better attitudes towards statistics.

Matsuda et al. (2013) in their study introduced an E-learning material that they developed using Three-Dimensional Virtual Reality (3D-VR) technology in Cyber ethics education. They verified the effectiveness of their method over conventional method and their method was found to be more effective than conventional method for Cyber ethics education.

Ray and Chakrabarti (2012) designed and implemented an affective E-learning strategy based on facial emotion recognition in which the learner’s affective state is identified using Biophysical signals which in turn explore the emotion of the learners during learning process. This produces a feedback that can be used to improve learning experiences. From the analysis of results, this strategy was found to be more effective in comparison with the other existing systems.
Kenni et al. (2012) conducted a quasi-experimental research on the effect of Concept Mapping instructional strategy on achievement in Nigeria Secondary schools. The population comprised of 168 Senior Secondary school class-Two Physics students. The study revealed that, Concept mapping instructional strategy contributed to achievement in Physics and there is significant effect of treatment on students’ retention of learned materials and students learning attitude.

Chang et al. (2011) conducted a study to find the effectiveness of integrating Mobile technology with Project Based Learning strategy (PBL) in order to enhance the quality of the Ecological Environment Learning projects in schools settings. Fifty nine university students enrolled in an e-learning course in a northern Taiwan University participated in the study. It was found that students have a positive attitude towards the proposed PBL e-learning system with mobile technology.

Saleh (2011) investigated the effect of Co-operative and Individualistic learning strategies on the academic performance of students in the general Chemistry laboratory through an experimental study. The findings revealed that the Co-operative learning strategy is more effective than Individualistic learning strategy and the students in the co-operative group performed significantly better.

Cooper et al. (2011) conducted a study to determine the effectiveness of instruction in the Paired Associates learning Strategy (PAS) on the ability of college students with Learning Disabilities (LD) to identify and recall important information. A single subject multiple probe research design was used. The sample consisted of nine college students who were identified as having LD. Results of the study indicated that the instruction using PAS improved students’ ability to identify important information from textbooks, create study cards and to recall that information in testing situations.

Brill and Hodges (2011) investigated the effectiveness of Peer Review as a learning strategy to foster the knowledge and skill attainment of adult
learners preparing for professional practice including those students who were preparing for instructional design and technological practice. It was found that Peer Review is an effective instructional strategy not only for developing instructional design and technology practice but also to address on-going concerns regarding the inadequate preparation of instructional design and technology professionals.

Dow Su (2011) conducted a study to design Information Communication Technology (ICT) courses related to experimental Chemistry for junior college students and to find their learning performance after completing these courses. A quasi –experimental approach was adopted for the study. The results showed that, this ICT integrated learning has more significant effect on students’ learning performance.

Victoria et al. (2011) conducted a study to find students’ perceptions and their relation to the outcomes of Blended learning in higher education. The sample consisted of 1431 students of University of Granada. The results revealed that the use of Blended learning had a positive effect in reducing dropout rates and in improving exam marks. Moreover, the students’ perceptions on Blending learning were interrelated with their final marks depending on the blended learning activities and on the students’ age, background and class attendance rate.

Wong and Looi (2010) conducted two case studies to find the effectiveness of Mobile Assisted Language Learning (MALL). The sample consisted of 40 students of Primary 2 class of Nan Chiou Primary school in Singapore. It was found that MALL has the potential of revolutionizing the language learning field by students’ use of mobile devices as personal learning tools to synergize formal and informal language learning spaces.

Liu et al. (2010) conducted a research to investigate the effect of Computer Assisted Concept Mapping Learning Strategy on English as a Foreign Language(EFL) College learners’ English reading comprehension ability. The sample consisted of 194 fresh men who were enrolled in the
English course. Through two-way ANOVA analysis, it was found that the Computer Assisted Concept Mapping Learning Strategy had greater reading benefit for the low level group than for the high level group. Also, it was found that, the Computer-Assisted Concept Mapping Learning Strategy enhanced learners’ use of other English reading strategies like listing, enforcing and reviewing.

Balasubramanian et al. (2010) in their study tried to find the role of Mobile phones in non formal and informal learning context among rural women for poor communities. A survey was conducted among a sample of 73 South Indian women. The study revealed that the transition from powerlessness to empowerment is possible in non formal learning settings and the low cost mobile technologies offer means to accelerate this process in the context of social capital.

Wilgis & Mc Connell (2008) conducted a small descriptive comparison study to find whether Concept Mapping Strategy can improve the critical thinking skills of Graduate Nurses during a hospital orientation program. Schuster’s Concept Map Care Plan Evaluation Tool was used to measure the critical thinking skills in concept maps. It was found that Concept mapping was a valuable teaching and evaluation strategy for this group.

Chang et al. (2007) conducted a study to investigate the influence of gender and major on college learning English as a Foreign Language (EFL) learning strategy in Taiwan. A total of 1758 Taiwanese College EFL learners took part in this research study. The participants completed two sets of self-reported questionnaires, including background characteristics and strategy inventory for language learning. The study found that:

- Statistically significant differences were found in the use of Cognitive strategies, Meta cognitive strategies, Social strategies and over all strategies with regard to gender.
- Statistically significant differences were found in the use of six subcategories of language learning strategies and overall strategies with regard to major.

Varghese (2004) conducted a study to compare the effect of Mastery Learning Strategy with the Textbook oriented approach on certain variables like achievement in Physics, retention power, Science interest, Scientific attitude, achievement motivation and self concept of Standard IX students of Kerala state. The sample consisted of 156 students of Standard IX studying in various schools of Kerala. It was found that the Mastery Learning Strategy is more effective than Textbook approach in enhancing the variables under study.

Mathew (2001) conducted a study to find out the effect of Programmed Learning, Supervised Learning Modules and the Guided Inductive Inquiry Model on the achievement of Biology of Secondary school students with Learning Disabilities (LD). Non Equivalent Pre-test, Post-test design was selected. Sample consisted of 408 students studying in Grade IX of Kerala state. It was found that the self instructional strategies and the modern instructional strategies were more effective in the achievement of Biology for Grade IX LD students.

Maccini and Hughes (2000) investigated the effect of Problem Solving strategy within a graduated teaching sequence (ie, concrete, semi concrete, abstract) on the representation and solution of problem solving skills encompassing integer numbers for secondary students with learning disabilities. Results showed that Problem-Solving skills involving integer numbers dramatically improved by following instructions at concrete, semi concrete and abstract levels.

Singh (1999) conducted a study to explore the effectiveness of using Video instructional package in Environmental education. Experimental method was used. Pre-test Post-test design was used for conducting the experiment. The sample consisted of 240 students of Standard IX studying in Secondary schools of Surat with Gujarati medium. The study revealed that the developed
Video instructional package was more effective in transacting Environmental education to the students of Standard IX.

3.2 Studies related to Web Based Learning

Artemiou et al. (2014) determined the Web based configurations that are applied to teach medical and veterinary communication skills, evaluated their effectiveness and suggested future directions for Web based communication teaching in Veterinary education. Empirical outcomes indicate that Web based learning is a visible method for expanding the approach to teaching history-taking and possibility to additional tasks of the veterinary medical interview.

Zibaei et al. (2014) in their study determined the efficiency of Web based education on anger management in guidance of school girls of Mashhad. In this study conducted on 130 female students randomly selected from Province number 4 of Mashhad, it was found that Web based anger control and management programme through indirect method at home was an effective way to improve anger control.

Jong et al. (2014) conducted a study to find the effectiveness of a Web based Computer-tailored smoking prevention intervention for Dutch adolescents. It was found that the Computer-tailored smoking intervention programmes were a promising way of preventing smoking initiation among adolescents for at least 6 months, in particular among the age cohort of 14-16 years.

Dragon et al. (2013) presents Metafora, both a platform for integrated tools as well as an emerging pedagogy for supporting Learning to Learn together in Science and Mathematics education in their study. They highlighted the potential benefits of their approach through the use of Metafora and its limitations in promoting some skills.

Sun & Looi (2013) in their paper traces a research process in the design and development of a Science learning Environment called WiMVT (Web based inquirer with Modeling and Visualization Technology) which was
designed to help Secondary school students to build an understanding of scientific conceptions, science inquiry process and to develop critical learning skills through model-based collaborative inquiry approach. The results demonstrated the potential abilities of the developed technology in enhancing the variables under study.

Sawant and Shinde (2012) conducted a study to find out the effect of Web Based education environment in schools with special reference to Satara District of Maharashtra. Out of 664 schools from Satara District, 96 schools (Grantable & Non Grantable) were selected from both rural and urban areas for the study. It was found that in schools, preliminary education can be easily delivered through Web Based education. Teaching using animations, power point presentations, CD’s or Audio Visuals have more impact on student’s mind compared to traditional teaching.

Sharma et al. (2011) statistically examined whether the Web Based tutorials and online discussion with subject experts can bring revolution in the education system. A questionnaire based survey to know the need of ICT tools for implementation of Web Based learning system in educational respondents (100 teachers and 100 students) from various professional education institutions of Uttar Pradesh was conducted. It was found that 75% of the faculties and 85% of the professional course students were of the opinion that Web Based tutorials and online discussion with subject experts is one of the innovative learning methods for the professional education.

Tsai et al. (2011) explored the effects of combined training of Web Based problem based learning and self regulated learning on low achieving students’ skill development through a quasi experimental study. The sample consisted of two classes of 76 undergraduates in a one-semester course titled “Web Based programming & Website planning”. Results showed that this approach enhanced students’ skills of Website planning and led to higher levels of involvement.
Yen et al. (2011) conducted a study to investigate the effect of motivation on students’ conceptual learning outcomes in Web Based as well as classroom based learning situation. Nine classes of Grade Eight students in which five classes taught through Web Based learning and the other four classes taught through classroom based learning were selected for the study. Conceptual tests and student’s motivation towards Science learning questionnaire were used for collecting data. Findings revealed that student’s motivational factor were correlated significantly with their conceptual learning outcomes in both Web Based and classroom based Science teaching.

Biswas (2009) conducted a study to find out an effective learning method for Web Based education on 31 undergraduate and 21 masters’ students studying in Bachelor of Science in Information Technology (BSIT) and Master of Information Systems (MIS) respectively in an online University of USA. The main focus of the study was to find whether visual strategy or multimedia presentation in Web Based education is more effective. It was found that some students prefer reading documents to watching video clips while others learn better from watching video clips than reading documents on the terminal. The study concluded that Web Based learning can be enhanced by the use of materials that are consistent in respect of students’ particular learning styles.

Clougherty and Wells (2008) in their study used Wiki, a type of Web site in Chemistry instruction for Problem-Based Learning (PBL) assignments. Students were asked to design their own laboratory exercise and use PBL in actuality, as well as to evaluate Wiki. Students found the wiki to be an effective tool for facilitating their collaboration in work as teams and believed that it greatly contributed to the quality of Peer review as well as made the course more engaging.

Erdogan et al. (2008) tried to find out the factors that influence academic achievement and attitudes in Web Based education through their study. 127 students enrolled in the e-MBA Masters Degree of Bilgi University were
selected for the survey. Data obtained through Demographic information questionnaire, Web Based education attitude scale and the average course grades (GPA) of these students were used for analysis. It was revealed that Web Based education have positive effects on the improvement of academic achievement and the Web use had positive effects mainly on motivation for learning and interest in the lessons.

Olson and Hale (2007) surveyed the administrators’ attitude towards Web Based instruction at five academic institutions in the University of Texas system. The survey was repeated on the same sample after six years. It was found that administers’ perceptions were positively inclined towards Web Based instruction through these years. They believe that high quality learning can take place in Web Based courses and they are interested in increasing Web Based courses.

Lee and Baylor (2006) in their paper entitled “Designing Meta Cognitive Maps for Web Based Learning” provides guidelines for designing Meta Cognitive maps in Web Based learning environments. This was made to support learners’ metacognitive activities to facilitate their orientation within Web Based learning environments. With this, learners are expected to perform both in cognitive and metacognitive activities effectively and efficiently.

Chen (2005) conducted a quantitative study to investigate whether different types of Web-browsing interface in Web Based instruction influence student’s learning achievement of varied educational objectives. This study also investigated a potential interaction between the interface and students’ prior knowledge, since prior knowledge had long been considered as an important learning variable for acquiring new information. A total of 137 undergraduate students participated in the study. Results showed significant main effects of independent variables in all criterion tests except for the treatment effect on a comprehensive knowledge test.

Alomyan (2004) in his paper entitled “Individual differences: Implications for Web Based learning design” investigated the effect of
individual differences in the context of Web Based learning and how Web Based learning systems can be adapted to learners’ needs and styles. Based on the analysis of the results, he suggested an Adaptive Web Based learning model, which illustrates the effects of individual differences, namely cognitive styles and prior knowledge on Web Based learning. According to him this model can be applied for the design of adaptive Web Based learning systems that can be tailored to match with needs and preferences of students.

Shive (2004) investigated the pedagogical and design characteristics of Chemistry related Websites offering Web Based Inquiry activities (WBIs) in the public domain. From a sample of 137 Chemistry-related Websites in the public domain, 17 were identified as WBIs using an instrument developed in accordance with national Science standards. Instructional and design features of these WBIs were described in this paper.

Simons and Clark (2004) in the paper “Supporting Inquiry in Science Classroom with the Web” focuses on Web Based Science inquiry and five representative Science learning environments like Whyville, WISE, River City, Knowledge Forum and Biokids. It was found that even though these environments differ from one another in important ways, they do share common features that sustain Science inquiry.

Shetlar and Sanders (2001) investigated the attitude of students towards Web enhanced instruction in an introductory Biology course. A sample of 110 students of Midsized rural university was used for the study. It was found that students have a high positive attitude towards Web enhanced component in their courses. Another finding was that female students were found to have more positive attitude towards Web enhanced instruction than male students. No significant difference was found among different racial groups.

Ahmed and Samuel (2000) used Web Based tutoring technology to deliver lesson-specific activities efficiently in an Accounting course. In this Web Based tutoring delivery approach many students can learn at the same time but in their own pace and according to their own learning potential. To
make learning more interesting, the Web Based user interface with motivational features were also designed by them. It was found to be a highly reusable framework for Web Based Intelligent Learning Environment which suits several knowledge domains.

3.3 Studies related to Meaningful Engaged Learning

Johannsen et al. (2012) evaluated the application of the Scholarship model including an evidence based approach to enhance meaningful learning and self-efficacy among Dental Hygiene (DH) and Physiotherapy (PT) students. Student’s learning experiences were measured through interviews, seminars and questionnaires. Results showed that students were overall satisfied with the learning experience. Also, the students became more engaged by practicing in a real situation.

Caldwell and Jones (2011) in their paper “Using Robotics to achieve Meaningfully Engaged Learning” reported that they used robotics as a technology tool to captivate and engage students in learning Computer Science concepts. It was found that Robotics engaged students in multiple modes of learning like: sensory, perceptual and cognitive information processing.

Park et al. (2011) conducted a three year long longitudinal study to examine the influence of three psychological predictors of emotional engagement like autonomy, competence and relatedness needs within specific learning contexts. For this, 94 Ninth Grade students of low socio economic status were studied at multiple time points over a one week period. It was found that the fulfillment of each type of psychological need in a particular learning content was related to emotional engagement in that context.

Paivi (2011) conducted a design-based research for designing, implementing and refining a Problem-Based learning course that combines video production to support student’s meaningful learning. The data were collected from the students of University of Lapland through questionnaire,
interviews and students’ performance. It was found that this approach is more effective to promote meaningful learning.

McLarty and Moran (2009) conducted a qualitative study to explore how to engage all young people in meaningful learning after 16 years in England. The respondents consisted of females and males aged between 14 and 18 years from different cultural, religious and social backgrounds. Results revealed that the availability of a large number of vocational opportunities, advices from career experts, learning environment will lead to meaningful engagement in learning.

Sadik (2008) developed a meaningful technology integrated approach called Digital Story Telling for engaging Students in meaningful learning. Students were asked to produce their own digital stories using MS (Microsoft) photo stories and they presented, shared and published their stories with other students in the class. Digital story Evaluation Rubric, technology observation instruments and interviews were used for evaluation. The findings showed that overall, the students did well in their projects and their stories met many of the pedagogical and technical attributes of digital stories.

Brill & Park (2008) conducted a study to explore emerging technologies (like Mobile learning, Augmented Reality, Virtual Reality and Ubiquitous learning), engaged learning, their features, and students of the interactive age and to identify connections across these realms for future research and practice. It was found that there are prominent connections between emerging technologies, engaged learning, and students and devices of the interaction age.

Fengfeng (2008) conducted a case study to examine the in situ use of educational computer games through engaged learning in a summer mathematics program to facilitate 4th and 5th graders’ cognitive mathematics achievement, metacognitive awareness and positive attitude towards mathematics learning. The results indicated that students developed more positive attitude towards mathematics learning through Computer mathematics
gaming, but there was no significant effect of Computer gaming on students’ cognitive test performance or metacognitive awareness development.

Olson (2008) conducted a literary review of engaged learning and strategies that can be used in planning and implementing instruction that engages students in the learning process. It was found that engaged learning is very beneficial for students. Strategies and practices like co-operative learning strategies, authentic learning tasks, technology, student led conference coupled with student portfolios and student self assessments promotes and encourages students to engage in learning.

Clary and Wandersee (2008) used Scientific Caricatures (SC) in the Earth Science classroom as an optical assessment tool for meaningful Science learning. Paired t-tests were used to compare individual students’ performances with the SC option as well as without the SC option and a significant positive difference favoring SC were found. Also it was found that students enjoyed expressing Science Content through SCs.

Bulger et al. (2006) conducted a study to find whether engaged learning environment will result in higher levels of on-task internet activities. For that they compared student behaviours during two types of instructions such as traditional lecture based lesson and interactive simulation exercise. A Classroom Behavioural Analysis System was used to measure student attention levels. It was found that the students who attended the simulation class performed a significantly higher number of on-task activities than the other students who attended traditional Lecture based lessons.

Duster and Waters (2006) in their article “Engaged learning across the curriculum: The vertical integration of food for thought” says about a new healthy educational movement called engaged learning which is emerging in US. They says that this kind of vertical integration of engaged learning has considerable potential to deepen connections between higher education and K-12 and simultaneously to address issues of education and health.
Hung et al. (2006) offered an engaged learning framework emphasizing problem and process which, they argue, are both necessary for authentic learning. The framework includes six indicators: ill structured, multidisciplinary problems; student ownership of learning goals, inquiry processes and strategies; student collaboration with shared, flexible roles and accountability; self monitoring and evaluation of the learning process; the use of teachers and experts to provide tools, techniques and support and real world tools that allow for open communication and sharing among students, teachers and experts.

Wang and Kang (2006) in their article, grouped indicators of engagement into three domains 1. cognitive, 2. emotional and 3. social. In the cognitive domain, engaged learning is hallmarked by knowledge construction and emergence as well as student ownership and self regulation. In the emotional domain, engaged learning is indicated by learners who feel curious yet secure and confident. In the social domain, there are indicators of information and group cohesion and acceptance within the context of collaboration.

Wieman (2005) in his article “Engaging students with Active thinking” discusses about the meaning of meaningful engagement in reference to Science. According to him, it means that students are both actively thinking about the subject and applying scientific ideas to solve problems, in much the same manner as an expert. Again he said that, if we want to seriously engage students in learning Science, we must attach as much importance to student beliefs, and how different teaching practices affect those beliefs as to the content we cover.

Bowen (2005) in his article stated that educators think of engagement in four related but different ways. They are 1. Student engagement with the learning process. 2. Student engagement with the object of the study. 3. Student engagement with contexts of the subject of study and 4. Student engagement with the human condition. He suggested some strategies like short-term
feedback, writing across the curriculum, co-operative learning to be implemented in meaningful engagement learning.

Mehta et al. (2005) measured and analysed student engagement in University classes where varying levels of Problem based learning method of instruction was used. The Student Engagement (SE) survey consisting of 14 questions was used to collect data from students of 56 classes at an upper mid-western university in the USA. Results revealed that a higher engagement is seen in higher level classes and also in those classes with fewer students.

Bawden et al. (2002) seeks to make explicit the essential features of an engagement model based on the separate engagement experiences of four colleagues: a sociologist, a rural developer, a teacher educator and a community psychologist. They shared and discussed what engagement means to them, and the interpretations of the conceptual, Philosophical and normative underpinnings of their work.

Novak (1990) conducted a research to find the effectiveness of using two metacognitive tools namely, Concept Maps and Vee diagrams to facilitate meaningful learning from Grade one through university instructions. The issues of the rote mode nature of school learning and resistance of students as well as teachers to move to meaningful learning strategies were discussed. The results showed that these metacognitive tools support both for cognitive and affective gains.

3.4 Studies related to Astronomy Education

Tian et al. (2014) used Smartphone Augmented Reality(AR) technology to develop a multi-viewpoint AR-based Mobile learning system for Moon observation that can be used in the real world environment. On analyzing its usefulness it was found that the developed system was effective in improving the observation and the learning of students and in enhancing their motivation to pursue lunar learning.
In the study conducted by Zimmerman et al. (2014), they choose “Space”- a 24 minute Planetarium show for teaching students about space. They compared the student learning about space in digital and computer environments immediately afterwards and six weeks later. Paired t-tests and an independent t-test were used to compare students learning. It was found that the space show via computer and Planetarium mode helped the students to learn about space more effectively.

Favia et al. (2014) examined the persistence of 215 common misconceptions in Astronomy and suggested correlations among them in an effort to improve the effectiveness of Astronomy misconception.

Belloni et al. (2013) in their paper named ‘Teaching Astronomy using Tracker’ describes the use of Tracker in introductory Astronomy to analyse a video consisting of a series of still images of star fields and sunspots. In their opinion as Astronomy focuses on concepts unfamiliar to most students, the visualization that the video analysis provides will be valuable.

Flurchick et al. (2013) in their study used the combination of a Web server and a computer Algebra system to provide students the ability to explore and investigate astronomical concepts. To them, this combination of technologies provides a framework to extend the classroom experience with independent student exploration.

Grover (2013) in his study evaluated the use of “Kalpana”: An interactive Dome based learning installation against conventional paper based and software based applications in teaching Astronomy. It was found to be significantly better and entertaining for students.

Speck et al. (2012) through their paper informs about 3D virtual learning Environments (VLEs) being developed by them as learning materials for an undergraduate Astronomy course. These materials will be used to test whether such VLES can augment Science learning so that it is more engaging, active, visual and effective.
Venkateswaram (2011) developed modules for teaching basic concepts in Astronomy using role play as a visuospatial scaffold and used extensively during the international year of Astronomy (2009) in India. The paper describes the pedagogical and cognitive imperatives that went into the design of the modules and preliminary qualitative result. He recommends this module as appropriate teaching/learning strategy in the context of low resources situation prevalent in most of the Indian schools.

Padalkar and Ramadas (2011) conducted a study to find the effectiveness of using diagrams as an effective pedagogic tool in teaching elementary Astronomy. According to them, diagrams in Astronomy represent an observed phenomenon, a model or an explanation which links a model to a phenomenon. After studying Grade 8 students from three schools in Maharastra it was found that this diagram centered pedagogy acts as an effective tool in teaching elementary Astronomy.

Cid and Lopez (2010) conducted a study on the impact of Stereo display on students’ understanding of Lunar Phases in the introductory Astronomy classes. For this they conducted fifteen Laboratory sections on the Lunar Phases of which half of them were taught using stereo visualizations which were projected by a portable Geo wall system running the Astrowall software and the other half of the laboratories were identical, but without stereo. It was found that both sets of laboratories showed a statistically significant gain in student comprehension, but there was no statistical difference between the stereo laboratories and the non stereo laboratories. They concluded that there was no advantage in using a stereo display in teaching about lunar phases.

Scott and Stephen (2010) created a series of videos for an online introductory Astronomy course at the Pennsylvania state university in part to address the lack of personal presence in online courses. Based on surveys administered to the students during the semester, it was found that these videos were effective in creating an instructor presence within the online course.
Moreover, students who perceived a strong instructor presence had a more positive attitude towards the course.

Longhini (2009) reported an activity of introduction to the study of Astronomy developed with a group of future Physics teachers at a Brazilian public university. Such activity had the goal of giving privileged emphasis to notions of spatiality, alternative conceptions of the participants and the process of interaction among peers, with the objective of encouraging discussions in regard to their models of the universe. Analysis of the activity in the perspective of the participants were indicated and additional considerations were made regarding its use as a resource for teaching Astronomy and for teacher training.

Fluke (2009) conducted a study on the use of Google Maps to provide virtual field trips as a component of a wholly online graduate course on the history of Astronomy. It was found that students used this Website as a component of their assessment and to support online discussions. It helped them to build a stronger online community among geographically distributed students.

Padalkar and Ramadas (2008) conducted a study to find the understanding of basic Astronomy by middle school students of the state of Maharashtra. They administered tests on observation, information from textbooks, information from cultural settings and explanations to class 7 students from three different settings, from communities with low educational and economic backgrounds. It was found that their mental models on Astronomy concepts need to be developed and the information that they gain from their textbooks and from other sources need to be integrated with their observations and with their mental models.

Padalkar & Subramaniam (2007) conducted a study to find out the reasoning processes underlying the explanation of the phases of the Moon. This study explored how qualified young adults explained the moon’s phases, how they changed the explanation when faced with inconsistency and the strategies
that they use to arrive at a correct and complete explanation. It was found that this process involves visuospatial reasoning based on mental models. Through detailed interview they analysed the strategies adopted by subjects qualified in Physics and the students of ‘Master of Design’ programme with prior qualification in architecture. The architects, who were more familiar with visualization techniques were found to solve the problem more quickly and accurately than the other group.

Grice (2006) in her paper “Resources for making Astronomy more accessible for blind and visually impaired students” listed a variety of printed and Web Based resources for teaching Astronomy to the Blind and Visually Impaired students.

Trumpera (2006) conducted a series of constructivist activities with future elementary and junior high school teachers which aimed at changing their conceptions about the cause of seasonal changes, and of several characteristics of the Sun-Earth-Moon relative movements like Moon phases, Sun and moon eclipses, and others. It was found that the experimental groups as well as the control groups improved their grasp of basic Astronomy concepts at a statistically significant level. Regarding the subject relevant to this study, only the experimental class and one of the control groups showed a statistically significant improvement and in both cases the experimental class made the most impressive progress of all.

Radnofsky (2004) in her paper named, “Teaching Astronomy online”, gives an overview of the practical, pedagogical and philosophical considerations in designing a Web Based Astronomy course and also the educational benefits of such online courses. She says that online education allows for increased student participation and equal access to college by all people including the military, the handicapped, fulltime employees, rural and senior citizens. Moreover it gives students more time to think critically about the new information.
Jackson (2003) describes a method which was developed in New Zealand for teaching Astronomy. In this method children observe and record the movement of their own shadows at regular intervals throughout the day and continue with a series of activities that can be extended throughout the year. This activity was found to be fascinating for both teachers and children and it can be done with very limited funding since it requires minimal equipment.

Barnett and Morran (2002) investigated the use of a project-based curriculum from the Challenger Centre in a fifth grade classroom to teach about the phases of the Moon and eclipses. The students were given opportunities to research information about the orbital motions of the Moon and Earth, as well as to explore an interactive computer model that displayed the Earth-Moon-Sun system from different three-dimensional perspectives. The researchers found that the students were able to increase their understanding of Moon phases after experiencing this series of lessons.

Samarapungavan, Vosniadou, & Brewer (1996) reported a study on the acquisition of knowledge about Astronomy by Indian children. They hypothesized that in cultures where both folk cosmologies and the scientific cosmological model are accessible to children, aspects of folk models are likely to be incorporated in children’s cosmologies if they provide a psychologically easier way of satisfying first-order constraints and their hypothesis proved to be true for Indian children. Children construct an initial understanding of the observed world on the basis of their everyday experiences and by the exposition to the adult culture’s theories of physical world. It was found that Indian children’s cosmologies honor a variety of universal first-order constraints. First order constraints are implicit assumptions that govern the construction of initial cosmological models. Eg: the assumption that the earth is flat and supported. They found that many Indian children have the idea that the earth is supported by an ocean or a body of water from folk cosmology.

Vincze and Molnar (1996) in their paper “Recent Trends in Teaching Astronomy” describes some new trends used by them to provide a foundation
in basic Astronomy and Astrophysics during three semesters for future elementary school teachers in Brezsenyi Daniel Teacher Training College, Hungary. The course included lectures on astronomical topics, opportunities for learning and applying research in the development of instruments and techniques for observation.

Mallon and Bruce (1982) used a participatory approach within a planetarium lesson for teaching some concepts in Astronomy. They compared this approach against a more traditional “star show” in the teaching of constellations. In both the cognitive and affective domains, the participatory method showed superiority, while the star show’s instructional effectiveness was not statistically significant.

Bieniek and Zeilik (1976) implemented Personalised System of Instruction in teaching Astronomy at Harvard University over seven semesters to investigate whether the personalized instruction remained an effective method. The immediate and personal feedback provided on the unit tests consistently received high ratings over all semesters. In general, the Personalised System of Instruction course continued to receive a positive response even though five different instructors were there in seven semesters.

Reed & Campbell (1972) investigated the usefulness of planetarium lessons on diurnal and yearly motions of the stars, planets and the Sun and on the celestial sphere. The study was based on behavioral objectives and the investigators developed two null hypotheses to be supported or refused. It was found that college students who were taught to manipulate and rectify (orient) celestial spheres scored higher on cognitive instruments than did students who studied these motions in the planetarium and no difference was measured in their attitudes.

**Conclusion**

The review of the related literature helped the investigator to know about various modern instructional strategies and its effect on certain variables like achievement, Scientific Attitude, self-concept, problem solving ability etc.
On reviewing the studies on Astronomy education, it is evident that innovative instructional strategies using Planetarium shows (Zimmerman et al., 2014), Videos (Belloni et al., 2013), interactive dome based learning (Grover, 2013) three dimensional virtual learning environments (Speck et al., 2012) etc. has significant impact on the learning of Astronomy among students. By analyzing the studies on Web Based education and Astronomy education the investigator found that very few studies have been conducted in India in these areas. Also, in India, there were only few attempts to build an effective strategy for learning Astronomy. This reveals that innovative learning strategies utilizing the potentialities of Web based education and Meaningful engaged learning must be developed for nurturing Astronomy education.