CHAPTER-II
LITERATURE REVIEW

2.0.0 INTRODUCTION

The first chapter deals with the introduction, conceptual framework, rationale of the study, objectives, hypotheses and delimitations of the research. The second chapter deals with the review of related literature. A literature review is a comprehensive summary of previous research on a topic. The literature review surveys scholarly articles, books, and other sources relevant to a particular area of research. The review should enumerate, describe, summarize, objectively evaluate and clarify this previous research. It should give a theoretical base for the research and help you (the author) determine the nature of your research. The literature review acknowledges the work of previous researchers, and in so doing, assures the reader that your work has been well conceived. It is assumed that by mentioning a previous work in the field of study, that the author has read, evaluated, and assimilated that work into the work at hand.

2.1.0 SIGNIFICANCE OF LITERATURE REVIEW

- Provides the interpretation of existing literature in light of updated developments in the field to help in establishing the consistency in knowledge and relevancy of existing materials
- It helps in calculating the impact of the latest information in the field by mapping their progress of knowledge.
- It brings out the dialects of contradictions between various thoughts within the field to establish facts
- The research gaps scrutinized initially are further explored to establish the latest facts of theories to add value to the field
- Indicates the current research place in the schema of a particular field
- Provides information for relevancy and coherency to check the research
- Apart from elucidating the continuance of knowledge, it also points out areas that require further investigation and thus aid as a starting point of any future research.

2.2.0 REVIEW OF LITERATURE

1. This paper presents a review of the literature on learning progressions. Two approaches to learning progressions are identified, named, and presented; the escalated approach and the landscape approach. First approach constructs a progression in terms of levels being its extremes, the lower anchor to the upper anchor and the second approach has

a stronger analytical component to define and construct the progression. Both the learning progressions are descriptions of the sequences of learning as typically developed towards more sophisticated ways of thinking during a defined timespan, context, frame topic.

2. American education policy seems poised to escalate and shift its two-decade commitment and standard and outcome-based reform. This briefly learning progression in science are empirically grounded and testable hypotheses about how students' understanding of, and ability to use, core scientific concepts and explanations and related scientific practices grow and become more sophisticated over time with appropriate instruction (NRC-2007). These hypotheses describe the pathways students are likely to follow to the mastery of core concepts, they are based on research about how students learning actually progress.

   "The empirical evidence on the relationship between students' instructional experiences and the resources made available to them and the rates at which they move along the progressions, gather during their development and ongoing validation, can form the basis, for a fairer set of expectations for what students and teachers should be able to accomplish, and thus a fairer basis for designing accountability systems and requirements."

3. Over the past few decades, there have been enormous opportunities and huge benefits of using learning analytics to improve educational processes. Thus, study shows that learning analytics is not only used to provide a better understanding of the different datasets collected about learners and how effective usage can help provide educational institutions with a competitive rapidly growing global economy.

4. The coupled influences of scholarship in the fields of Psychology, Philosophy, and Pedagogy beginning in the 1950s, set in motion the emergence of new images, methodological perspectives, theories, and design principles about learners and learning. Advances in cognitive and sociocultural psychology, shifting images of the nature of science, recognition of the importance of disciplinary discourse practices in learning, the scaffolding of learning by tools and technologies, along with the adoption of 'assessment for learning' instructional strategies are among the factors that have led researchers and practitioners to advance positions that learning ought to be coordinated and sequenced along conceptual trajectories, developmental corridors, and learning progressions (LP). Learning Progressions and developmental pathways are relatively new research domains.

5. New theoretical frameworks in psychology, philosophy, and pedagogy, along with new technological platforms for aiding the delivery of instruction and the analysis of learning (e.g., evidence-centered design performance assessments) are shifting thinking for framing learning goals and designing science learning environments. There are numerous challenges and opportunities for researchers, curriculum planners, and teachers in the quest to design extended coherent sequences of teaching and learning. The shift away from teaching what we know to instructional formats that focus on reasoning and how we know and why be believe it, reflects a change of learning goals that seek competence with scientific and epistemic practices. Taking a scientific reasoning and a 'science as practice' view applied to disciplinary and interdisciplinary contexts, and increasingly, to transdisciplinary contexts that merge natural sciences, social sciences, and the humanities, is becoming the new normal. [5]
6. The paper is an analytical review of the design, development and reporting of learning progressions and teaching sequences. Research questions are: (1) what criteria are being used to propose a 'hypothetical learning progression/trajectory' and (2) what measurements/evidence are being used to empirically define and refine a 'hypothetical learning progression/trajectory'? Publications from five topic areas are examined: teaching sequences, teaching experiments, didactics, learning trajectories in mathematics education and learning progressions in science education. The reviewed publications are drawn from journal special issues, conference reports and monographs. The review is coordinated around four frameworks of Learning Progressions (LP): conceptual domain, disciplinary practices, assessment/measurement and theoretical/guiding conceptions. Our findings and analyses show there is a distinction between the preferred learning pathways that focus on 'Evolutionary LP' models and the less preferred but potentially good LP starting place curriculum coherence focused 'Validation LP' models. We report on the respective features and characteristics for each. [6]
7. The research was aimed to analyze the trends of the learning progression to improve the students' conceptual understanding in biology. Learning progression is the way of thinking of analysing changes in students' level of understanding at different grades or ages. Learning progression has been issued since 2009. This study reviewed the research articles and reviews published on online databases, such as Google Scholar, Science Direct, and Wiley Online Library. The result showed the learning progression had been developed in genetic, natural selection, evolution, ecology, and biodiversity.

The review of articles with various topics showed the learning progression can improve the students' conceptual understanding in biology at different levels of education. Learning progression can become the reference to assess the students' learning development according to their stages of ages and different school levels. Through learning progression, students' ideas are built so they can construct a better understanding of biology. Learning progressions developed in biology include several topics such as genetics, natural selection, evolution, ecology, biodiversity, and so forth. The instruments used in learning progressions can be oral or written tests, and other instruments for specific topics, such as the tree of life to teach evolution. LP was developed by analysing the students' understanding levels toward the topic at various learning stages. LP enables the teachers to assess and strengthen students' conceptual understanding in biology learning. [7]

8. This paper presents a review of the literature on Learning Progressions. Two approaches to Learning Progressions are identified, named, and presented: the escalated approach and the landscape approach. The first approach constructs a progression in terms of levels, being its extremes the lower anchor and upper anchor, and having a strong empirical component in the depiction of the progression. The second approach has a stronger analytical component to define and construct the progression, presenting connections among elements of the progression by levels and threads, while resting mainly in previous research for validating its analysis of progress on learning. Similarities, main features, and the principal identified rationale of each of the approaches are discussed. Research pieces representing the approaches are briefly shown as examples. [8]
9. In this study, we explored how learning progressions were established in a context-based science teaching unit. A science class in secondary school was followed by a teaching unit in Biology, in which the Ebola disease was used as context. Teaching was planned using the didactical model organizing purposes. Learning progressions were studied as continuity between teaching purposes, the science content and the context in four sequential lessons. The analysis of teaching evidenced a considerable variation in how learning progressions were constituted within lessons and showed how learning progressions could develop between lessons through the combination of different teaching activities. By consistently mentioning and referring to Ebola, the teacher had a pivotal role in establishing relations between teaching purposes, the content and the context. Furthermore, our results evidence the important role of the context in

supporting students' learning of science content. Finally, we discuss concrete actions in the planning of the unit to improve lessons that evidenced a weaker connection to the context. [9]

10. The purpose of this study was to explore grade eight students' views in terms of different scientific reasoning progress levels. To explore students' views, phenomenographic study was used. The qualitative analysis of students' interviews elicited three major themes of students' views about scientific reasoning progress levels: naïve, mixed, and scientific, along with the underlying ways of reasoning patterns. It was revealed that students think that scientific knowledge is static, fixed, universal, certain, and unchangeable. It is recommended that a need to consider inquiry-based teaching in combination with the contextualized approach of nature of science in school science curriculum and classroom instruction to promote students' scientific views on the nature of science and higher scientific reasoning abilities. [10]
11. This study integrated elements of culturally relevant pedagogy into a science learning progression framework, with the goal of enhancing teachers' cultural knowledge and thereby creating better teaching practices in an urban public high school science classroom. The study was conducted using teachers, an administrator, a science coach, and students involved in science courses in public high school. Through a qualitative intrinsic case study, data were collected and analyzed using traditional methods. Data from primary participants (educators) were analyzed through identification of big ideas, open coding, and themes. Through this process, patterns and emergent ideas were reported. Outcomes of this study demonstrated that educators lack knowledge about research-based academic frameworks and multicultural education strategies, but benefit through institutionally-based professional development. Students from diverse cultures responded positively to culturally-based instruction. Their progress was further manifested in better communication and discourse with their teacher and peers, and increased academic outcomes. This study has postulated and provided an example for science teachers to expand and improve multicultural knowledge, ultimately transferring these skills to their pedagogical practice. [11]
12. Papers were collected in order to summarize the distribution of topics of LT/LPs among current research. During the initial review, papers were included if they used the phrase "learning trajectory," "learning progression," "instructional theory," "conceptual change," "developmental progressions," or "longitudinal analysis," and were published within the last 15 years. Reviews of the research on LT/LPs provided a rich source of

relevant literature (Lobato & Walters, 2017; Groff, 2017). The resulting 124 papers were categorized as: 1) presenting an LT/LP for a content domain, 2) general theoretical papers, or 3) applications of LT/LPs to curriculum, teaching, or informal assessment. Of the 124 papers, 85 discussed specific LT/LPs. Some of the 85 papers reported on the same LT/LP, often written by the same author(s). In order to examine the distribution of different LT/LPs, duplicates were eliminated, reducing the total number of distinct LT/LPs to 75. [12]

13. Teachers at the K-12 level have a critical role in including engineering in their instruction. More teachers who are equipped with the knowledge and skills necessary to teach science using the engineering design process are needed. Aiming to build tools to measure and track the progress in teacher' attitudes and their understanding of the engineering design process suggested the use of learning progressions approach. The purpose of the study was to develop two teacher learning progressions for K-12 engineering education. The study followed design-based research with three phases of methodology framework; developing initial learning progressions, implementing a teacher professional development program, and refining the learning progressions. Data was collected from different groups of in-service science teachers. Data sources included written assessments, cognitive interviews, teacher logs, and clinical interviews. The analysis of data resulted in refined and empirically supported versions of the learning progressions. Implications and recommendations for future research were discussed in light of the findings and the relevant literature.[13]
14. As the Philippines moves towards implementing the K-12 curriculum, there has been a mismatch in teacher preparation in science. The present teacher education curriculum prepares science teachers to specialize in a specific field (e.g. integrated science, biology, chemistry, and physics). However, in the K-12 curriculum, they are required to teach all the sciences in a spiral progression approach. Hence, this study analyzed the experiences of science teachers in teaching chemistry in the K-12 curriculum in order to identify their challenges and how they are overcoming them. Findings suggest that the teacher's content, pedagogy, and assessment in chemistry are problematic; specifically, challenges such as instruction-related factors, teacher competence, in-service training sufficiency, job satisfaction, support from upper management, laboratory adequacy, school resources, assessment tools, and others influence teacher success in teaching chemistry. These identified challenges greatly affect the ultimate beneficiaries of education, which is the learner.[14]

15. Our focus is on the effects that dated ideas about the nature of science (NOS) have on curriculum, instruction and assessments. First we examine historical developments in teaching about NOS, beginning with the seminal ideas of James Conant. Next we provide an overview of recent developments in philosophy and cognitive sciences that have shifted NOS characterizations away from general heuristic principles toward cognitive and social elements. Next, we analyze two alternative views regarding 'explicitly teaching' NOS in pre-college programs. Version 1 is grounded in teachers presenting 'Consensus-based Heuristic Principles' in science lessons and activities. Version 2 is grounded in learners' experience of 'Building and Refining Model-Based Scientific Practices' in critique and communication enactments that occur in longer immersion units and learning progressions. We argue that Version 2 is to be preferred over Version 1 because it develops the critical epistemic cognitive and social practices that scientists and science learners use when (1) developing and evaluating scientific evidence, explanations and knowledge and (2) critiquing and communicating scientific ideas and information; thereby promoting science literacy. [15]
16. This study tests a hypothesized learning progression for the concept of energy. It looks at 14 specific ideas under the categories of (i) Energy Forms and Transformations; (ii) Energy Transfer; (iii) Energy Dissipation and Degradation; and (iv) Energy Conservation. It then examines students' growth of understanding within each of these ideas at three levels of increasing conceptual complexity. The basic level of the model focuses on simple energy relationships and easily observable effects of energy processes; the intermediate level focuses on more complex energy concepts and applications; and the advanced level focuses on still more complex energy concepts, often requiring an atomic/molecular model to explain phenomena. The study includes results from 359 distractor-driven, multiple-choice test items administered to over 20,000 students in grades 4 through 12 from across the U.S. Rasch analysis provided linear measures of student performance and item difficulty on the same scale. Results largely supported a model of students' growth of understanding that progresses from an understanding of forms and transformations of energy-to-energy transfer to conservation while also progressing along a separate dimension of cognitive complexity. An analysis of the current state of students' understanding with respect to the knowledge identified in the learning progression showed that elementary level students perform well in comparison to expectations but that middle and high school students' performance does not meet expectations. [16]

17. The study we have carried out aims to characterize 15- to 16-year-old students' learning progressions throughout the implementation of a teaching–learning sequence on the acoustic properties of materials. The purpose is to better understand students' modeling processes about this topic and to identify how the instructional design and actual enactment influences students' learning progressions. This article presents the design principles which elicit the structure and types of modeling and inquiry activities designed to promote students' development of three conceptual models. Some of these activities are enhanced by the use of ICT such as sound level meters connected to data capture systems, which facilitate the measurement of the intensity level of sound emitted by a sound source and transmitted through different materials. Framing this study within the design-based research paradigm, it consists of the experimentation of the designed teaching sequence with two groups of students (n = 29) in their science classes. The analysis of students' written productions together with classroom observations of the implementation of the teaching sequence allowed characterizing students' development of the conceptual models. Moreover, we could evidence the influence of different modelling and inquiry activities on students' development of the conceptual models, identifying those that have a major impact on students' modelling processes. Having evidenced different levels of development of each conceptual model, our results have been interpreted in terms of the attributes of each conceptual model, the distance between students' preliminary mental models and the intended conceptual models, and the instructional design and enactment. [17]
18. Research on learning progressions has led to advances in understanding student learning about big ideas in science, but teachers struggle to leverage the full potential of learning progressions for classroom instruction. Because learning progressions lay out how students' ideas change over a long period of time, learning progressions could help teachers build better understanding of student thinking, appropriate learning goals, and instructional moves for supporting students in developing more sophisticated i In this study, we explored the potential of learning progression-based curriculum materials to support teachers in developing more sophisticated content knowledge (CK) and pedagogical content knowledge (PCK) for teaching about water in environmental systems. Teachers participated in professional development that introduced them to a learning progression for water in environmental systems and curriculum materials based on this learning progression. Teachers completed written assessments of their CK and PCK prior to the workshops and a year later. Analyses showed that teachers who

taught lessons using the learning progression-based curriculum materials showed modest increases in CK, knowledge of learning goals, and knowledge of student thinking. These increases were greater than analogous changes evident for teachers who did not use the curriculum materials. However, even among those who implemented the curriculum materials, teachers' post-assessment performance did not yet reflect knowledge for supporting students in developing model-based reasoning about water. These results show that learning progressions have potential for supporting teacher learning, but that the ubiquity of traditional school science discourse may limit their potential for both student and teacher progress toward model-based reasoning. [18]

19. In this study, we explored how learning progressions were established in a context-based science teaching unit. A science class in secondary school was followed by a teaching unit in Biology, in which the Ebola disease was used as context. Teaching was planned using the didactical model organizing purposes. Learning progressions were studied as continuity between teaching purposes, the science content and the context in four sequential lessons. The analysis of teaching evidenced a considerable variation in how learning progressions were constituted within lessons and showed how learning progressions could develop between lessons through the combination of different teaching activities. By consistently mentioning and referring to Ebola, the teacher had a pivotal role in establishing relations between teaching purposes, the content and the context. Furthermore, our results evidence the important role of the context in supporting students' learning of science content. Finally, we discuss concrete actions in the planning of the unit to improve lessons that evidenced a weaker connection to the context. [19]
20. There is a great deal of detail in this piece. For the sake of potentially interested readers, I extract a set of the key propositions that speak to the authors 'work, in addition to providing additional commentary and/or perspective. Why build learning progressions in the first place? According to Smith et al. (this issue) These standards consist mostly of brief statements of propositional knowledge that students of different ages should understand. Because they do not provide operational definitions of understanding, they must be elaborated before they can be used as a basis for assessment. (p. 5) With an overarching emphasis on epistemological understanding, learning and learning progressions become the same idea. And although progression is itself a metaphor for a scheme based on understanding prior knowledge, Smith et al. (this issue) do not seek to privilege any one path over another, particularly (to their credit) because there is no

evidence to back such a claim: First, learning progressions are not developmentally inevitable but depend on instruction. Second, there is no single "correct order." There may be multiple pathways by which certain understandings can be reached. Which pathway is taken may be influenced by prior instructional experiences, individual differences, and current instruction? Third, actual learning is more like ecological succession, with changes taking place simultaneously in multiple interconnected ways, than like the artificially constrained and ordered accounts that we can give in this article. Finally, the learning progression that we can suggest is partly hypothetical or inferential. We do not have long-term longitudinal accounts of learning by individual students. (p. 5–6) The most provocative critique—and one that is barely stated explicitly—asks how rational any set of standards is when some suggested order of ideas has no empirical basis in understanding how learners come to understand those ideas. [20]

21. This paper draws attention to the literature in the areas of learning, specifically, constructivism, conceptual change and cognitive development. It emphasizes the contribution of such research to our understanding of the learning process. This literature provides guidelines for teachers, at all levels, in their attempt to have their students achieve learning with understanding. Research about the constructive nature of students' learning processes, about students' mental models, and students' misconceptions have important implications for teachers who wish to model scientific reasoning in an effective fashion for their students. This paper aims to communicate this research to teachers, textbook authors, and college professors who involved in the preparation of science teachers. This paper is divided into two major parts. The first part concentrates on a critical review of the three most influential learning theories and constructivist view of learning and discusses the foundation upon which the constructivist theory of learning has been rooted. [21]

22. Motivation is the very heart of the learning process. Adequate motivation not only sets in motion the activity, which results in learning, but also sustains and directs it. It has been stated, "Motivation arouses interest. Interest is the mother of attention and attention is the mother of learning. Thus, to secure learning pupils must catch the mother, grandmother and great grandmother." Motivation is an indispensable technique for learning. It energizes and accelerates the behaviour of learner. Desirable changes in learner's behaviour are only possible when a learner is properly motivated. No learning

is possible without motivation. Thus, achievement motive come into picture when an individual knows that this performance will be evaluated, that the consequence of this actions will be either a success or failure and that good performance will produce a feeling of pride in accomplishment. Here achievement motive may be considered as a disposition to approach success or a capacity for taking pride in accomplishment when success at one or another activity as achieved. Many factors related to achievement motivation influence the performance of the students in the subjects. Hence this study attempts to know the relationship of achievement in science and achievement motivation among students. And the found result from this study was that there is significant relationship in achievement in science and achievement motivation. [22]

23. The present preliminary research work was intended to measure the scientific attitude, scientific aptitude and scientific knowledge of secondary school students in the selected schools of two districts in Tamilnadu, India. The normative survey method was applied and a total of six null hypotheses(gender, studying class, medium of instruction, board of affiliation, locality and type of management) were framed. The sample consisted of 76 secondary school students from seven different schools in Chennai and Thiruvallur districts. The standardized tools were used in the study. The data were collected, recorded and analysed using Statistical Package for Social Sciences (SPSS-19.0 version), IBM Corporation. The measuring scores (low, average and high) were prepared using Normal Probability Curve (NPC) method. The most statistically significant results were obtained for all selected variables except board of affiliation (State and Central Board of Secondary Education) towards scientific attitude and scientific knowledge. Hence the present study concluded that the samples drawn from the selected schools were standardized for conducting further experimental study.[23]

2.3.0 CONCLUSION

The history of science education has changed dramatically throughout the centuries. At first, simply being able to read and write was considered acceptable. Eventually, as technology became more demanding, the views on education began to change. A common goal among educators was to encourage students to act like scientists. Ultimately, this new way of thinking led to the notion of scientific literacy for all students, which is still a topic of debate today. Learning progression in science in students can be observed and modified through changing the teaching style. Chapter-

III the methodology, sample, design, tools, procedure of data collection and statistical techniques will be detailed.