DEVELOPMENT OF STEM-BASED MODEL CURRICULUM ON SELECTED CONCEPTS FOR GRADE 3 CHILDREN

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By

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'Certified as bonafide research work'

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DECLARATION

I hereby declare that the thesis entitled **"Development of STEM-based model curriculum on selected concepts for grade 3 children"** is a bonafide record of research work done by me during the course of study, under the supervision and guidance of Dr. Dhanya N, Associate Professor, Department of Home Science, St. Teresa's College (Autonomous) Ernakulam.

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INTRODUCTION

CHAPTER – 1

INTRODUCTION

The phrase “stem,” which stands for science, technology, engineering, and mathematics, has dominated international discourse in the fields of education, industry, research, and competitiveness. Students from preschool to postgraduate levels use the term to define professions in their different fields. When the National Science Foundation (NSF) in the United States started referring to the research areas as “smet” in the 1990s, a program officer for the NSF voiced concerns that the term sounded too similar to “smut.”2001 saw the creation of “stem” (Donahoe, 2013; Sanders, 2009).

Stem words have been ambiguous ever since. Some define stem as studying and working in the hard sciences and mathematics; others include the social sciences and other related subjects. Some authors claim that a “confusing picture” is produced when “agglomerating disparate technical skills” into the catch-all word (donahoe, 2013). Even scientists working in stem disciplines frequently misunderstand the phrase and think it has to do with botany or stem cell research (Bybee, 2010). Confusion and dispute are also being brought about by presumptions about what constitutes a quality stem education and incorrect definitions of stem in educational settings. Often, stem only serves as an acronym for the four disciplines. Other times, writers stress how crucial it is to integrate the disciplines. (Morrison and Bartlet,2009).

The majority of people are unaware of this, including the majority of teachers and pupils. When the abbreviation “STEM” is mentioned in an educational context, some people may associate it with stem cell research or anything floral (Angier, 2010). There is a need to motivate leaders to grasp STEM ideas and act upon them. The 10 chapters of the book include topics such as lessons learned from the Sputnik incident, the difficulties facing STEM education, and how STEM relates to other educational changes. The functions of the federal government, states, districts, and particular schools are also covered. The book promotes STEM thinking and action by providing suggestions and ideas for creating action plans. Leaders at all levels, including legislators, teachers in STEM fields, faculty, administrators, and educators, are advised to read it (Bybee, 2013).

Even though there have been numerous requests to enhance science and math instruction for our pupils, educational reformation has moved slowly. Though definitions of STEM (science, technology, engineering, and mathematics) vary widely among stakeholders, the acronym has been embraced by many programs as a key focus for reviving American competitiveness in the global arena. In the midst of a regional "STEM movement," this research explores the ideas about STEM that faculty members from a public Research I institution have. Teachers addressed two open-ended questions: (1) what is STEM? And (2) what impact does STEM have on your life? The findings imply that these faculty members do not have a shared understanding of STEM, even though 72% of them had a meaningful conception of the field… Their idea is probably derived from their field of study or from the way STEM influences their day-to-day activities. While non-STEM faculty members frequently felt negatively about STEM, STEM faculty members were more likely to have a neutral or positive perception of the subject (Breiner et al., 2012).

In the last few decades, a great deal has been learned about how young children learn STEM disciplines and how educators can foster such learning. However, there are still significant gaps in our ability to: (a) measure EC STEM learning; (b) increase EC educators' knowledge about and comfort with STEM ideas; (c) institute effective policies to expand access to high-quality STEM learning opportunities worldwide; and (d) create and disseminate robust curricular materials, especially integrated STEM materials, specifically designed for EC learners. These findings are summarized in this chapter, which highlights the many advantages of STEM education for young children (Hapgood et al., 2020).

The case for a STEM education that empowers kids to investigate and feel the kind of connectivity that permeates everyday life. Although most people believe that STEM curriculum should be included into authentic, real-world contexts, most present policies and practices favour disciplinary approaches to knowledge that are narrowly focused on what can be easily measured or tested for achievement. On the other hand, neither the challenges that face our society today nor the concerns that impact students' lives outside of it are unidisciplinary. In this article, we examine how an integrated approach to STEM education can help students have more opportunity to participate in trans disciplinary, contextual, issue-based learning (Rennie et al., 2018). The uncertainty of what defines a "TEM" lesson is one problem with modern STEM education. The fact that STEM is made up of four different but linked subjects contributes to this uncertainty. We view a STEM lesson as an integrated project including several disciplines, where the final product is a lesson that employs a balanced approach and incorporates knowledge and abilities from all domains. We think that chances for meaningful learning are created by balanced integration. This chapter presents a review of contemporary practitioner literature in secondary education that was gathered and examined according to the degree of integration of the individual STEM disciplines and the degree of links between these domains. We discovered that there is a great deal of diversity in the kinds of courses that are labelled as “STEM,” and that the majority of lessons showed disciplinary bias in favour of a particular discipline. We believe that a number of factors, such as the diversity of stakeholders, the expertise and experiences of educators, and the demands of a regular school day, contribute to the observed imbalance in integration. We think that if the definition of “STEM” is made more clear, teachers will be able to design more balanced curricula and provide chances for real-world learning (Sagro et al., 2020).

The last ten years have seen a global uptake of the phrase STEM, which now stands for a variety of solutions to various problems. In the context of education, STEM is being interpreted as an interdisciplinary, skills-focused curriculum organizer that has the potential to interest and keep students. This essay focuses on the STEM curriculum and explores the factors that have shaped the way that STEM is currently understood as well as the challenges, conflicts, and epistemological questions that this curriculum brings up. This is accomplished by the article by analysing past and present curriculum movements and debates, and by doing so, it poses concerns regarding the underlying presumptions, structure, and focus of STEM curricula before outlining some potential future paths (Millar, 2020)

More teachers are eager to look at how integrated STEM curricula may equip students with 21st century skills and talents, as STEM education has gained popularity in Australia recently. Our organization has been providing a one-year professional development program since 2014 to help primary and secondary school teachers in school-based teams create and execute integrated STEM curricula that are appropriate for their pupils. Participating teachers work in a variety of educational environments and have a range of experiences, including different school sizes, regions, and socioeconomic backgrounds. Pre- and post-stem assessments of teacher efficacy, teacher outcome expectations, pedagogical practices, and STEM career awareness were used to determine the effects of professional learning on teachers. Teachers’ efficacy and outcomes show statistically significant changes. The findings show large effect sizes and statistically significant changes in teacher efficacy, outcome expectancies, and STEM career knowledge. Improvements in curriculum design and delivery, a rise in the utilization of small-group problem solving through inquiry, a rise in student involvement, and an increase in the chances for student reasoning have all been linked to major improvements in teaching techniques (Anderson and Tully, 2024).

United States continues to be concerned about social justice and maintaining a workforce that is competitive on a global scale due to the lack of diversity in STEM fields. Campus administrators can use the information from this study to be more proactive in meeting students' needs by taking into account a diverse range of identities in addition to structural forms of diversity. Our understanding of diversity in STEM majors is expanded by data from a large-scale, multi-institution study on students' opinions of inclusive courses and institutional commitment to diversity. The findings urge college administrators to think about how culturally relevant and inclusive curricula extend beyond the course material and to take into account handicap status and sexual orientation in discussions on diversity (Lorenz et al., 2021).

In order to attain equity in STEM fields (science, technology, engineering, and mathematics), it is imperative to draw and retain a diverse student body in higher education. Change has been sluggish despite cries for action for decades. Rather than addressing the classroom issues that result in many students dropping out of STEM programs, recommendations have mostly concentrated on minority group members themselves. STEM will not change if these obstacles are not removed, even with financing and initiatives targeted at underrepresented populations. Rather, we need to make changes in the classrooms that deter many students from historically marginalized communities (HECs) from pursuing careers in STEM. In order to bring about change on a large scale, we list the areas that require attention and suggest actions that educators, academic administrators, and governmental organizations might do (refer to the table). Active learning strategies, friendly classroom environments, and content that According to research, classrooms that are friendly, active learning strategies, and content that is pertinent to HEC members are all particularly deserving of notice. All STEM students, regardless of background, can benefit from such evidence-based instructional strategies (Elgin et al., 2022).

The case for STEM education Is a worthwhile read if you have any interest in STEM policy, programs, or practices, or if you are involved in STEM activities at any level. This book, published by Rodger W. Bybee, aims to motivate people in leadership positions to better comprehend and support STEM activities. The ten chapters in the book achieve the following goals: Put STEM in perspective by describing the difficulties in STEM education, incorporating lessons learned from the 1950s and 1960s Sputnik moment, and contrasting STEM now with other educational reforms; Examine the proper roles that the federal government, states, districts, and particular schools should play; Provide a number of suggestions and ideas that you may utilize to create STEM action plans. Putting a focus on. The case for STEM education, which places equal emphasis on thinking and doing, is essential reading for leaders at all levels, including state and federal policy makers, educators in charge of STEM initiatives at the state level, faculty members in colleges and universities who train future STEM educators, local administrators who decide on district and school program decisions, and STEM discipline representatives in the classroom."-The rear cover (Bybee, 2013)

The issue of successfully implementing STEM education science, technology, education, and math as a new interdisciplinary educational method in the Ukrainian educational system. The definition, objectives, and promises of STEM education, as well as the legislative framework for STEM education in Ukraine, are the topics of discussion. The author discusses the obstacles and difficulties that Ukraine faces in implementing STEM education effectively. The primary national and international sources used in the research on STEM education are mostly primary sources from Ukraine's legislative base. The introduction of the STEM program into the Ukrainian educational system is a great chance to prepare future workers with solid foundations in science, computer science, and mathematics for success in the global high-tech labour market (Byrka, 2017)

The teaching of Science, Technology, Engineering, and Mathematics (STEM) has grown increasingly important as economic competitiveness has truly gone global due to the "flattening" of the global economy in the 21^{st} century. With the removal of historical barriers between various courses, STEM education has developed into a meta-discipline that emphasizes creativity and the applied process of creating answers to challenging contextual problems utilizing available tools and technologies. Programs must incorporate technology and engineering into the science and mathematics curricula, encourage scientific inquiry and the engineering design process, and provide a rigorous curriculum, instruction, and evaluation in order to engage students in high-quality STEM education. The STEM vision must involve every student, and educators must have access to opportunities for professional development that will enable them to assist every student in pursuing a STEM education (Odell and Kennady, 2014).

STEM education must incorporate science, technology, engineering, and mathematics into a mega discipline in order to keep up with current trends. But putting integrated STEM education into practice is not a simple task—many problems crop up once it is put into place. Consequently, a systematic review was carried out to collect data from the most recent empirical investigations in order to identify the fundamental problems with integrated STEM education. The PRISMA guidelines were employed to locate pertinent articles from 2010 to 2019 through the use of Google Scholar, Wiley, and Scopus databases. As a result, 17 articles in all were found. Results indicated that the main problem is the teacher. It suggests that the quest of integrated STEM education revolves around the teacher as the most crucial component (Yuzie, 2021).

The development of critical thinking abilities Is widely seen as a major educational objective, and integrated STEM-based approaches have been shown to have the ability to improve critical thinking. Therefore, in order to improve the critical thinking abilities of secondary school biology students, this study looked at integrated STEM instructional materials for genetic learning (Angwal, 2022). At all educational levels, one of the main objectives of the educational system is the development of critical thinking. The goal of critical thinking (CT) development is to assist students in acquiring the abilities and attitudes necessary for a prosperous career. It also describes high-level, effective teaching methods. Because of his intricacy, CT is one of the most important 21st century abilities, yet it can be challenging for teachers to teach. Experts disagree on both the CT notion and whether or not it belongs to a particular area (Tripon and Gabureanu, 2020). There is little evidence suggesting that critical thinking merely develops because of instruction in a discipline. Some experts argue that there is a requirement for specific teaching of critical thinking . The attention of researchers and specialists in critical thinking education extends to methods of confirming the efficacy of teaching strategies in this regard. However, it is equally crucial for businesses and teachers to evaluate the critical thinking skills of kids who are potential employees. Norris & Ennis (1989) recommend using standardized examinations to measure students' critical thinking (CT) since CT is a generalized intellectual skill that shows up in generally comparable ways across fields (Brookfield, 2002). The article discusses the value of helping students develop critical thinking abilities, with a focus on the relationship between critical thinking and choosing a STEM career, using ICT to support CT development, and the potential for teaching CT in STEM fields (Halpern, 2014).

Relevance of the Study

The study of STEM subjects—Science, Technology, Engineering, and Mathematics—has drawn a lot of attention lately since it is essential to promoting innovation, accelerating economic growth, and solving global issues. This section emphasizes how important STEM education is to modern culture. Globalization and the quickening pace of technological innovation have increased demand for those with STEM skills. That being said, there is a large disparity between the qualifications held by the workers and the abilities that sectors require. Educational institutions seek to close this gap and get students ready for jobs in high-demand industries by placing a strong emphasis on STEM education.

Critical thinking, creativity, and problem-solving are all fostered by STEM education and are necessary for innovation. In an era of disruptive developments and technology advancements, cultivating an innovative culture is essential to staying competitive in the global economy. The use of STEM curricula gives pupils the skills and mindset needed to innovate and adjust to a constantly changing environment. Multidisciplinary approaches based on STEM concepts are needed to address many of the urgent issues facing society today, including cybersecurity risks, healthcare inequities, and climate change. By giving students a solid foundation in STEM subjects, teachers enable them to take on challenging real-world issues and make a good impact on society.

Obtaining superior Not all demographic groups receive the same amount of STEM education, and underrepresented groups frequently face obstacles to enrollment and success. Through the promotion of equity and inclusion and the guarantee that all students, regardless of background, have access to opportunities in STEM fields, effective STEM curriculum implementation can help resolve these inequities. In summary, the value of STEM education goes beyond a student's potential for employment to include wider societal advantages including social justice, innovation, and economic growth. This study looks into how STEM curricula are implemented in an effort to add to the continuing conversation about workforce development and educational reform in the twenty-first century.

Even though the value of STEM education is widely acknowledged, more study is still needed to determine how well particular curriculum implementation strategies work. This section highlights the main areas of inquiry and provides justification for studying the implementation of STEM curricula. Careful planning, resource management, and teacher preparation are necessary for the implementation of STEM curricula in schools. On the best ways to incorporate STEM concepts into the current educational frameworks, there is, still, disagreement. The finest methods that optimize learning outcomes, long-term performance, and student engagement can be found through research in this field.

Even though STEM education may have advantages, there are also obstacles that many schools and teachers must overcome in order to successfully integrate STEM curricula. These difficulties could include a lack of resources, insufficient chances for professional growth, and reluctance to change. Research can help educators overcome these obstacles and realize the full potential of STEM education by looking at implementation hurdles and pointing to potential solutions. Although anecdotal evidence points to the benefits of STEM education on students' academic performance and preparedness for the workforce, empirical study is required to thoroughly assess these results. Researcher performance, attitudes toward STEM subjects, and post-graduation trajectories may all be measured. This allows researchers to make evidence-based decisions about educational policy and practice and offer important insights into how well STEM curricula are implemented.

The dynamic sector of STEM education Is marked by constant innovation and development. Research on the application of STEM curricula can support a cycle of continuous improvement by producing new information, advising programmatic changes, and assisting in data-driven institutional and policy decision-making. Teachers and legislators can guarantee that STEM education stays responsive to students' needs and the demands of the workforce of the twenty-first century by conducting comprehensive research.

To sum up, research on the application of STEM curricula is critical to improving our knowledge of how to best prepare kids for success in a world that is becoming more complicated and linked by the day. This project intends to support excellent educational results for all students and contribute to the continuous improvement of STEM education by addressing important questions about best practices, implementation challenges, impact, and outcomes.

Aim- To develop a comprehensive STEM curriculum manual for integrating it into primary school grade 3 with the aim of enhancing engagement, interaction, comprehension of concept, and better learning outcomes among young learners.

Objectives of the Study

General Objectives

1. To develop a comprehensive book manual integrating STEM activities into the primary school curriculum of third standard.
2. To enhance engagement, interaction, comprehension and better learning outcomes among the primary school children through the implementation of STEM based educational activities.
3.

Specific Objectives

1. To review existing literature on STEM based curriculum and educational early childhood development.
2. To design and develop interactive learning activities and resources based on STEM Curriculum Model to scientific experiments and mathematical activities which is easily catchable for the students through day today life.
3. To evaluate the impact of the STEM curriculum on student engagement, interaction, comprehension and better learning outcomes.
4. To conduct test whether the developed curriculum manual in the primary school setting is accessible, effective or relevant.

REVIEW OF LITERATURE

CHAPTER-2

REVIEW OF LITERATURE

A literature review is a thorough summary of previous research on a particular subject, highlighting existing knowledge and gaps in the field to support the need for further research. Other arguments that have been put forth include the following: "make a writer learn as much as possible about the subject chosen," "show readers that the author is knowledgeable about the subject," "credibility," and "integrity." Denney and Tewskbury (2013, p.218)
According to the American Psychological Association (in Meesala, 2014, p.4 from APA 2010)“authors of literature review evaluate a body of literature by identifying relations, contradictions, gaps, and inconsistencies in the literature and by suggesting the next step needed to solve the research problem”

The review of literature pertaining to the study “*Development* of STEAM based model curriculum on selected concepts for grade 3 children” is reviewed under the following headings: -

2.1 Prevalence of STEM based curriculum

2.2 Effectiveness of STEM based curriculum

2.3 Integration of Science in STEM Curriculum

2.4 Integration of Mathematics in STEM curriculum

2.5Problem based learning approach in STEM curriculum

2.6 Innovation of STEM based curriculum

2.7 Teacher and Parent Perspectives on STEM based learning

2.8 Gaps in research

2.1 Prevalence of STEAM based curriculum

According to Falloon G, Stevenson M, Ki B, Fraser S, Geiger Vincent, 2021, the study on building STEAM in school, Building STEM leadership capacity was the goal of the Principals as STEM Leaders (PASL) project, a national research and professional learning program for principals supported by the Australian Government. Six learning modules were delivered in clusters as part of the initiative, and case studies describing various school approaches to STEM leadership and education were produced. This article examines the elements that went into creating the STEM profiles of four distinct schools, highlighting the distinctive methods and leadership techniques each used to create STEM curricula that catered to the various learning requirements of their student body. It places these schools' efforts in the context of the larger PASL professional learning program, contributing to the scant empirical literature that describes the various ways in which schools address the "STEM challenge," which, in the majority of cases, represents a disruptive innovation to established curricula and structures. A recurring theme in all of the cases was the critical role played by school leaders in articulating a coherent, fact-based STEM vision as well as "walking the talk" and actively participating in STEM initiatives. This helped to mitigate the problems of a strict curriculum and external evaluation requirements to some extent by fostering relational trust and a strong dedication to and understanding of STEM throughout the entire school. The study emphasizes how creating cutting-edge STEM programs in schools requires a complex interplay between professional learning, leadership, curriculum design, pedagogy, and school culture.

Handelsman J, Elgin S, Estrada M, Hays S, & Johnson T.2022, explores how to achieve STEAM diversity to fix the classroom. In order to attain equity in STEM fields (science, technology, engineering, and mathematics), it is imperative to draw and retain a diverse student body in higher education. Change has been sluggish despite cries for action for decades. Rather than addressing the classroom issues that result in many students dropping out of STEM programs, recommendations have mostly concentrated on minority group members themselves. STEM will not change if these obstacles are not removed, even with financing and initiatives targeted at underrepresented populations. Rather, we need to make changes in the classrooms that deter many students from historically marginalized communities (HECs) from pursuing careers in STEM. In order to bring about change on a large scale, we list the areas that require attention and suggest actions that educators, academic administrators, and governmental organizations might do. For every background students this evidence based classroom practices is beneficial.

Elizabeth Mary, Alvarez V, Tacket M, Leon Isabela & Ramanujam A. 2020, examines design thinking based STEAM learning and they resulted on achieving scale and sustainability through the ignite model. Critical thinkers, creative innovators, and problem solvers are needed to find solutions to the world's most serious problems. However, resources for comprehensive STEM design-thinking courses at the basic and secondary school levels are frequently lacking in rural communities across the globe. Ignite is a cutting-edge approach to STEM education that offers a framework for applying design thinking to overcome this imbalance. As a result of the advancement of technology, students are better equipped to comprehend the sustainable development goals (SDGs) and can draw connections or firsthand experience with community or health-related issues. The fundamental formula for any Ignite program is as follows: (1) students acquire a particular set of engineering skills; (2) students apply the human-centered design process in teams; and (3) students use the engineering skills to produce a solution for a (SDG). In a Duke University course on design-thinking biomedical engineering, Ignite started with just four undergraduate students. Since 2017, 79 more students from Guatemala and the United States have trained as trainers and have taught over 1,500 students in 16 different schools in Guatemala using an evidence-based peer-led co-learning model. Preliminary data indicates that the program has a positive effect on students' perceptions of STEM at the first school where Ignite was launched, Instituto Indigena Nuestra Senora del Socorro (IINSS). Based on initial data, it appears that this program is sustainable and scalable because of its student-led, peer-led learning approach and because FUNDEGUA, a local partner, is overseeing the local implementation of Ignite in Guatemala.

Murphy C, Venkat H, Leahy M, & Broderick N in 2023, National Council for Curriculum and Assessment (NCCA). The main conclusions from curriculum- and literature-based overview of primary STEM integration, as well as our comprehensive literature analysis of learning in primary science education, are outlined in this Executive Summary. The reports, draft curricula, and literature bases related to the main issue consulted in these documents serve as the foundation for the Primary STEM integration overview. A comparative examination of a sample of worldwide curricula is also utilized for the overview of digital technologies. The Primary Science Education literature study is based on a comparative analysis of the structure and science content found in the same sample of international curricula, which led to a systematic review of pertinent, internationally peer-reviewed research articles from the past 10 years. Any endeavor to connect or integrate two or more STEM courses is referred to as integrated STEM (iSTEM) throughout the study.

Larkin K, & Lowrie T in 2023, explains teaching approaches for STEM integration in pre and primary school. Over the past five years, a number of literature reviews and meta-analyses have examined different facets of STEM education; however, they have focused on certain areas of STEM, such as digital games, robotics, early childhood education, or teacher perspectives. Furthermore, no comprehensive assessment of STEM integration has been carried out in the last ten years. The results of a Systematic Qualitative Literature Review on STEM education for kids in formal education settings, ages 4 to 12, are presented in this paper. The article first gives a summary of the descriptive findings from the 60 research publications that are considered for analysis, together with information about the research environment, participants' ages, dates and countries of study, and research procedures utilized.

2.2 Effectiveness of STEAM based curriculum

Anwar S, Menekse M & Guzey S, in 2022, conducted a study to assess the effectiveness of an integrated STEM curriculum unit on middle school students, life science learning. Calls for change in K-12 science education and the National Academy of Engineering's Grand Challenges for Engineering in the 21st Century highlight the importance of enhancing science teaching, engaging students, and improving learning. In this study, we created and put into action a curriculum unit for sixth-grade students (totaling 1305 students). The curriculum unit blended science and engineering content and activities to teach about ecology, water pollution, and engineering design. We examined how effective this integrated STEM unit was in enhancing students' science learning outcomes through pre-, post-, and delayed post-assessments. We gathered data from both pre- and post-assessments for students in the baseline group (using the district-adopted curriculum) and the intervention group (using the integrated life science and engineering curriculum). By comparing the two groups, we discovered that the intervention group showed better science learning outcomes. Additionally, the intervention group students retained science knowledge even after 8 weeks of instruction. Our analysis also considered students' gender and People of Color (POC) status. Overall, this study demonstrates the positive impact of an integrated STEM curriculum focused on engineering design and practices in enhancing students' science learning outcomes.

Gunawan S& Jen C in 2020, explores the effect of application of stem curriculum integration model to living technology teaching on business school students. In order to help students learn more effectively by integrating different subjects and teaching methods, there is a focus on using team teaching and cooperative learning to teach various topics in a more integrated way. However, it has been found that subject-specific teaching is still common in the field of living technology education. By integrating and applying the knowledge learned in class, students can improve their problem-solving skills. To achieve the research goals and test hypotheses effectively, a non-equivalent test experimental design was used in this study. The study focused on 312 business school students at Parahyangan Catholic University (UNPAR) in Indonesia. The research findings are as follows: 1. The STEM curriculum integration model has a significant impact on learning outcomes. 2. The STEM curriculum integration model has a notable effect on learning improvement. 3. Living technology teaching has shown significant impacts.

Nihra M, Said M, Tasir Z & Mustafa N in 2016 had done a meta-analysis on effective strategies for integrated STEM education.Their study concluded that Reforming STEM education is crucial for the country to stay competitive in the global economy. In the past, STEM subjects were taught separately, making it difficult for students to apply their knowledge to real-world problems. Integrated STEM education has shown to improve students' problem-solving and critical thinking skills. This study focused on the teaching strategies used in integrated STEM education. The research method involved reviewing literature from sources like ERIC, Science Direct, and SpringerLink. Keywords like integration strategies, science and technology, and STEM in education were used. The study found that project-based learning is the most effective strategy in implementing STEM education, helping students develop skills needed to succeed in a knowledge-based society. Educators new to STEM education can use these findings to explore how project-based learning can be incorporated into their teaching.

Havice W, Waugaman C, Walker K & Havice P in 2018, explained that The combination of science, technology, engineering, and mathematics (STEM) education, known as integrative STEM education, is a new way of teaching that brings together different subjects like math, science, and engineering. This approach uses engineering design to help students learn. In the past 11 years, 475 teachers and school administrators from South Carolina have taken part in a program called the Integrative STEM Education Institute. During the program, they learned how to create and use integrative STEM activities in their classrooms. They also learned how to use problem-based and project-based learning to help students work together and learn different skills. The goal of this article was to see how well the program worked and how it helped teachers and students.

According to Cetin A, in 2020 by examining project based stem training in a primary school Cetin concluded that The study used a qualitative research design called phenomenological design. The participants were 18 students and 2 teachers from a state primary school in Anatolia during the 2017-2018 school year. Data was gathered through interviews, some of which were recorded, and analyzed using content analysis. The findings showed that for STEM practices to be successful, a structured plan with preparation, implementation, and evaluation stages is necessary. Additionally, STEM training helps students discover their talents, improve critical thinking and problem-solving skills, and enhance manual dexterity. The study also indicated that these practices are beneficial for students.

Tsai Fu, Sheng H, Chao K & Yi K in 2021 conducted a study on development and effectiveness evaluation of stem based game design project for preservice is primary teacher education. This study aimed to address the lack of technology education content knowledge in Taiwan's primary teacher education by creating a STEM-based game-design project. The project focused on helping preservice primary teachers learn computational thinking concepts in a teacher education course. The preservice teachers were required to develop a two-player educational game for primary students, using Scratch and Arduino microcontroller boards. The games were tested by primary students and revised based on their feedback. Pre-tests and post-tests were conducted to evaluate the participants' improvement in knowledge and attitudes. The results of the research show that the project not only helped preservice primary teachers create educational games and Arduino-based game controllers, but also improved their understanding of computational thinking concepts, energy knowledge, and programming attitude. The majority of preservice primary teachers involved in the study expressed satisfaction with the project activity.

2.3 Integration of science in STEAM Curriculum

According to Kubat U, 2018, the study of integration of steam into science classes aims to explore how science teachers incorporate science, technology, engineering, and mathematics (STEM) into their lessons. It also seeks to understand the advantages and disadvantages they have encountered while integrating STEM, as well as the challenges they face during the implementation process. To achieve these goals, researchers developed a semistructured interview form and utilized a qualitative research approach. Rather than teaching the four disciplines independently, STEM emphasizes a holistic and interdisciplinary approach. The study involved 12 science teachers in Mugla during the 2017-2018 academic year. Findings indicate that while teachers have a positive outlook on using STEM activities, they struggle to implement them effectively due to issues with physical conditions and time management. Educators noted that STEM education motivates students to conduct research.

Ultay N, Zivali Arzu, Hilal Y, Yilmaz K & Topatan M in 2020,explained that Their research focuses on how teaching the grade 3 science unit “Let’s Know the Matter” along with STEM activities impacts student academic success. The study included 24 third grade students in the 2019-2020 school year. The teaching method used was the 5E model (enter, explore, explain, elaborate, evaluate), and student feedback on the STEM activities was gathered. A pretest-posttest research design was used, where the “Let’s Know the Matter Test (MT)” was given at the beginning to assess students’ prior knowledge and again at the end to see what they had learned. Student opinions on the STEM activities were collected through interviews. The qualitative data were sorted into different categories based on common themes. The results showed that the 5E instructional model had an impact on student learning.

Taconis R, Gresnigt R, Keulen H & Baartmaan L in 2014, conducted a study on promoting Science and technology in primary education. Combining different subjects in school seems like a good idea for focusing more on science and technology in elementary education. Understanding the pros and cons of this approach could help improve the curriculum. This study looked at integrated curricula in elementary schools from 1994 to 2011. We sorted the integrated curricula into different types based on existing research. We focused on important factors like what students learn and how successful the integration is. A group of experts helped analyze the data and test our initial thoughts. We found that the success of the integration was tied to how much students and teachers learned, how excited they were about the subjects, and how committed the teachers were. The level of teacher commitment, the time spent on the new approach, the level of training needed, the support for teachers, and the challenges of blending with traditional curricula were all important. Most projects successfully increased the time spent on science in school. Our model solves the problem of defining integrated curricula and gives a clear guide for making decisions about implementing this type of education.

2.4 Integration of Mathematics in STEAM curriculum

Jeon S & Star J in 2024 explores disciplinary and inter disciplinary education in stem. In this study we discuss the importance of combining math and science in STEM education, despite the obstacles it may bring. We examine ways to tackle these challenges, particularly by using mathematical modeling, scientific modeling, and computational modeling. To show how math can be used in science classes in a well-rounded curriculum, we introduce EcoMOD, a virtual reality STEM program for elementary students. Our analysis reveals that EcoMOD effectively blends math and science by incorporating modeling, and it also works to address integration difficulties through its curriculum, design, and teaching assistance.

Margaret M & Nite S, in 2014 addresses their study on stem integration in mathematics standards. Middle school STEM curriculum can help students transition to more advanced science, technology, engineering, and math classes in high school. Students who are exposed to this type of curriculum are more likely to pursue STEM majors in college and eventually work in a STEM field. Four middle school math standards were reviewed to see how they incorporated STEM: NCTM Principles and Standards for School Mathematics, Texas Essential Knowledge and Skills (TEKS), Common Core State Standards for Mathematics (CCSSM), and Texas College and Career Readiness Standards (TCCRS). The study looked for instances where 2 or more STEM subjects were combined, real-world problems that required multiple STEM subjects, and project-based learning activities. The NCTM standards clearly showed STEM integration. While the CCSSM did not emphasize STEM integration in content, it did include it in mathematical practices. The TEKS mentioned STEM integration more than the CCSSM, and the TCCRS strongly supported combining subjects, including non-STEM ones.

According to Stohlmann M, in 2020, Many high school math teachers struggle to effectively integrate STEM concepts into their classrooms, which can hinder students' motivation and achievement. To address this issue, I propose a focus on integrated STEM education, specifically emphasizing the integration of mathematics. By incorporating STEM subjects with a focus on math, students can experience increased motivation, interest, and success in the classroom. Additionally, this approach can better equip students with the necessary skills and knowledge to make positive contributions to society. This article explores three strategies that high school math teachers can use to implement integrated STEM education, including using open-ended problems in engineering design challenges, mathematical modeling, and incorporating technology into math lessons. By utilizing these methods, students are more likely to find mathematics meaningful and valuable. Various examples and common instructional elements are provided to support the implementation of integrated STEM education in the math classroom.

According to Tezer M, in 2019, the role of mathematical modelling in stem integration and education explains that With the advancement of technology, the workforce in society has shifted, and creative engineering applications have become prominent in the age of informatics. As a result, the education levels of the workforce have also evolved. The STEM education model in many countries focuses on teaching science, math, technology, and engineering from primary school to higher education. STEM education has become increasingly important in our country, playing a key role in developing new skills, fostering creativity, innovation, and entrepreneurship, as well as enabling individuals to switch between professions and adapt to new jobs. In today's world, technology demands diverse skills from individuals working in various fields due to rapid advancements. Different teaching strategies, such as mathematical modeling, are crucial in integrating STEM education. Mathematical modeling involves analyzing real-life situations using mathematical methods. The use of mathematical modeling cycles in STEM education at all levels has gained significance in recent years as it enhances students' motivation and improves their learning through focused attention.

Hassan M, Abdullah A, Ismail N, Suhud S, & Hamzah M in 2019 conducted a study on mathematics curriculum Framework for early childhood education based on STEAM.These days, there is a growing focus on adding Science, Technology, Engineering, and Mathematics (STEM) education to school curriculums all over the world. Many researchers in early childhood education have talked about how important it is for kids to start learning STEM subjects at a young age. But in Malaysia, there aren't many programs or standards in place yet for teaching STEM to young children. That's why this study is aiming to create a framework for teaching math to three- and four-year-olds that's based on STEM.

The math curriculum and activities in this study were made using the ADDIE model, with input from eight experts and teachers. These individuals were given evaluation forms to share their thoughts on the new math curriculum.

2.5 problem based learning approach in STEM curriculum

Widowati C, Purwanto A & Albar Z in 2021 conducted a study aims to investigate how incorporating problem-based learning in STEM education can enhance the environmental understanding of elementary school students. The research approach is qualitative and involves reviewing literature. By searching various journals such as Science Direct, Science Education Journal, ERIC, and using keywords like Problem-Based Learning, Science, Technology, Engineering, Mathematics (STEM), environmental literacy, and scientific literacy, a total of 3,298 journals were found. These included 2016 journals from Sciencedirect, 873 journals from ERIC, and 49 journals from the Indonesian Science Education Journal. After the search process, 8 relevant journals were selected, analyzed, and summarized. These journals mostly highlight the effectiveness of integrating Problem-Based Learning in STEM education to enhance student literacy. The approach involves identifying environmental issues, generating ideas, solving problems, creating solutions, and testing them. It is believed that this method is successful in improving students' knowledge and attitudes. Overall, the literature review suggests that integrating STEM education with the PBL learning model can positively impact environmental literacy in elementary school students.

Dischino M, A James, Donnelly J Massa N, Hanes F, in 2011 addresses in their study that Problem-based learning (PBL) is a way of teaching where students work together to solve real-life problems, helping them learn actively. PBL has been used in medical education for a long time and is now being used in science, technology, engineering, and math (STEM) education as well. Studies have shown that PBL helps students learn better and remember more, improves their critical thinking and problem-solving skills, teamwork, and the ability to use what they've learned in different situations – all important skills for doing well in the workplace today.

According to Smith K, Maynard N, Berry A, & Spiteri T in 2022, conducted a study on principles of problem based learning in stem education using expert wisdom and Research to frame educational practice. The study explains that Helping teachers improve their knowledge, skills, and confidence in Science, Technology, Engineering, and Mathematics

(STEM) education is crucial for fostering a culture of innovation and productivity in society. It is important to develop STEM literacies that involve the ability to recognize, apply, and combine concepts from STEM areas to understand complex issues and create innovative solutions. However, teachers have pointed out a lack of examples of STEM integration as a barrier to successfully implementing integrated STEM education in schools. Problem Based Learning (PBL) has been used in higher education as an effective way to learn in STEM fields and could be a valuable method to integrate knowledge and skills across STEM subjects in school-based STEM education. To make PBL beneficial for STEM education in schools and enhance teachers' ability to teach STEM, it is essential to have a better understanding of this approach. This article aims to establish a set of principles for supporting a PBL model of STEM education in schools by drawing insights from literature and expert focus groups of PBL professionals. The analysis of data revealed four key principles of PBL: (a) adaptable knowledge, skills, and abilities; (b) active and strategic metacognitive thinking; (c) collaboration driven by internal motivation; and (d) problems rooted in real and meaningful contexts. The findings of the study offer evidence-based assistance for teachers who are considering implementing a PBL approach in school-based STEM education.

The study conducted by Laforce M, Noble E, & Blackwell C in 2017 explores In response to concerns about the future of the U.S. economy and workforce, educators and policymakers are focusing more on getting more students interested in, qualified for, and actively pursuing careers in science, technology, engineering, and mathematics (STEM). A recent study looked at survey responses from 3852 high school students in STEM schools across the U.S. to see how project- and problem-based learning (PBL) could help with this goal. The study found that students who rated PBL highly were more likely to be interested in pursuing a STEM career, have a strong intrinsic motivation for science, and believe in their abilities in both science and math. The study also showed that students' interest in a future STEM career was influenced by their intrinsic motivation for science and their beliefs in their abilities, which were both affected by their experiences with PBL. These findings suggest that PBL can play a key role in increasing students' positive attitudes towards STEM and their interest in pursuing STEM careers. This study, one of the few of its kind, offers important insights for educators, school leaders, and policymakers looking for effective ways to encourage students to choose STEM careers.

2.6 Innovation of STEAM based curriculum

Garner P, Gabitova N, Gupta A, & Wood T in 2018, through cultural studies of science education explains the development of an after-school and summer-based science, technology, engineering, and mathematics curriculum infused with the arts and social emotional learning content (STEAM SEL). Its design was motivated by theory and research that suggest that STEM education is well-suited for teaching empathy and other emotion-related skills. In this paper, we describe the activities associated with the development and design of the program and the curriculum. We provide expert-ratings of the STEAM and social emotional elements of the program and present instructor and participant feedback about the program's content and its delivery. Our results revealed that infusing the arts and social emotional learning content into science education created a holistic STEM-related curriculum that holds potential for enhancing young children's interest in and appreciation for science and its applications. The data also suggested that the program was well-developed and, generally well-executed. However, experts rated the STEAM elements of the program more positively than the SEL elements, especially with regard to sequencing of lessons and integration among the lessons and hands-on activities, indicating that program revisions are warranted.

According to Anderson J, Tytler R, & Williams G in 2022, In response to worries in Australia about how students feel and their decreasing interest in STEM subjects during their last years of high school, various programs have been created to help teachers come up with new and creative STEM lessons. The STEM Academy program teamed up with groups of high school teachers who teach STEM subjects to improve their ability to make challenging, real-life problems that would interest and inspire their students. A study was done using surveys and interviews with 70 teachers from twelve schools, three program leaders, and school administrators to learn more about the experiences, the program's role, and the different ways schools are changing their STEM lessons. By using an innovation framework, the researchers were able to understand how teachers were improving their STEM teaching methods to make them more effective and long-lasting. This led to the discovery of three models that showed different ways of approaching the challenge of including STEM in regular school subjects.

Watters J & Christensen C in 2014 explained that Governments have realized that technology trades depend on knowledge from science, technology, engineering, and mathematics (STEM) fields. However, there is strong evidence showing that students are losing interest in these subjects in schools because they feel the curriculum is not relevant. This has implications for both vocational education and higher education. In this study, we share initial findings on the creation of two curricula that aim to combine science and math with workplace knowledge and practices. We believe these curricula offer educational opportunities for students to follow their desired career paths. These curricula were developed jointly by industry and education professionals in the mining, aerospace, and wine tourism sectors. The goal was to provide relevant knowledge for students transitioning from school to the workplace as trade apprentices in these industries. An examination of the curricula and related policy documents shows that they focus on practical skills through applied learning methods in teaching and assessment. While important scientific and mathematical concepts are included, the incorporation of workplace knowledge varies between the curricula. The level of practical applications in the models depends on factors such as the teacher's industry experience. Our findings emphasize the need for teachers with significant practical industry knowledge and the role of school policies in aligning learning experiences with industry requirements.

Ling Tan & Foong Leong in 2014 explained that Specialized science, technology, engineering, and mathematics (STEM) schools create niche areas in an attempt to attract the best students, establish the school status, and justify their privilege to valuable resources. One Singapore STEM school does this in applied science learning to differentiate its curriculum from the national prescribed curriculum. Reflecting on the issues of curriculum innovation from the perspective of a teacher and head of department in this school, the second author discusses the constraints in curriculum innovation in a specialized school context embedded within a larger system of the national curriculum. We reflect on her experiences in designing, planning, writing, and implementing applied science courses and the challenges in having to simultaneously address the standardized assessment guidelines.

Corlu M, Carpraro R, & Carpraro M in 2014 through their study on education and Science addresses that Improving education in Science, Technology, Engineering, and Mathematics (STEM) is crucial for Turkey's economic competitiveness. Some critics argue that Turkish teachers were not ready for the changes in teacher education. The authors of this article proposed a STEM education model after studying curriculum integration, STEM education, teaching knowledge, and educational reforms in Turkey. The model highlights the significance of combining mathematics and science in teaching to shift from traditional teaching methods to a more innovative integrated approach.

2.7 Teacher and parent perspectives on STEAM based learning

Aleksieva L, Mirtschewa I & Radeva S in 2021 conducted a study on preschool teacher' s knowledge, perspective and practices in stem education They explains Early STEM education can help children develop their knowledge by creating, discussing, and testing ideas to solve problems. Teachers play a crucial role in guiding children to think like scientists, mathematicians, engineers, and technology users by asking open-ended questions and encouraging them to test their theories. Preschool teachers’ understanding and perspectives greatly impact how they teach STEM and whether students meet the learning goals. It is essential to explore teachers’ thoughts and experiences to provide them with the right training and support. This study examined teachers’ beliefs about STEM education and how participating in a training program influenced them. The findings clearly show that preschool teachers need more training in STEM education and provide guidance on developing effective STEM courses for them.

Ampartzaki M, Kalogiannakis M, Papadakis S & Ginnakou V in 2022 eplores that Teachers, student-teachers, parents, artists, and STEM professionals were surveyed to gather their opinions on STEM, STEAM, female representation, and underachievement in STEM. The results showed that while some knew about STEAM, only a few had experience implementing it. Educators faced difficulties in understanding the methodological principles of STEAM and lacked educational resources. They also received limited support from policymakers and advisers. STEAM was seen as a way to enhance the curriculum with hands-on learning, improve critical thinking and communication skills, and benefit overall development. It was believed that STEAM could increase motivation and participation among girls and disadvantaged students. However, educators and parents acknowledged the challenges faced by disadvantaged students but seemed unaware of female underachievement in STEM subjects and careers.

According to Delahunty T, Prendergast M, & Ni Maire in 2021 Integrative STEM education is seen as a great way for students to learn important skills for the 21st century. In Ireland, there has been a recent focus on integrating STEM education from early years through primary school. However, there are concerns about barriers to truly integrating STEM subjects in schools. Teachers play a key role in the success of integrated STEM education, but they often face challenges due to overloaded curricula and a focus on individual subjects. Research is needed to understand how primary school teachers in Ireland view integrated STEM education. This study interviewed six teachers who were part of a STEM education module in their postgraduate studies. The teachers shared their thoughts on the potential benefits and difficulties of integrating STEM in their classrooms. The study will explore whether an integrated STEM model is realistic or just an idealistic concept.

Watson S, M Omah, Duncan W, Peters L, in 2022, through the research in Science and Technology education, explores the school administrator's perceptions of the district's or school's parental stem awareness, strategies to promote stem awareness and student stem preparation. The results showed that 71% of principals and 36% of superintendents think that K-12 parents do not know much about STEM (including STEM awareness in general). Specifically, K-12 administrators worry that parents are unaware of: (1) STEM opportunities available at school for their children; (2) the importance of getting involved in STEM activities with their children; and (3) the level of readiness required to get their children ready for STEM careers.In conclusion, this study highlights the need for more STEM awareness among parents of K-12 students. It also suggests that school administrators do not know how to improve STEM awareness and student preparation for STEM careers and college, which can have a negative impact on STEM teachers, students, and parents.

Simunovic M & Babarovic T, in 2020 explaines through the conducted study that In the field of science, technology, engineering, and mathematics (STEM) education, families are a valuable resource that can help students stay motivated and succeed. This paper looks at how parents' beliefs can shape their children's attitudes towards STEM subjects, drawing on the ideas of the Eccles model and the expectancy-value theory. We explore how parents' values and confidence in STEM, their views on their children's abilities in STEM, and their hopes for their children's success in STEM can all impact how well students do in these subjects. Research suggests that these beliefs can play a big role in students' motivation, performance, and career choices in STEM. The way parents talk to their children about STEM is really important, and studies show that parents' beliefs can affect how their children see themselves in relation to STEM. We also look at how parents' ideas about gender can influence their children's views on STEM and how this can affect their career choices. It's not clear yet how parents pass on their beliefs about STEM to their children, as researchers haven't focused much on how parents and children talk about STEM together. Finally, we suggest ways to help parents feel more confident about STEM and to challenge stereotypes about STEM careers and professionals. By understanding these issues better, we can improve how we study and support parents in helping their children succeed in STEM.

2.7 Gaps in research

After reviewing the literature it is clear that even though the incorporation of STEAM techniques into school curricula has received a lot of attention there is still a significant research gap concerning the sustainability and long-term effects of learning experiences for young children. Previous research has primarily concentrated on immediate results like motivation, awareness, engagement and learning gains. STEM education combines science, technology, engineering, and mathematics into a single curriculum, allowing students to learn all four subjects together. This approach helps students apply their knowledge to real-life situations, encouraging them to create, innovate, and discover. Research shows that students who embrace STEM education have greater chances of landing jobs at top companies and achieving their life goals while making a positive impact on the environment. Schools are important for teaching students. A person spends a large portion of their life attending school. STEM education helps kids develop skills like critical thinking, problem-solving, and creativity. They also learn how to use these skills in their everyday lives to make the world a better place.One of the key aspects of STEM education is its importance in developing critical thinking skills in students. When students are exposed to this type of education from a young age, they naturally become curious and innovative. This not only encourages them to ask questions but also empowers them to think critically.As their critical thinking skills improve, students also learn how to solve problems effectively. By introducing STEM education early on, children learn how to analyze problems and come up with creative solutions. Additionally, it teaches them to consider the bigger picture rather than focusing on small details.

METHODOLOGY

CHAPTER -3

METHODOLOGY

According to Kothari (2004), the research design is the plan that guides how the research is carried out. It lays out the steps for gathering, measuring, and analyzing data. The design also outlines the tasks that the researcher will perform.The methodology adopted for the study ***"Development of STEM based model curriculum on selected concepts for grade 3 children"*** gives under the following subheadings:

3.1 Selection of Area

3.2 Selection of Sample

3.3 Selection of the Tools

3.4 Development of Tools

- 3.4.1 Development of self-designed questionnaire to evaluate the current learning status of children and their approach towards STEM learning.
- 3.4.2 Development of a curriculum book for grade 3 children based on STEAM concept of SCRT syllabus (self-designed).
- 3.4.3 Tool to check the level of awareness of children on selected concepts during pre and post interventions.
- 3.4.4 Development of a checklist for expert evaluation.

3.4 Conduct of the Study

3.6 Analyses and Interpretation

3.1 Selection of Area

The one of the important aspects of the study is to choose the location for conducting and for the present research, Chottanikkara government vocational higher secondary school in Ernakulam district was selected. Because Ernakulam district is very important for preschool education. Ernakulam district is a key area for early childhood education programs because of its diverse population and strong educational history. Rural areas like Chottanikkara are especially known for having many early childhood education centers and other educational resources that cater to children from various backgrounds.

The current area situated within Ernakulam district, was selected as the study area for some reasons. First of all, Chottanikkara is well known but rural area that meets the educational needs of young children. Second the district is a perfect place to conduct research on lower primary education practices because of its accessible location and strategic location. Furthermore, the varied socioeconomic environment of Chottanikkara offers an excellent framework for researching the effects of intervention of STEAM based curriculum for grade 3 children across various demographic groups.

The school selected for the study , belongs to a rural area and rural people are provided with the knowledge and skills necessary to thrive in the modern economy thanks to education. It also helps to break down social barriers and empowers people to take on leadership roles within their own community. Primary school teachers are instrumental in implementing stem based instruction by using their expertise to create engaging, engaging lessons that meet each student's individual needs and abilities.

The present study focused on introducing STEM based curriculum in grade 3 children. Given the need and importance of providing a practical educational exposure to the students of government school in a rural area and the ease of access for researchers compared to other areas, it was chosen as the pre-eminent location for selecting a suitable sample.

3.2 Selection of Sample

The sample for this study comprises primary schools children enrolled of the grade 3 children in chottanikkara vocational higher secondary school. The participants were selected based on their age range (typically 8 years old) who follows SCRT syllabus.

The sampling method employed for the selection of samples is purposive sampling. Purpose sampling is 'used to select respondents who are most likely to yield relevant and useful data' (kelly, 2010) and is a way of identifying and selecting cases that will use limited research funds effectively (palinkas 2015).In this case, students are chosen based on their age, enrollment in current school and availability for participation in the study.

The sample chosen for the study consists of 30 children presented in both divisions of standard 3 in the school. The selection of these specific institution was based on their accessibility and willingness to participate in the study. STEM curriculum is the practical educational exposure under science, and technology which enables the children vocationally too so it has to be started from very early educational period and hence the standard 3 was selected for sampling. The SCRT syllabus was taken into concern due to the finding that most of the rural areas in the state follows that.

3.3 Selection of the Tools

Takona, (2002), characterized research methods as "essential tools to measure such variables as opinion, values, concepts, attitudes, perceptions, motivation, and so on," citing questionnaires and interviews as effective tools for conducting research in education. The tool used for the present study are as included:

1. Development of self-designed questionnaire to evaluate the current learning status of children and their approach towards STEM learning.
2. Development of a curriculum book based on selected concepts in SCRT syllabus (science and mathematics) of standard 3 (self-designed).
3. Development of checklist for evaluation of curriculum book by experts .
4. Development of a tools to assess the performance level of the students before and after the implementation of STEM curriculum :
   i) Questions based on their syllabus for pre and post-test of intervention
   ii) Checklist to evaluate the current learning outcome of children based on effectiveness, relevance etc.

3.4 Development of Tool

3.4.1 Development of Self designed questionnaire revaluate the current learning status of children and their approach towards STEM learning.

A self-designed questionnaire was developed to get the information of students light general profile, academic status, current learning methods, and there approach towards STEM learning.

The questions includes their name, type of family they belongs to, if they have a tuition for learning, the favourite subject, the time for learning each day, is interested in Computer Based learning, if excited in group work, are they accessible with activities based on the curriculum, the current status of learning method for mathematics and Science, etc respectively. The details based on these questions are analysed to get the chance of developing a STEM based curriculum booklet

3.4.2 Development of a curriculum book based on selected concepts in SCRT syllabus (Science and mathematics) of standard 3.(self-designed)

The publication of 'Exploring science and mathematics around : a comprehensive curriculum guide,' a primary school curriculum book, is an example of an all-encompassing approach to improving early childhood education. The stem curriculum guide seamlessly incorporates experimental principles into practical application with the intention of increasing engagement, motivation, and improved learning outcomes. The book begins with a brief summary of science experiments and mathematical learning methods, highlighting its benefits for early childhood education and providing teachers with some basic information. Then it offers a diverse range of activities that are carefully crafted to meet the developmental needs of young students, based on their academic needs, and are in accordance with scrt curriculum principles. Each activity comes with specific objectives and detailed instructions, making it simple for students and teachers to follow. This activity-based curriculum develops social and emotional skills in addition to academic skills, laying out a solid foundation for their future growth and success. To achieve this, play exploration, mathematical knowledge, science experiments, and social interaction are all integrated into the learning process.

3.4.3 Development of a tools to assess the performance level of the students before and after the implementation of STEM curriculum.

The self-designed pre and post-test of intervention was based on their learning concepts the test tool consisted of two category one for science and mathematics, each included with four lessons. There is two questions given under each lessons and to understand the previous and current performance level of students after the implementation of STEM based learning. Another evaluation were based on assessing child's engagement, comprehension of concept, learning outcome, acceptability and active interaction in STEM based activities. The results were noted so that the researcher could analyse the improvement and also test the efficacy of main tool: STEM curriculum guide.

3.4.4 Checklist for evaluation by experts (self –designed)

The self-designed checklist was developed by the investigator to understand the level of quality of the developed curriculum guide. It helps to collect the details about the relevance, attraction and effectiveness of the developed tool. It included table.

3.5 Conduct of study

Phase I: Development of self-designed questionnaire to evaluate the current learning status and approach of students towards STEM learning.

Phase II: Development of Curriculum book named "Exploring science and mathematics around: a comprehensive curriculum guide" based on selected concepts in SCRT syllabus of standard 3.

Phase III: The implementation if the STEM curriculum

Phase IV: The development of checklist for evaluation and evaluating its effectiveness.

Phase V: Development of a tool to assess the performance level of the students before and after the implementation of STEM curriculum.

Phase VI: Assessed the current level of performance after the implementation of STEM-based learning by teachers.

Phase I: Development of self-designed questionnaire to evaluate the current learning status of children and their approach towards STEM learning.

On the basis of the self-designed questionnaire a survey is done on 30 students in 3rd standard of Chottanikkara government vocational higher secondary school and the result is analyzed to get the current learning status of children.

Phase II: Development of curriculum book named " Exploring science and mathematics around : a comprehensive curriculum guide "

The self-designed curriculum book consists of different types of effective science experiments and mathematical activities based on the SCRT syllabus. The curriculum guide includes the materials required for the activities, the way of implementation, the learning outcome or the aim of the activity.

Phase 1I1:Implementation of the STEM Based curriculum

These activities being introduced to the children by one week of their regular school hours. Both the divisions of the Standard 3 students are taught the concepts in their text book based on several science experiments and mathematical activities.

Phase IV: Preparation of checklist and evaluation by experts and evaluating its effectiveness.

The checklist contained the evolutional means for quality of the developed curriculum guide in the aspect of relevance, attraction, effectiveness etc. is designed and the evaluation is done by 10 primary school teachers.

Phase V: Development of a tool to assess the performance level of the students before and after the implementation of STEAM based curriculum.

The self-designed pre-test was carefully arranged by the researcher in the class. The test tool consisted of eight questions for both science and maths subjects, taken two questions from each chapter to understand the performance level of each child. After the implementation of STEM-based learning. Another evaluation were based on assessing child's engagement, active interaction comprehension of concept , learning outcome, acceptability and social interaction through STEM based learning.

Phase VI: Assessed the current level of performance after the implementation of game-based learning.

- Gave primary school teachers a tour of the STEM curriculum book and instruction on how to use it in the classroom.
- Designed stimulating STEM learning exercises that adhered to their curriculum goals and were based on the books content.

- During STEM learning sessions, observed the development and engagement of students and made necessary adjustments to maximize effectiveness.
- Assessed the success of STEM curriculum book to the third standard students through observation, surveys and assessment of their learning outcome.

3.6 Analysis and interpretation

The figure given below depicts the research design of the study entitled *"Development of STEM Based Model Curriculum on Selected Concepts of grade 3 children "*

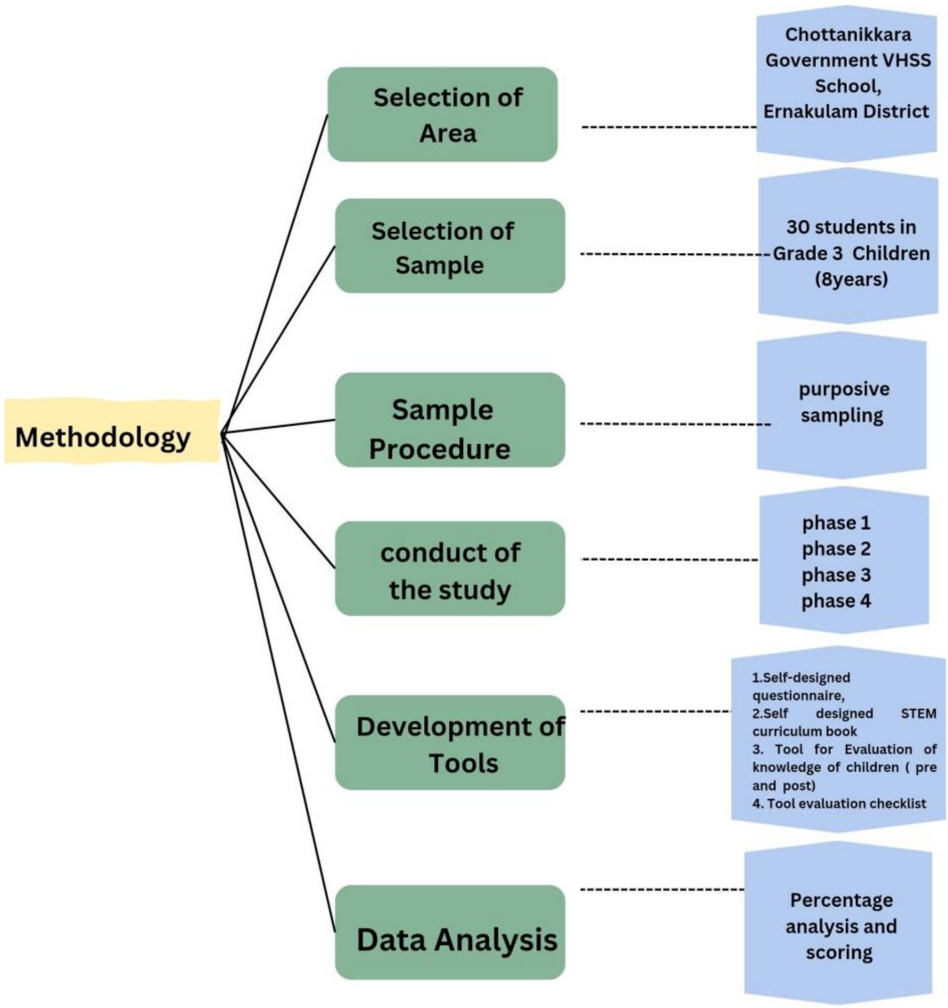

Fig.1 Research Design

RESULTS AND DISCUSSION

CHAPTER- 4

RESULTS AND DISCUSSION

The results obtained after the Analysis of data and its discussion is described in this chapter. For the ease of understanding and convenience as well, the results are discussed under the following headings:

4.1 Survey on standard 3 students to get the current status to implement STEM Curriculum

4.1.1 General information of respondents.

4.1.2 Academic details of the respondents.

4.1.3 Approach of Respondents towards STEM.

4.1.4 Methods used to learn Science

4.1.5 Methods used to learn Mathematics.

4.2 Evaluation of Evolved package by the respondents

4.2.1 Knowledge of the Respondents in Environmental Science

4.2.2 Knowledge of the Respondents in Mathematics

4.3 Development of STEM based Curriculum book for improving the learning outcome of the third standard students.

4.3.1 Development of tool

4.3.2 Evaluation of the developed tool by Teachers.

4.1.1 General information of respondents.

The table below depicts the general information of the selected children taken for the study.

Table 1

General details of Respondents

Sl. No	Particulars	Respondents	
		N=30	°/.
1.	Gender		
	• Male	15	50
	• Female	15	50
2	Have Siblings		
	• Yes	25	83
	• No	5	17
3	Type of Family		
	• Nuclear Family	17	57
	• Joint family	13	43.

It is evident from the table that half of the respondents were males and others were females. More than 80 percentage were having siblings and only sixteen percent of students were single children . About 56 percent of students belonged to nuclear family while only 43 percent were from joint family.

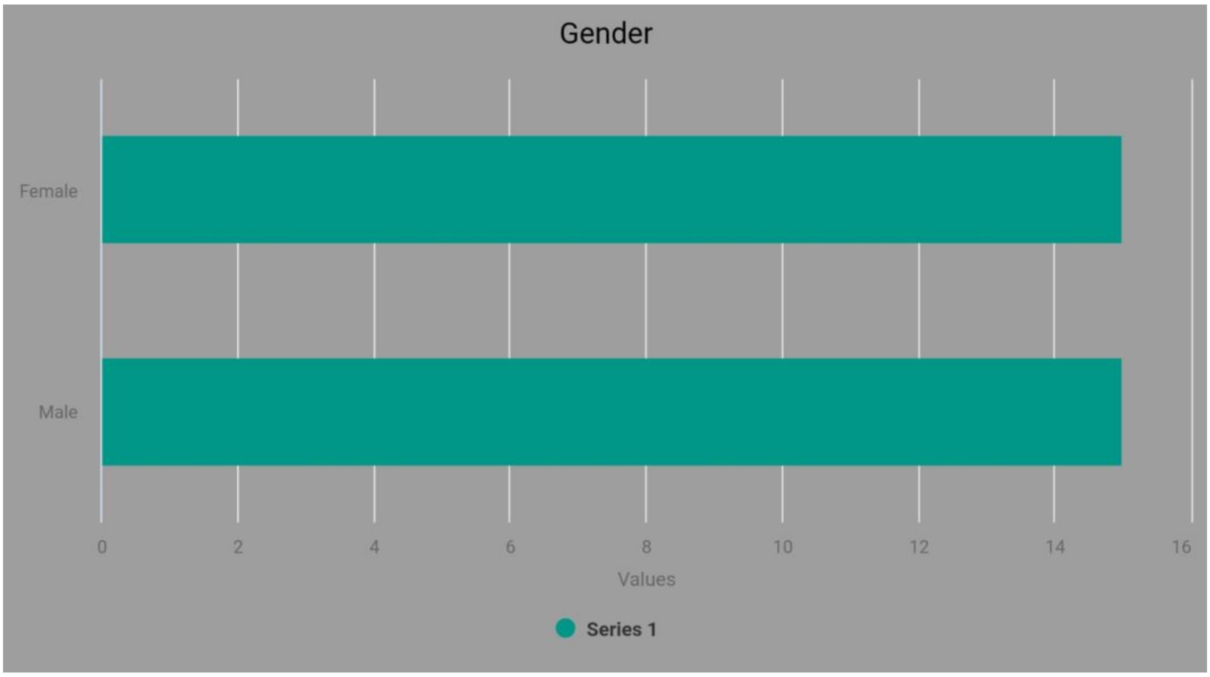

Fig 2 Gender of Respondents

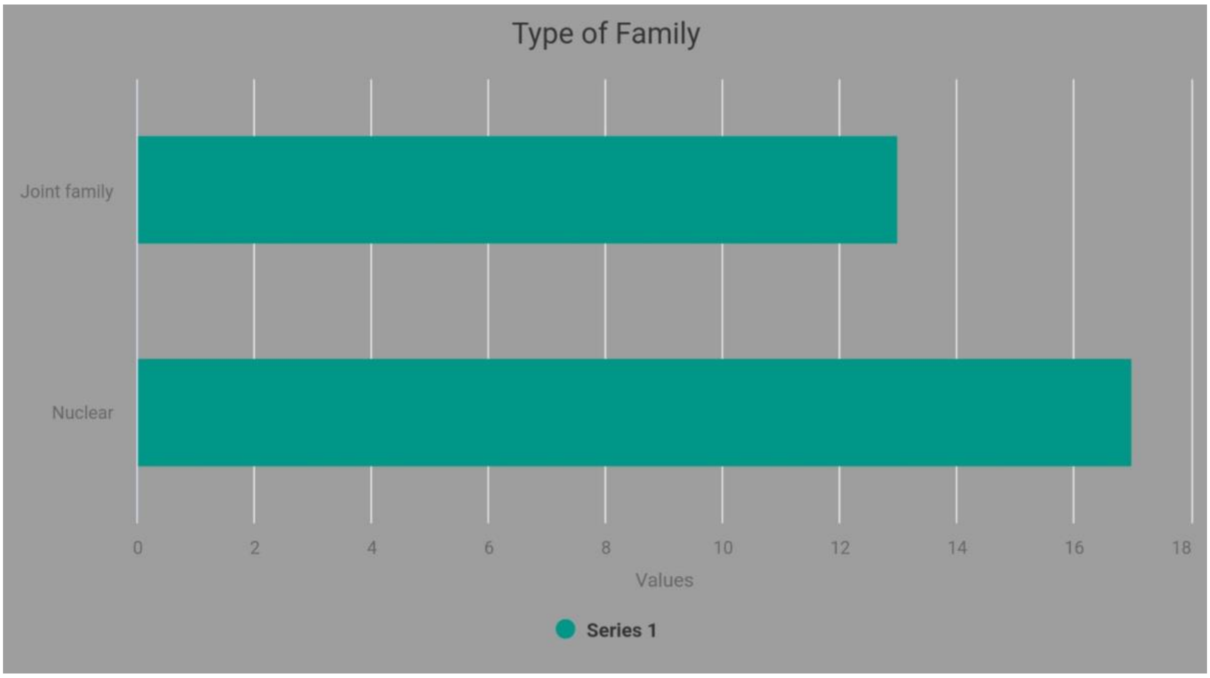

Fig 3.Type of family

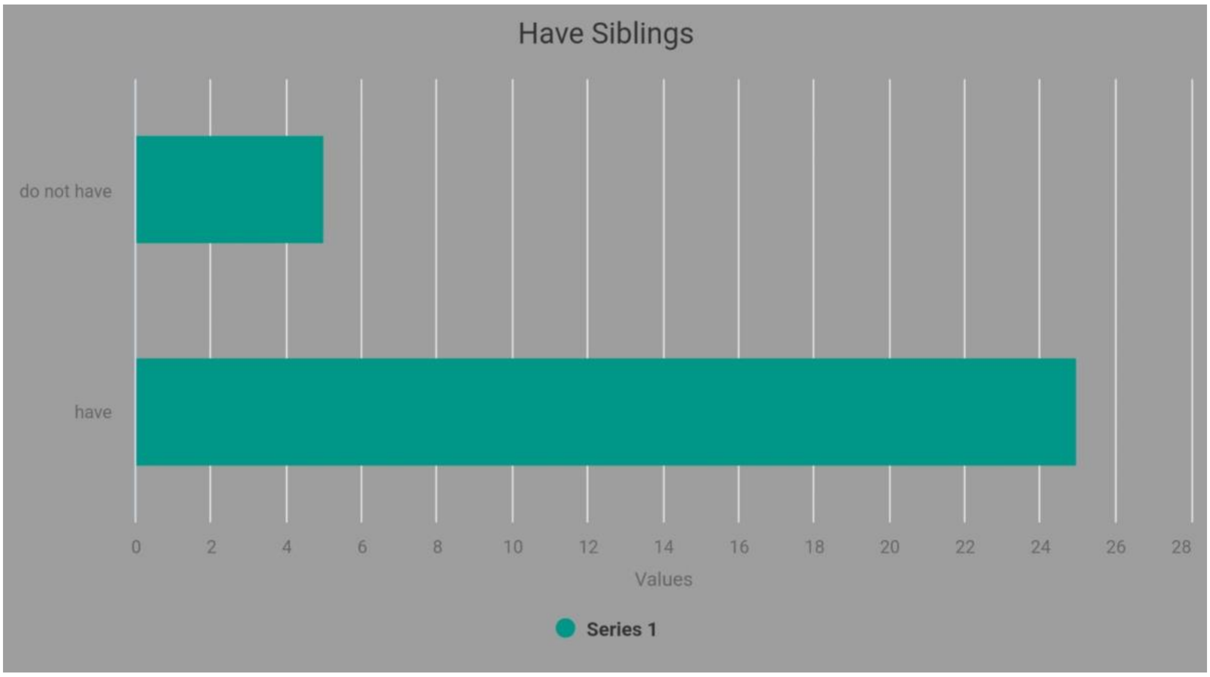

Fig.4 Respondents having siblings.

Numerous research in psychology and education support the idea that a child's interest in science is correlated with their family environment. For instance, a 2011 study by Maltese and Tai discovered that parental support and encouragement had a major impact on adolescents' enthusiasm in science. Furthermore, Lazarides and Buchholz's (2019) study emphasized the influence of cultural perspectives on education on kids' enthusiasm for learning and participation in science. You should have a strong basis for further exploration of this idea from these references.

4.1.2 Academic details of the respondents.

Academic details of the respondents are given in the table 2 and figure 2

Table.2

Academic details of Respondents

Sl. No	Particulars	Respondents	
		N=30	°/.
1.	Favourite Subject		
	• Mathematics	10	33
	• Science	8	27
	• Malayalam	6	20
	• English	6	20
2	Study Time		
	• 1-2 hrs	20	67
	• 3-6 hrs	10	33
3	Have Tuition		
	• Yes	16	53
	• No	14	47

The graph detailing the above information are:

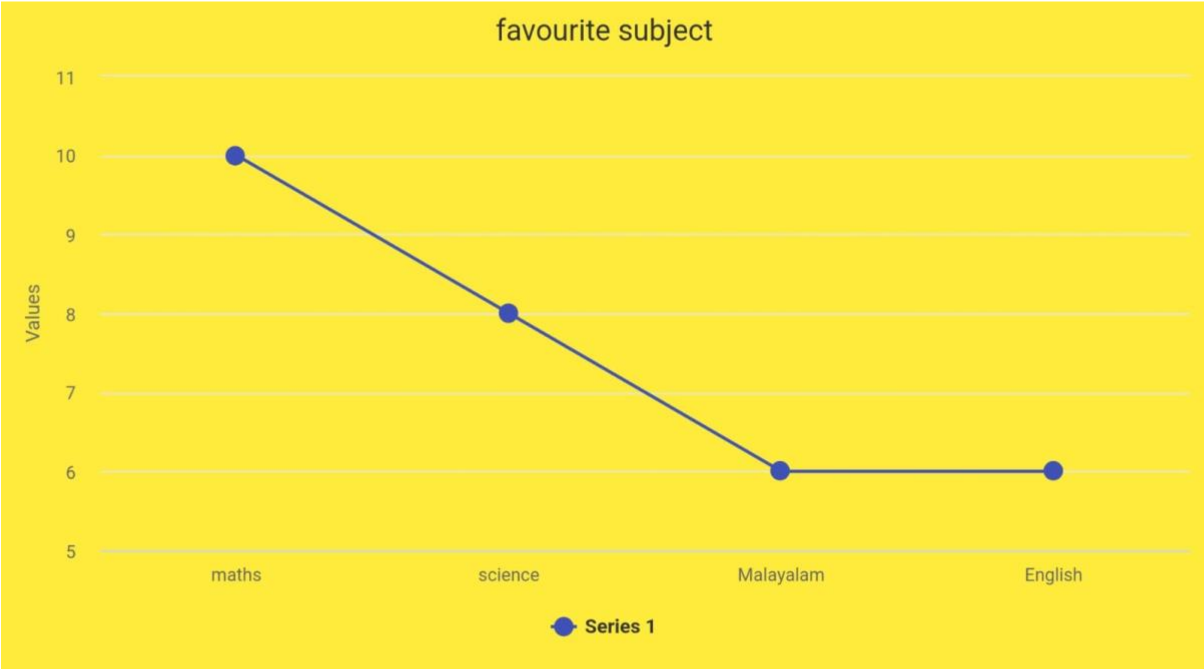

Fig.5 Favourite subject of Respondents.

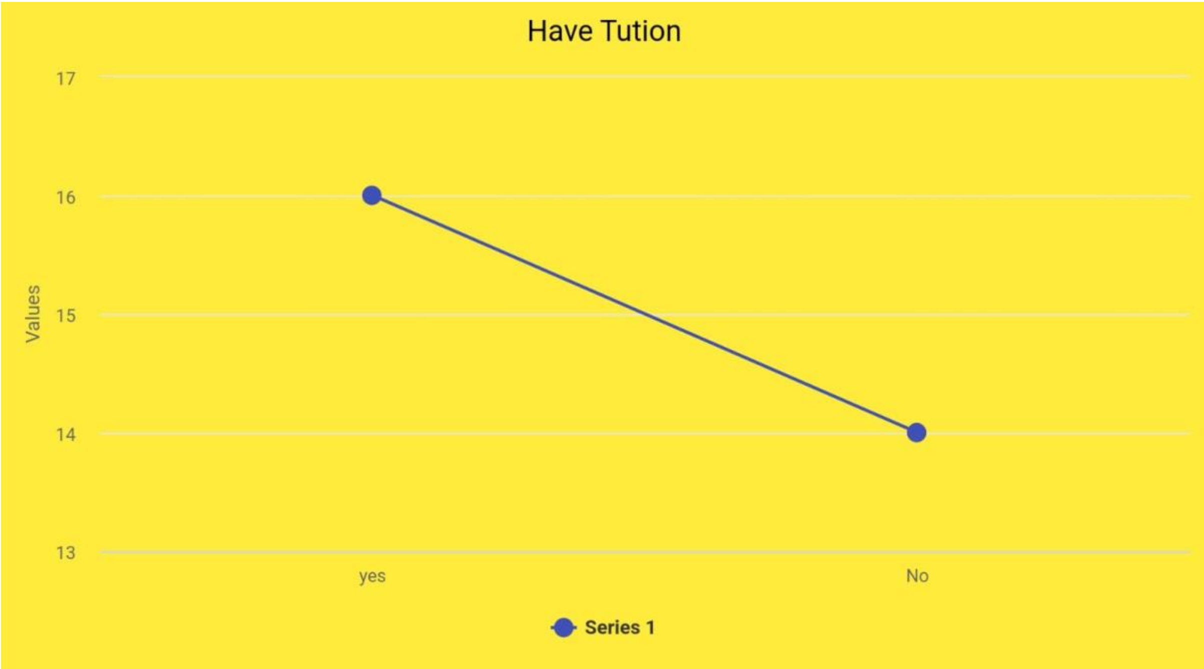

Fig. 6 Respondents having tution

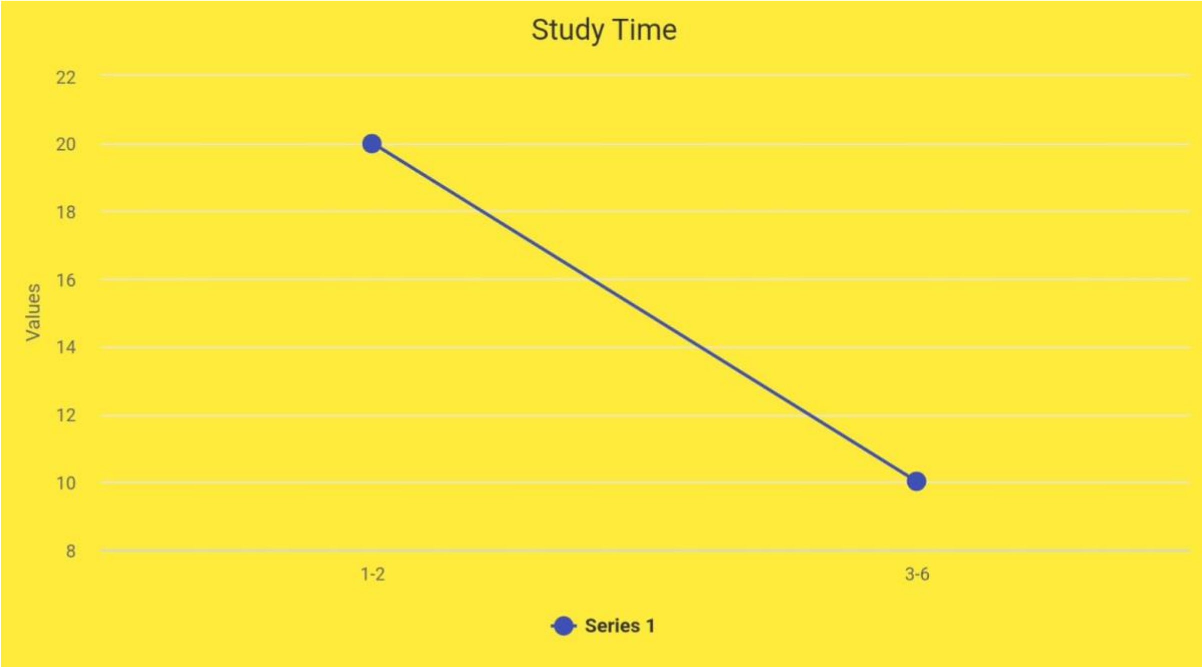

Fig. 7 Study time of Respondents.

The table and figure shows that among favourite subject studied, mathematics were preferred by 30 percent followed by science (27 percent). The language is Malayalam and English were preferred by only 20 percent for each. 67percent spent1-2 hours for study and 30 percent children spent 3 to 6 hours. 53 percent children under took tuitions for the study and the rest 47 percent doesn't.

4.1.3 Approach of Respondents towards STEM.

It can be evaluated that whether the children are positively approaching in current status to STEM based learning. The responses are given in table 3 and figure 3.

Table 3.

Approach towards STEM Learning

Sl. No	**Particulars**	**Respondents**	
		N=30	°/.
1.	Level of interest in science, Maths and Technology.		
	• Very good	18	60
	• Neutral	9	30
	• Not interested	3	10
2.	Engagement in science activities out of school		
	• Rarely	19	65
	• Monthly	6	21
	• Daily	4	14
3	Confident level to solve problem in maths		
	• Confident	10	35
	• Neutral	13	44
	• Not confident	6	21
4	Interested in group work to complete project.		
	• Yes	21	70

	• Sometimes	7	23
	• No	2	7
5	Feel about computers for learning		
	• Excited	22	74
	• Neutral	6	20
	• Don't prefer	2	6

The graph detailing the above information are:

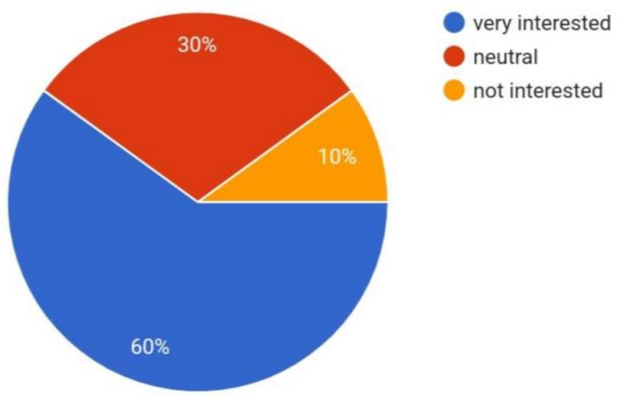

Fig. 8 : Level of interest in science, Maths and Technology

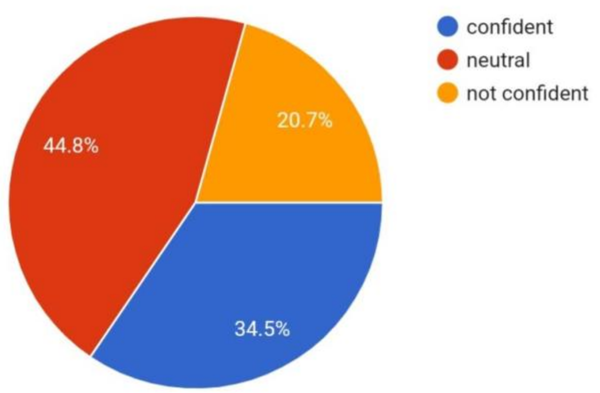

Fig. 9 : Confident level to solve problem in maths

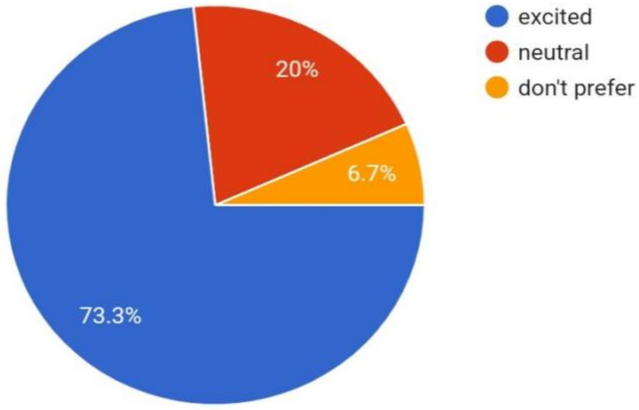

Fig .10 : Feel about computers for learning

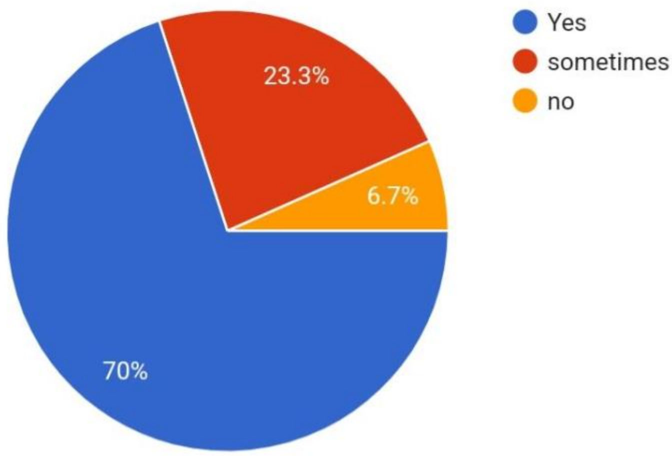

Fig. 11: Interested in group work to complete project.

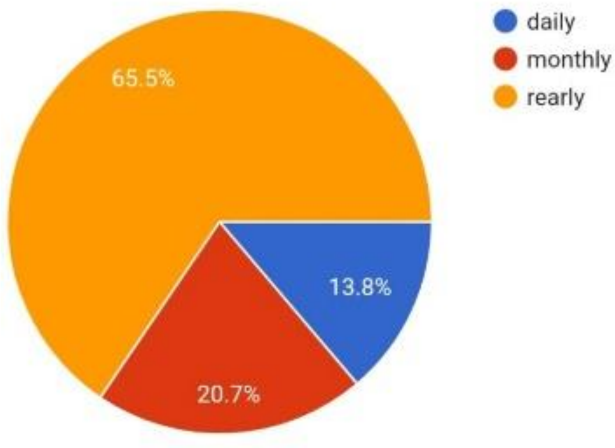

Fig .12 : Engagement in science activities out of school

Data on students' interest and engagement in science, math, and technology, as well as their confidence levels and preferences for group work and computer-based learning, are presented in the table. Level of Interest in Science, Math, and Technology: 60percent of respondents have a very good level of interest. 30percent are neutral. 10 percent are not interested. This indicates that most students have a positive interest in these subjects, with only a small percentage demonstrating disinterest.

Engagement in Science Activities Outside of School: 65 percent of students rarely engage in science activities outside of school. 21percent engage monthly. 14 percent engage daily. Interpretation: Most students are not heavily involved in science activities outside of school, with most engaging infrequently. Most students only occasionally participate in extracurricular science activities, rather than being significantly involved.

Math Confidence Level: 35 percent of students feel comfortable tackling mathematical challenges. 44 percent are indifferent. 21percent lack confidence. Interpretation: A considerable proportion of pupils exhibit neutrality or low confidence when tackling mathematical issues, suggesting a possible domain for enhancement or assistance. 70 percent of students are interested in working in groups to complete a project. 23 percent express sporadic interest. 7 percent say they're not curious. Analysis: Most students are amenable to and prefer working in groups to finish projects, indicating that a collaborative learning environment might be helpful. Seventy four percent of students are enthusiastic about utilizing computers for learning. Twenty percent are indifferent. Six percent don't think it's better about computer learning. A positive attitude toward technology integration in school is indicated by the majority of students' enthusiasm for using computers for learning. Overall, the data points to areas where kids may do better, such as confidence in solving arithmetic problems, even though they generally show a fair level of interest in science, math, and technology. Furthermore, students appear to support the development of collaborative learning settings and the use of technology in the classroom.

4.1.4 Methods used to learn Science

It is evaluated that what were the other methods or techniques used to teach children about the concepts in Science before the implementation of stem curriculum. The result of the study is detailed in the following table and figure.

Sl. No	Particulars	Respondents	
		N=30	°/.
1.	The concept of water		
	• Lectures	11	36
	• Discussion	2	7
	• Guided practice	5	17
	• Worksheet	4	13
	• Demonstration	8	26
2.	The concept of Soil		
	• Lectures	9	30
	• Discussion	3	10
	• Guided practice	6	20
	• Worksheet	5	17
	• Demonstration	7	23
3	The concept of colourful butterfly		

	• Lectures	11	37
	• Discussion	10	33
	• Guided practices	9	30
	• Worksheet	7	23
	• Demonstration	3	10
4	The features of Kerala		
	• Lectures	12	40
	• Discussion	4	13
	• Guided practice	6	20
	• Worksheet	7	24
	• Demonstration	1	3

Table 4. Methods used to learn science

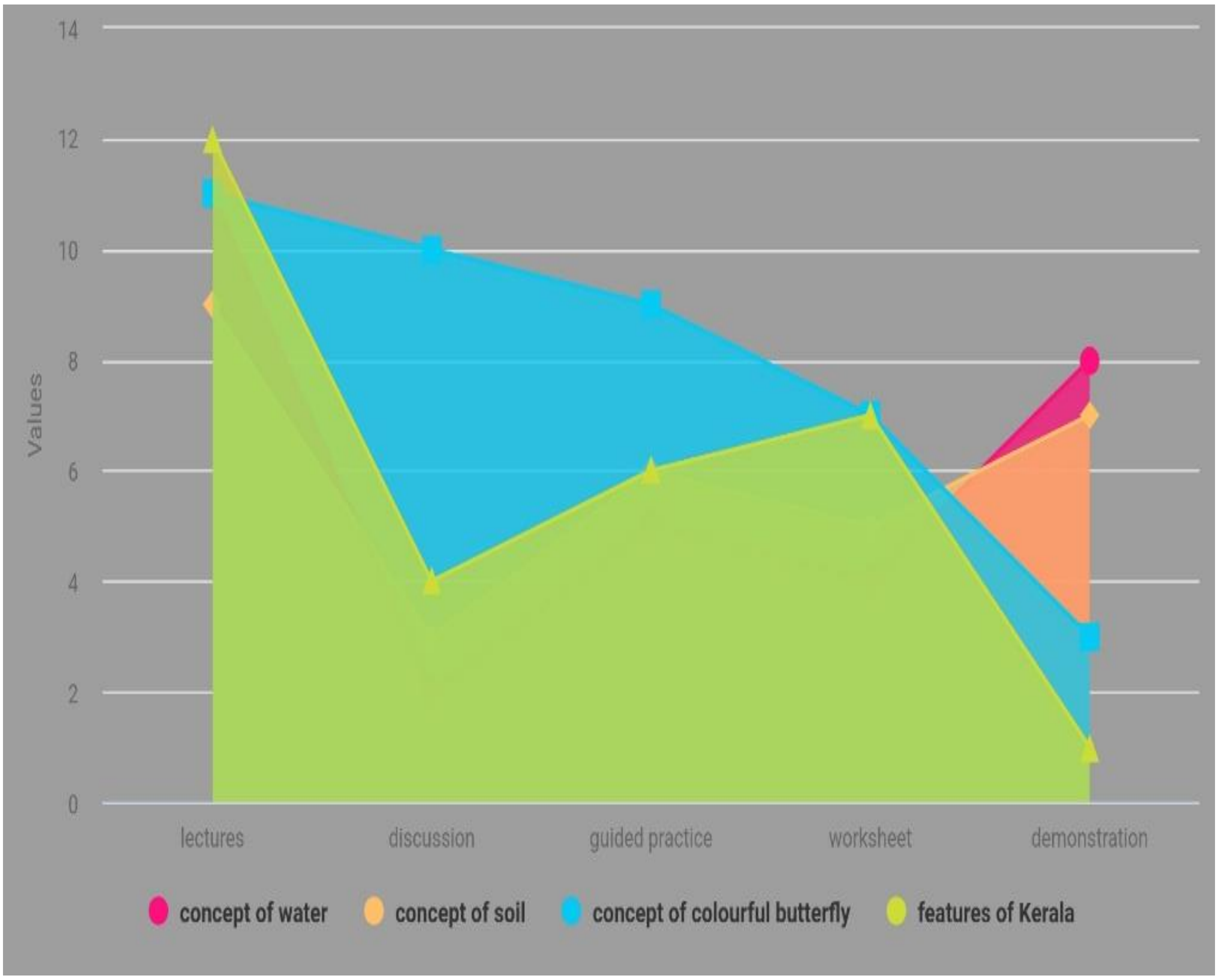

Fig. 13 Methods used to learn science

The table lists the teaching strategies applied for each of the four concepts—soil, water, colourful butterflies, and Kerala features across 30 respondents, along with the corresponding percentages. For all concepts, lectures were the most often used strategy; however, for colourful butterflies, conversations were more popular. The least number of demonstrations were used, especially for Kerala's characteristics.

Among the thirty respondents, 11 (or 36%) received their education on the concept of water through lectures. Discussion: Just 2 out of 30 respondents, or 7 percent said that their main teaching strategy was having talks. Guided Practice: Five respondents, or seventeen percent, reported having learnt via guided practice sessions. Worksheet: Four respondents, or thirteen percent, said they used worksheets as their main source of learning material. Eight of the thirty responders, or 26 percent of the sample, were given a demonstration. Overall, it illustrates how different teaching strategies are distributed and how well respondents understand the notion of water through each strategy's preference or efficacy.

Thirty percent students learned through lectures and 23 were based on demonstration and the remaining few in takers land the concept of soil through discussions, worksheets and guided practices. The concept of butterfly was learned by the students through lectures by 37 percent of them. 33 percent of students learn to discussion, 30 percent with guided practices and the rest few in takers studied through worksheet and demonstration. The features of Kerala was launched by the student mostly by lectures by 40 percent of them. While 25 percent learned through worksheets, and the remaining few for discussion, demonstration and guided practices. Overall, addressing kids' unique learning requirements and better preparing them for success in school and beyond can be achieved through the implementation of STEM curricula employing a variety of teaching approaches.

4.1.5 Methods used to learn Mathematics.

It is evaluated that what were the other methods or techniques used to teach children about the concepts in Maths before the implementation of stem curriculum. The result of the study is detailed in the following table and figure.

Sl. No	Particulars	Respondents	
		N=30	°/.
1.	The concept of Shape		
	• Solving problem	2	7
	• Explanation	5	17
	• Drawing on board	18	60
	• Observation	5	17
2	The concept of time		
	• By solving problem	15	50
	• Explanation	5	17

	• Drawing on board	3	10
	• Observation	7	23
3.	The concept of measurement		
	• By solving problem	11	37
	• Explanation	3	10
	• Drawing	7	23
	• Observation	9	30
4.	The concept of weight		
	• By solving problem	9	30
	• Explanation	11	37
	• Drawing	3	10
	• Observation	7	23

Table 5. Methods used to learn mathematics before

The graph detailing the above information

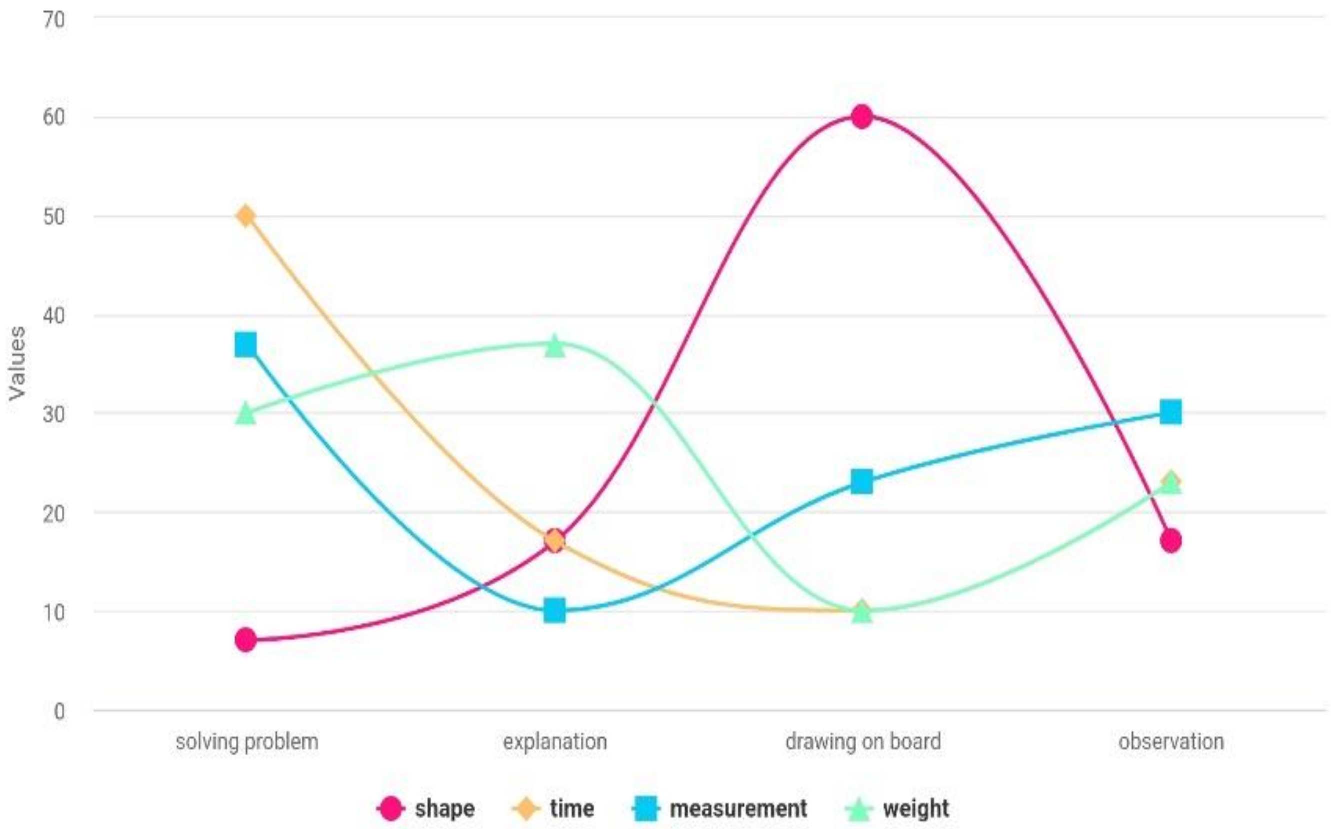

Fig . 14 Methods used to learn mathematics before

It appears that survey data on respondents' perceptions and interactions with several mathematical concepts pertaining to shape, time, measurement, and weight are displayed in this table. An explanation for every category is provided below: Shape: Solving Problems: Merely 2 out of 30 respondents, or 7 percent , said they preferred to comprehend the idea of shape through problem-solving. An explanation is needed for 5 responders, or 17 percent to understand the notion. Drawing on the Board: Sixty-eight percent of respondents, or eighteen, said that drawing on the board helps them grasp shape. Observation: Five responders, or 17 percent , feel that observation helps them understand. Time: Solving Problems: Fifteen respondents, or fifty percent, said that their favorite way to comprehend time is to solve problems. Explanation: Five respondents, or seventeen percent, said they use explanations to comprehend time. Drawing on the Board: Just 3 respondents (10%) said that they like to understand the concept of time by drawing on the board. 7 respondents, or 23 percent , said they would rather observe things to understand time. Measurement: Problem-Solving: Eleven responders, or 37 percent , said they would rather grasp measurement through problem-solving. Explanation: Three respondents (10%) said they need explanations to understand how measurements are made. Drawing: 7 responders, or 23 percent said that drawing clarifies measuring.

Three respondents (10%) said they need explanations to understand how measurements are made. Drawing: 7 responders, or 23 percent , said that drawing clarifies measuring. Observation: Nine respondents (30%) feel that observation is a better way to understand measurement. Weight: Resolving Problems: Nine responders, or thirty percent, said that their favorite way to comprehend weight is by solving problems. Explanation: Of the respondents, 11 or 37 percent , use explanations to make sense of their weight. Drawing: Three respondents (10%) said that drawing was useful in helping them comprehend weight. 7 respondents, or 23 percent said they would rather observe in order to understand weight.

Overall, the data points to sketching on the board as the most popular approach across all categories, with explanation and problem-solving coming in second and third. Though it is less common than the other techniques, observation is also thought to be beneficial. According to the statistics, multiple teaching strategies are applied for every mathematical subject, which reflects the range of strategies educators employ to accommodate students' varying learning preferences and styles. Frequently used tactics include problem-solving, visual aids, practical exercises, and demonstrations. The table concludes by highlighting how crucial it is to use a variety of instructional strategies in order to successfully communicate mathematical ideas. To improve their students' comprehension and interest in mathematics, teachers can think about implementing demonstrations, hands-on activities, visual aids, and problem-solving exercises. Furthermore, learning preferences can be used to better adapt instructional tactics for improved results.

4.2 Evaluation of Evolved package by the respondents

The tables below shows the score of the children based on the performance and the comprehension of concepts before and after the implementation of stem curriculum.

4.2.1 Knowledge of the Respondents in Environmental Science

The table 6 and figure 6 show the knowledge of the respondents on the concepts of Environmental science.

Sl. No	Concepts in Subjects	Pre- test		Post - test	
		Mean of scoring (3= excellent, 2= very good, 1= good)	**PercentagE (N=30) Out of 3**	**Mean of scoring (3=excellent, 2= very good, 1= good)**	**Percentage (N=30) out of 3**
1.	Source of water	2	67	3	100
2	Available conditions of water	1	33	2	67
3	Life cycle of butterfly	1	33	3	100
4	Uses and formation of soil	1	33	2	67
5	Types of soil	1	33	3	100
6	Features about Kerala	2	67	3	100

Table 6 Knowledge of Respondents on Environmental Science topics

The graphs showing the details about the pre test and post of students to evaluate the knowledge in Environmental Science are:

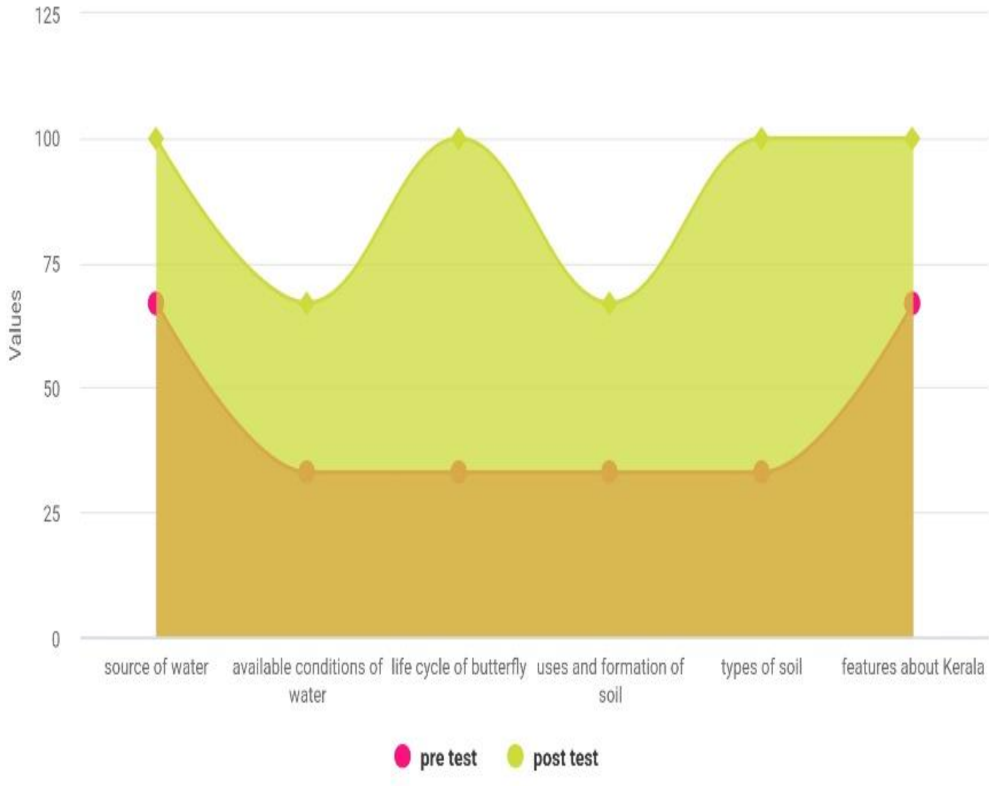

Fig .15 Knowledge of Respondents on Environmental Science topics

This table shows the mean scores and percentages for the pre- and post-test results for key topics in various subjects. With regard to "Source of water," the average score prior to testing was 2 (67%), but it significantly improved to 3 (100%) after testing. Comparably, all scores for "Types of soil" and "Life cycle of butterfly" increased from 1 to 3, indicating a significant improvement from the pre-test to the post-test. Though there was some progress, it was not as noticeable for concepts like "Available conditions of water" and "Uses and formation of soil," as scores increased from 1 to 2. The mean score for "Features about Kerala" increased from 2 (67%) to 3 (100%). The post-test results show improved comprehension of every topic overall. All things considered, the post-test results show improved comprehension of all topics, while certain concepts have improved more than others. This proposes efficient methods for these subjects' instruction and learning.

4.6.2 Knowledge of the Respondents on Mathematics

The table 6 and figure 7 show the knowledge of the respondents on the concepts of Mathematics .

Sl. No	Concepts in Subjects	Pre- test		Post - test	
		Mean of scoring (3= excellent, 2= very good, 1= good)	Percentage (N=30) Out of 3	Mean of scoring (3=excellent, 2= very good, 1= good)	Percentage (N=30) out of 3
1.	Knowledge on various shapes	2	67	3	100
2	Concept of time in day to day life and knowing time difference	1	33	2	67
3	Identifying time on clock	2	67	3	100
4	Conversion of measurements	1	33	2	67
5	Calculations in Weight	1	33	2	67
6	Calculations in Measurements	1	67	3	100

Table 7 Knowledge of Respondents on Mathematics topics

The graphs showing the details about the pre test and post of students to evaluate the knowledge in Mathematics are:

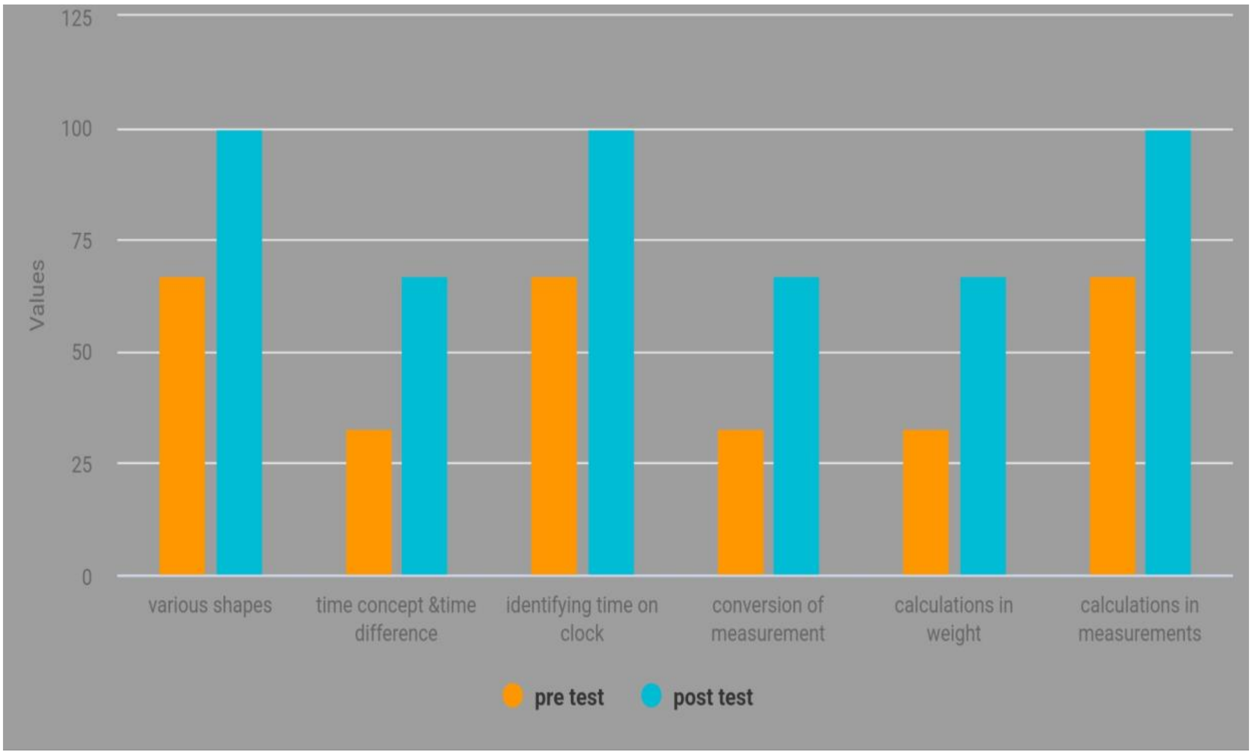

Fig . 16 Knowledge of Respondents on Mathematics topics

It is evident from the table that the knowledge of different shapes Pre-test: A mean score of two indicates a solid comprehension level (67%) of the material. Post-test: A mean score of three indicates a 100 percent knowledge level. Understanding time in daily life and being aware of temporal differences: Pre-test: A mean score of one indicates a 33% understanding level, which is relatively poor. Post-test: A mean score of two indicates a very good level of improvement (67%). Determining the time on a clock: Pre-test: A mean score of two (67%) suggests a high grasp. Post-test: A mean score of three indicates a 100% knowledge level. Measurement conversion: Pre-test: A mean score of 1 indicates a 33% understanding level, which is relatively poor. Post-test: A mean score of two indicates a very good degree of improvement (67%). Weight Calculations are like in, Pre-test a mean score of 1 indicates a 33 percent understanding level, which is relatively poor. Post-test: A mean score of two indicates a very good degree of improvement (67%).

Measurement-Based Calculations: Pre-test: A mean score of 1 indicates a 33 percent understanding level, which is relatively poor. Post-test: A mean score of three indicates a 100 Percent knowledge level.

Overall, from the pre-test to the post-test, there is a noticeable increase in comprehension of every topic. The areas where participants improved the most were Calculations in Measurements, Concept of Time, and Clock Identification. The study emphasizes how well the interventions or teaching strategies worked in between the pre- and post-test sessions. Nonetheless, there is still opportunity for development in certain ideas, such as conversion of measurements and calculations in weight. More research may be done to pinpoint the precise areas in which participants had the greatest difficulty so that teaching methods could be adjusted appropriately.

4.3 Development of STEM based Curriculum book for improving the learning outcome of the third standard students.

4.3.1 Development of tool

The creation of a STEM curriculum book is a crucial undertaking in the effort to provide third standard pupils with an engaging and productive learning environment. STEM education, which combines science, technology, engineering, and math, provides an interdisciplinary approach that fosters students' creativity, critical thinking, and problem-solving abilities. This paper outlines the goals, structure, and content of a self-created STEM curriculum book that aims to improve third standard students' learning results. Proficiency in STEM subjects is essential for navigating the complexity of the modern day in a world that is changing quickly. To establish a fundamental comprehension and admiration for these disciplines, early STEM education integration is essential. Studies reveal that incorporating STEM subjects improves student performance academically while also fostering critical abilities like teamwork, creativity, and flexibility. Students are better prepared to face the difficulties of the workforce of the twenty-first century by incorporating STEM principles into their early education.

The STEM curriculum book was developed in accordance with a thorough structure intended to support students' learning experiences. Third-standard children' cognitive and developmental demands are taken into consideration when designing the curriculum, which guarantees a steady increase in abstraction and complexity. In order to promote active participation and experience learning, the design principles place a high priority on practical, inquiry-based learning methodologies. In addition, the curriculum book incorporates cross-curricular links that demonstrate how STEM fields are related to real-world applications. The curriculum book covers science, technology, engineering, and mathematics (STEM) subjects across a broad range of topics. Every chapter has been carefully designed to convey ideas in an understandable way, and it is enhanced by projects, experiments, and interactive activities. Students are encouraged to cultivate a growth mindset, critical thinking abilities, and curiosity through guided exploration. The way the material is organized promotes group projects and the growth of interpersonal and communication skills.

The STEM-based curriculum book must be implemented strategically, which calls for resource allocation, teacher preparation, and training. Workshops for professional development give teachers the pedagogical expertise and teaching techniques they need to successfully lead STEM learning experiences. Additionally, incorporating technologically advanced teaching aids and resources enhances student learning and expands learning outside of the classroom. Teachers can monitor student progress and adjust instruction to fit each student's unique learning needs by using continuous assessment and feedback methods. Third-standard children can benefit greatly from the creation and use of a self-developed STEM curriculum book, which can improve learning outcomes and help them acquire 21st-

Plate 1. Children doing activity.

century skills. Science, technology, engineering, and math teachers can enable students to become lifelong learners, innovators, and problem solvers by combining these subjects into a coherent whole. Together, with a dedication to high standards in education, we can develop a new generation of STEM-literate people who will be ready to succeed in a world that is getting more and more complicated.

Plate 2. Glimpse of activity book.

4.3.2 Evaluation of the developed tool by Teachers.

The self designed STEM model curriculum booklet was evaluated by the 10 primary school teachers based on some parameters:

Clarity, Depth, and Coherence of the Content: Assess the booklet's content to make sure it successfully conveys important STEM concepts. Engagement & Interactivity: Take into account how much interaction and engagement the booklet offers the pupils, for example, through interactive features, experiments, or hands-on activities. Relevance and Application: Evaluate whether the curriculum aids students in understanding how STEM principles are used in a variety of contexts, and determine how relevant the information is to situations and applications in the real world. Differentiation and Accessibility: Take into account how the curriculum provides possibilities for both differentiation and accessibility for all learners while addressing the various requirements and learning styles of the pupils. Evaluation and Comments: Discuss how well the assessment techniques in the booklet measure students' comprehension and development. It tells how well the assessment techniques in the booklet measure students' comprehension and development as well as how well timely and helpful the feedback is. Integration of STEM Disciplines: Evaluate how well the program combines ideas from math, science, technology, and engineering to give students a comprehensive understanding of STEM subjects. Creativity and Innovation: Examine whether open-ended tasks, design projects, or other creative activities in the curriculum encourage students' creativity and innovation. Collaboration and Communication: Assess how the curriculum provides opportunity for group projects and peer-to-peer talks to foster collaborative learning and the development of communication skills. Metacognition and Reflection: Take into account whether the curriculum promotes students' development of metacognitive abilities including goal-setting and self-evaluation as well as reflection on their learning process. In order to determine areas of strength and areas for improvement, get input from peers and students who have used or studied the curriculum material. By taking these factors into account, educators can assess a self-developed STEM-based model curriculum booklet's efficacy in helping students meet their learning objectives in a thorough and comprehensive manner.

The prepared module was given to the 10 primary school teachers for evaluating its effectiveness.. The report of the evaluation as given by the respondents is given in table 8.

Sl. No.	Parameters	Scores									
		Excellent		Very good		Good		Fair		Poor	
		(N=10)	%	(N=10)	%	(N=10)	%	(N=10)	%	(N=10)	%
1	Content clarity and depth	7	70	3	30						
2	Creativity and innovation	8	80	2	20						
3	Collaboration and communication	6	60	4	40						
4	Reflection and metacognitive	6	60	3	30	1	10				
5	Feedback from students	9	90	1	10						
6	Engagement and interaction	8	80	2	20						
7	Relevance and application	7	70	2	20	1	10				
8	Differentiation and accessibility	7	70	2	20	1					
9	Integration of STEM disciplines	6	60	4	40						
10	Alignment with learning objectives.	6	60	3	30	1	10				

Table 8. Evaluation of the developed curriculum book by teachers

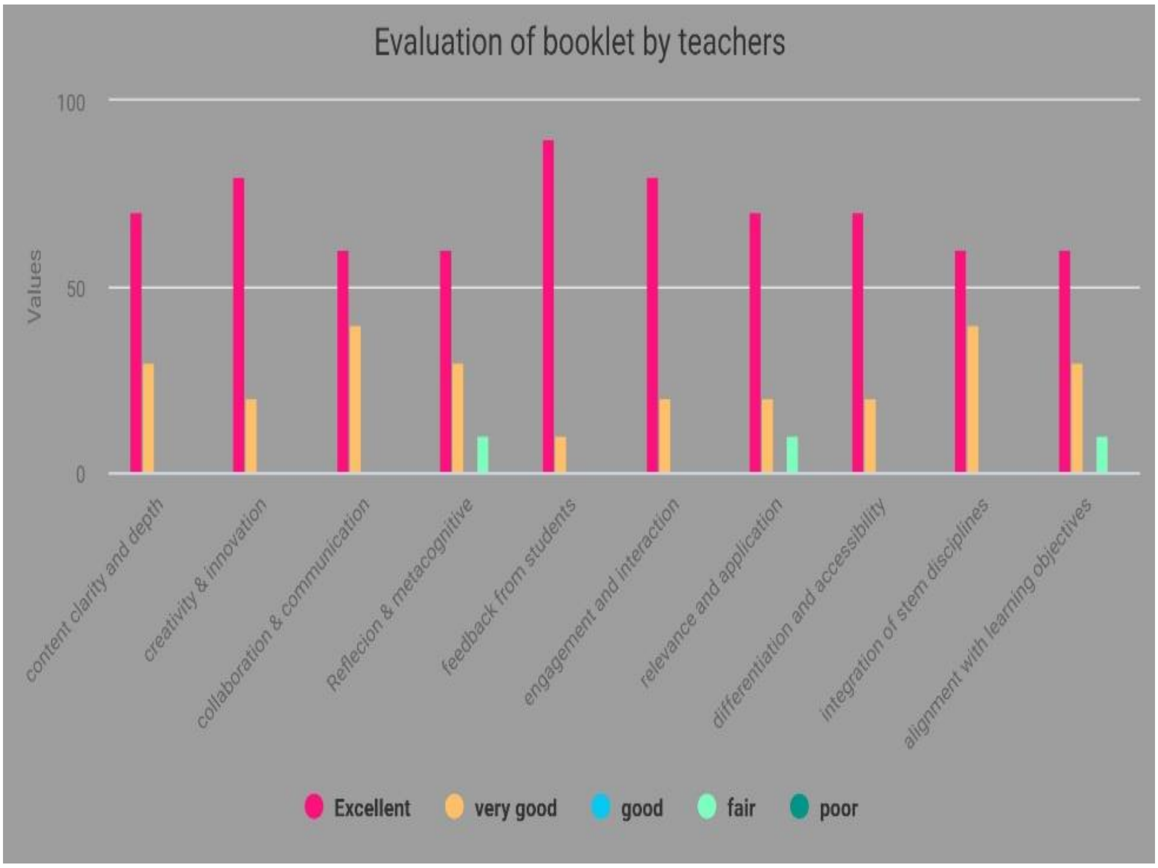

Fig. 17 Evaluation of the developed curriculum book by teacher

The evaluation results for several factors pertaining to the efficiency of instruction are shown in this table. The following analysis, justification, and conclusion are drawn from the data: The vast majority of responders (70%) rated content clarity and depth as "Excellent," demonstrating a solid comprehension and presentation of the subject matter. Innovative and creative teaching techniques were evident in the large majority (80%) who assessed this parameter as "Excellent," indicating that they were creative and innovative. Cooperation and communication: of the respondents, 60% percent ranked this criterion as "Excellent," and 40 percent rated it as "Very good," suggesting that there is still opportunity for progress in these areas despite the fact that the skills are effective. Metacognition and reflection: The majority of respondents (60%) scored this criteria as "Excellent," suggesting that the teacher promotes students' critical thinking and introspection. Student feedback: A resounding 90 percent of respondents gave this metric a “Excellent” rating, indicating a high level of satisfaction with the instructor's input. Similar to inventiveness, 80 percent of respondents evaluated engagement and interaction as “Excellent,” indicating strong levels of interaction and engagement from students throughout class.

Relevance and application: Although 70 percent of respondents ranked this criteria as “Excellent,” 20 percent rated it as “Good,” suggesting that although most people found the content’s relevance and application to be satisfactory, there was room for improvement. Distinction and accessibility: Most respondents (70%) gave this metric a “Excellent” rating, indicating that the measures for differentiation and accessibility were working. But 20 percent said it was “Good,” indicating that improvements are still necessary. STEM discipline integration: 60% of respondents gave this metric a “Excellent” rating, while 40 percent gave it a “Very good” rating, indicating good integration but with some space for improvement. Alignment with learning objectives: With the majority of respondents (60%) rating this attribute as “Excellent,” it is clear that the instructional strategies closely correspond with the desired learning outcomes. I

In summary, the evaluation’s overall findings are mainly favorable, with the majority of the parameters earning good scores. There are still certain things that could be done better, like improving accessibility and differentiation tactics, relevance and applicability, and teamwork and communication. These results can direct future instructional strategies to further improve students’ learning experiences.

SUMMARY AND CONCLUSION

CHAPTER -5

SUMMARY AND CONCLUSION

The study Undertaker by the researcher was on "Development of STEAM based model curriculum on selected concepts for grade 3 children". In the present study 10 base to curriculum book were developed on the selected concepts of 3rd standard students based on SCERT syllabus. The area selected for the present study was Chottanikkara government vocational higher secondary school, in Ernakulam District. December for the present study was 30 students from both the divisions in the school, having the age of 8 years. The method of sampling adopted was purpose is sampling. The tool used for the research included self-designed toolkit to evaluate the current status of Academics and the learning approach of students towards STEM concept and a remediation curriculum booklet for better learning outcome of students true science experiments and mathematical activities. Data was collected, consolidated and analysed using percentage analysis.

Findings

The findings of the study can be summarise as follows

5.1 General information of the Respondent

- It is evident from the table that half of the respondents were males and others were females.
- More than 80 percentage were having siblings and only sixteen percent of students were single child.
- About 56 percent of students belongs to nuclear family while only 43 percent have join family.

5.2 Academic details of Respondents

- Among favourite subject studied, mathematics were preferred by 30 percent followed by science (27 percent). The language is Malayalam and English were preferred by only 20 percent for each.
- Sixty seven percent spent1-2 hours for study and 30 percent children spent 3 to 6 hours.

- Fifty three percent children under took tuitions for the study and the rest 47 percent doesn't.

5.3 Approach towards STEM Learning

- Level of Interest in Science, Math, and Technology: 60% of respondents have a very good level of interest. 30 percent are neutral. 10 percent are not interested.
- Engagement in Science Activities Outside of School: 65 percent of students rarely engage in science activities outside of school. 21percent engage monthly. 14 percent engage daily.
- Math Confidence Level: 35 percent of students feel comfortable tackling mathematical challenges. 44 percent are indifferent. 21 percent lack confidence.
- Seventy percent of students are interested in working in groups to complete a project. 23 percent express sporadic interest. 7 percent say they're not curious.
- Seventy four percent of students are enthusiastic about utilizing computers for learning. Twenty percent are indifferent about computer learning while six percent don't think it's better.

5.4 Methods used to learn science before

- Thirty six percent of students learn the concept of water through lectures and 17 percent through guided practices and the remaining rest few take other methods like demonstration, worksheets etc.
- Thirty percent of students law and the concept of soil through lectures ,23 percent through demonstration s and 20 percent through guided practices.
- Thirty seven percent of students learned the concept of butterfly through lectures, 33 percent by discussions and 30 percent true guided practices.
- Forty percent of students learned the concept of Kerala through lectures,24 percent through worksheets and 20 percent through guided practices.

5.5 Methods used to learn Maths before

- Sixty percent of students learned the concept of Shape fruit drawing and 17 percent by both explanation and observation and the remaining few learners true problem solving method.
- Fifty percent of students learned they concept of time by solving problem, 23 percent by observation and the remaining few by explanation and drawing.

- The concept of measurement was learned by solving problems by 37 percent students, 30 percent by observation and 23 percent by drawing method.
- The concept of way to was learned through 37 percent of students by explanation, 30 percent by solving problem and few others with other methods like drawing and observation.

5.6 Evaluation of the Evolved Package by Respondents

5.6.1 Knowledge of Respondents on Environmental Science

- There was a noticeable increase in comprehension for every issue examined, with average scores rising noticeably for "Types of soil," "Life cycle of butterflies," "Source of water," and "Features about Kerala."
- Though ideas like "Uses and formation of soil" and "Available conditions of water" demonstrated development, it was not as significant as in other areas.
- The post-test findings show improved understanding of every subject evaluated, indicating an overall successful learning outcome.

5.6.2 Knowledge of Respondents on Mathematics

- From the pre-test to the post-test, participants demonstrated a significant improvement in all assessed topics.
- Significant improvements were noted in the comprehension of the Concept of Time, Calculations in Measurements, and Clock Identification.
- Measurement conversion and weight calculations had rather low initial comprehension levels, but post-test results showed a significant improvement.
- The usefulness of interventions or instructional techniques used in between the pre- and post-test sessions is highlighted in the study.

5.7 Assessing the Effectiveness of the STEM based Curriculum booklet

There was a significant difference in pre test and post test scores this employees that there is a definite effect of the developed curriculum book to improve learning outcome of students. The evaluation's conclusions are largely positive, with most of the parameters receiving high marks. Certain aspects still need to be improved, such as teamwork and communication, relevance and applicability, accessibility and differentiation strategies, and so on. Future instructional tactics can be guided by these findings to further enhance students' educational experiences.

Conclusion

The presence study discuss "Development of STEAM based model curriculum on selected concepts for grade 3 children". It analyse children's various background details upon the knowledge level on the topic.

The study concludes the improved, learning outcome of students on the basis of selected concepts in science and mathematics. The curriculum book developed by the investigator was sufficient to provide science experiments and mathematical activities and there is a positive difference before and after the implementation of Curriculum by proper comprehension of concept, engagement, interaction and overall effectiveness. These findings imply that the implementation of STEM curriculum is a successful strategy among students.

Limitations

- The study was limited to the Ernakulam District.
- It was difficult to obtain a large sample of children with the specific learning disability, so only a small sample were obtained.

Recommendations

The study puts forward the following implications :

- This code authorities and teachers have to focus more on STEM based curriculum.
- Teachers must be provided with proper instructions and training programs based on the STEM learning approach.
- Make parents aware about the characteristics of STEM Education for getting better supports for children.
- Enhance more facilities in primary schools for improving the learning outcome of children through the science experiments and mathematical activities

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APPENDICES

APPENDIX :1

STEM Curriculum Booklet

APPENDIX – 2

Questionnaire to evaluate the current learning status of children and their approach towards STEM learning :

General details :

1. Name:
2. Gender
3. Have siblings : yes
   No
4. Type of family : nuclear family
   Joint family

Academic details :

1. Favourite subject :
   - mathematics
   - Science
   - Malayalam
   - English
2. Study time:
   - 1-2 hrs
   - 3-6 hrs
3. Having tution
   - No
   - Yes

Approach towards STEM Learning

1. Level of interest in science, maths and technology :
   - Very good
   - Normal
   - Not interested
2. Engagement in science activities out of school :
   - Rearly
   - Monthly
   - Daily

3.Confident level to solve problem in maths:

- Confident
- Neutral
- Not confident

4. Interested in group work to complete project :
    - Yes
    - Sometimes
    - No
5. Feel about computers for learning :
    - Excited
    - Neutral
    - Don't prefer

Methods to learn science before :

1. The concept of water:
    - Lectures
    - Discussion
    - Guided practice
    - Worksheet
    - Demonstration
2. The concept of soil:
    - Lectures
    - Discussion

    Guided practice
    - Worksheet
    - Demonstration
3. The concept of colourful butterfly :

    - Lectures
    - Discussion
    - Guided practice
    - Worksheet
    - Demonstration
4. The features of Kerala –

- Lectures
- Discussion
- Guided practice
- Worksheet
- Demonstration

Methods to learn mathematics before-

1. The concept of shape:
    - Solving problems
    - Explanation
    - Drawing on board
    - Observation
2. The concept of time:
    - Solving problems
    - Explanation
    - Drawing on board
    - Observation
3. The concept of measurement :
    - Solving problems
    - Explanation
    - Drawing on board
    - Observation
4. The concept of Weight :
    - Solving problems
    - Explanation
    - Drawing on board
    - Observation

APPENDIX 3

Self-designed tool to valuate the knowledge im ENVIRONMENTAL SCIENCE, (pre and post test).

1.______,______and _______ etc are sources of water.

2.

A	B
Feel cold	Droughts
No water	Diseases
Polluted water	Rain

3 .How many stages will take a caterpillar to become an adult butterfly?

4. Where does butterflies hatches its egg??

5 . pot is an object made of ----------.

A	B
Sandy soil	Red color
Alluvial soil	Sticky
Clay soil	Black granules
Black soil	Tiny granule
Red soil	Top soil

6. .Soil is formed by the breaking down of ____ and _____.

8. Captial of Kerala is _______.

9. Oru state Kerala has ___ no. of districts.

10. -----------is our state animal.

11. What is the third stage in life cycle of a butterfly?
    a) Larvae
    b) Pupa
    c) Egg

12. The wonders of colour that fly from flower to flower are called...........
13. In which leaves do butterfly usually lays egg?
14. The decaying of substance makes the soil ....
    a. Fertile
    b. Change
    c. Harder
15. Destroying of agriculture leads to:
    a. Soil erosion
    b. Soil fertility
    c. Soil availability
16. Arum travelled from Kottayam to Trivandrum. What all districts does he see in-between the journey?
17. Which district is near to kannur?
    a. Idukki
    b. Kasaragod
    c. Kollam

18.

Need of water	Drinking water.
Rain comes	Cooking
Purification	Plants and trees sprout

19. Overflowing tanks reduce water

a. Wastage
b. Availability

APPENDIX 4

Self- designed tool to evaluate the pre and post knowledge

MATHEMATICS

1. Find out the shapes hidden in this picture.

2. Count the number of rectangles in the above figure.
3. Draw two circles and a rectangle at its top.
4. Match the following :

6 Am	Class begins in the school
10 Am	Goes to Sleep
9 Pm	Wakes up in the morning

5. Guess the time.
   a) 3 hours 10 mins.

b) 2 hours 10 mins.
c) 2 hours 50 mins.

6. Ramu have Two thread each with 7 cm and paru have 4 threads with 5 cm each. Who have a longer one?
7. One and half meter is...
   a) 60 meter and 30 cm
   b) 150 cm.
   c) 1000 meter and 500 cm

8. A shopkeeper had a sale of 50 gm of dal to 7 families and the dal in the shop got over. How much grams of dal was there in the shop?
9. There are 210 gm of cumin seed in a shop and it have to be packed as 70 gm packets. How many packets will be there.
10. Match the following.

1 Kg	500 ml
½ Litre	3000 m
3 km	1000

10. A lunch box contains 700 gm. After the lunch it weighed only 250 gm. What was the weight of the food?.
11. There was 7 litres and 400 ml of milk in a farm. After the morning sale it reduced to 2 litres and 300 ml. How much were sold then?.

12. Match the following.

1000 ml	¼ km.
750 gm	1 litre.
250 meter	¾ kilo gram

13. How many kg is 1500 gm?
   a. 1 kg
   b. 1 ½ kg
   c. 15 kg

14. Fill in the blanks.

Arrival time of train	Departure time of train	Time taken
7.30	4.20	
5:20	6:20	1 hour
9:15	12:40	

15. Reenu took 35 minutes less than three hours. How much is that?

   a. 275 minutes
   b. 145 minutes
   c. 135 minutes

17.

A tree to grow	A leap year
Take a bath	Years
To get February 29	A day
Sun rise	Minutes

18.

a). 12 hr 45 min

b). 1 hour 15 min

c). 1 hour 40 min

19.How maby lines are there in a triangle? What about in a square?

20.Find out number of circles in the figure.

APPENDIX 5

Tool Evaluation Checklist

Sl.No	Parameters	Scores				
		Excellent	Very good	Good	Fair	Poor
1.	Content clarity and depth					
2.	Creativity and innovation					
3.	Collaboration and communication					
4.	Reflection and metacognitive					
5.	Feedback from students					
6.	Engagement and interaction					
7.	Relevance and application					
8.	Differentiation and accessibility					
9.	Integration of STEM disciplines					
10.	Alignment with learning objectives.					