ENHANCED LEARNING IN PRIMARY SCHOOL CHILDREN THROUGH CREATIVE AND ERGONOMICALLY DESIGNED INTERIORS

Dissertation submitted to

ST. TERESA'S COLLEGE (AUTONOMOUS),

ERNAKULAM

Affiliated to

MAHATMA GANDHI UNIVERSITY

In partial fulfilment of the requirement for

THE AWARD OF THE DEGREE OF MASTER OF SCIENCE IN HOME SCIENCE (BRANCH B) RESOURCE MANAGEMENT AND INTERIOR DESIGNING

By

ANAGHA JAYAKUMAR

(Register No. AM20HRM001)

Department of Home Science and Centre for Research

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DECLARATION

I hereby declare that the thesis “Enhanced Learning In Primary School Children Through Creative And Ergonomically Designed Interiors” is a bonafide record of research work done by me during the course of study, under the supervision and guidance of Dr. Leena Leon, Assistant Professor, Department of Home Science, St. Teresa's College (Autonomous), Ernakulam.

Ms. Anagha Jayakumar

Place:

Date:

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CONTENTS

ABSTRACT

The major development of a child both mentally and physically takes place at the age of primary education. It is the primary school where the children get more socialization and develop their socio-emotional skills. The aim of the study is to assess the existing learning environments in primary schools, to analyse the scope of implementing ergonomically designed interiors in primary school classes and to develop an ergonomically designed and modified classroom interior model for enhanced learning. This study was conducted among five selected government schools of Thiruvananthapuram district through convenience sampling. Questionnaires was distributed among the students and teachers for data collection. The major findings of the study was that the teachers and students were not happy about the ergonomic aspects of design in the school. 65% of the teachers opined that the backpain experienced by the students might be due to the poor design of classroom furniture. Many schools lack the necessary units of basic electronic devices like fan and lighting. The benches without backrest caused improper sitting posture among the students. Applying ergonomics to the classroom design can help to improve the overall learning conditions and also the students learning abilities. So based upon the data analysis and observation of the researcher found that the current designs are not up to the mark. So by incorporating the suggestions given by students and teachers, a 3D model of a creative and ergonomically modified interior was developed for enhanced learning.

Keywords: *Ergonomically designed, Enhanced learning, learning environment, ergonomical knowledge*

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Chapter 1

INTRODUCTION

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INTRODUCTION

Earlier when people did more physical work like farming, hunting, rearing animals, etc, they were healthier and had fewer physical problems. They were physically active and consistently groomed their body in such a way to be healthy and capable of any kind of work. They had less or no health issues compared to the issues people have today. They lead a pleased and healthy life as they find their living making use of their body. Nowadays people tend to like sedentary work more, and they rarely use their bodies for physical work, which has made their body parts weaker and incapable of physical work. Most people prefer office work overwork that demands physical acts. This definitely has caused a drastic change in the capability of the human body, which will lose its natural abilities unless it is tamed well. Another issue that can occur due to sedentary work is the so-called Musculoskeletal diseases, which in turn affect the productivity of both the worker and the organisation. Sitting in the same position for a long time affects the human body negatively. If the sitting position is not comfortable, that may cause serious issues.

This situation is not only seen in working places but also at the schools and colleges where students sit for about five to seven hours a day. They spend most of their time in schools and colleges sitting inside the class. Students are the wealth of the future. Hence it is a significant area to be considered for the physical well-being and healthy life of every student. Having good physical health can also influence their mental health, making them feel confident and comfortable throughout their lives. This in turn benefits their personal life, their family, society, and the whole nation. So the question is, how to make a healthy and comfortable space for the sedentary life situations.

Being in a comfortable space for particular purposes, such as working with a computer, stitching a garment, embroidery, writing an article, learning, etc. enhances

productivity to a great extent. We usually use one or two parts of our body to do specific work. But actually, it takes our whole-body effort to complete a task effectively. Hence it is important to give proper care to all of our body parts while we work. The solution is an ergonomically designed workspace.

"Ergonomics is the study of people in their workplace and is the process in which workplaces, products, and systems are designed or rearranged so that they fit the people who use them. It aims to improve workspaces and environments to reduce the risk of injury. International Ergonomics Association definition: "Ergonomics is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data, and methods to design in order to optimise human well-being and overall system performance." Ergonomics is a science-based discipline. It brings together knowledge from anatomy and physiology, psychology, engineering, and statistics and ensures that the designs complement the strengths and abilities of people who use it." (*Ergonomics*, n.d.)

It is the primary school where the children get more socialisation and develop their socio-emotional skills. During this period, children continue to learn how to identify and express emotions and needs. Self-regulation and empathy are essential social skills to help children be successful emotionally, socially, and academically. They will be so energetic and sometimes impulsive. They need enough playtime in order to physically release energy and it will be unstructured and is important to foster creativity. Their attention span is still limited but they become more engaged in activities. They will become more abstract thinkers and will be able to grasp and associate multiple concepts at a time. At this age, they will be reading to learn instead of learning to read. Hence it is very important to provide them with an ergonomically designed and eco-friendly school environment to nurture all these physiological and psychological benefits for bringing up better human beings for the future. For that investment in children and the environment is wise- thus enhanced learning in children through an ergonomically designed interior became the rationale of the research.

A school is a place far from home where children spend a lot of time doing different activities as part of education which makes them better people for themselves and the world. They may get involved in activities like learning new skills, acquiring knowledge of different disciplines, doing physical activities or sports, getting socialised with other children, creating new relations, and learning things. All these activities in turn influence their personality development and their life ahead. Every school has many elements that add to its function of helping mould each children's life, which includes the school equipment like a desk, chairs, blackboard, sports equipment, computers, books, etc, the works like learning, teaching, playing etc, the school environments like classrooms, staff rooms, library, playground, etc. The children come across all these elements during the time he/she spends time in school. So these elements have the potential to influence the children physically and psychologically. Hence it is important that these elements should be constructed with utmost care. Care should be given from the stage of construction of a school. Designing all the elements of a school ergonomically can improve the children’s potential to learn things more efficiently as well as promotes good health conditions among them.

THE RELEVANCE OF THE STUDY

Meticulous interior design solutions for educational settings have proven to have a positive impact on children and also on the overall environment inside the institution. This is achieved by addressing the interrelating social, aesthetic, and economic matters within a school building and especially in classrooms. The outcome of school designs should create spaces that are functional, safe, comfortable, and healthy. Creating healthy and ergonomically designed school environments is very crucial for the overall development and well-being of children. Teaching students at primary school is at the right age to know about sustainability and the environment that gives them the tools they need to solve the global challenges they are facing now and in the future. Education that promotes this type of literacy includes both curriculum and instructional practices that are interdisciplinary, environment-based, and rooted in the context that uniquely surrounds each student.

AIMS AND OBJECTIVE OF THIS STUDY

The aim of the study was to assess the primary school learning environment and suggest an ergonomically modified classroom interior for enhanced learning.

The objectives are listed below:

1. To assess the existing learning environments in primary schools.
2. To analyse the scope of implementing ergonomically designed interiors in primary school classes.
3. To develop an ergonomically designed and modified classroom interior model for enhanced learning
4. To check the feasibility and promote the same for enhanced learning in primary school.

Chapter 2

REVIEW OF LITERATURE

CHAPTER- 2

REVIEW OF LITERATURE

The review of literature of this study entitled " **Enhanced Learning In Primary School Children Through Creative And Ergonomically Designed Interiors**" is discussed under the following headings.

1.1. Significance of primary school age.

1.2. Importance of learning at primary school.

1.3. Meaning of enhanced learning.

1.4. Impact of well-designed classroom

1.5. Issues with ill-designed classrooms.

1.6. Significance of creatively and ergonomically designed classroom interior.

2.1. Significance of primary school age

The age when children go to primary school, that is in the grades from one to seven is called the primary school age in Kerala. Primary school education is subdivided into a lower primary and an upper primary where classes from one to four belong to the lower primary and classes from five to seven belong to the upper primary. Commonly the age between six to twelve is considered to be the primary school age. During this age phase, many developmental changes occur in the children. They will undergo physical, emotional, and mental developments that can lead to the formation of their personality. Major physical changes occur during this age, which also affects them mentally.

School-age children most often have smooth and strong motor skills. However, their coordination (especially eye-hand), endurance, balance, and physical abilities vary. Fine motor skills may also vary widely. These skills can affect a child's ability to write neatly, dress appropriately, and perform certain chores, such as making beds or doing dishes. There will be big differences in height, weight, and build among children of this age range. It is important to remember that genetic background, as well as nutrition and exercise, may affect a child's growth. A sense of body image begins developing around age 6. Sedentary habits in school-age children are linked to a risk for obesity and heart disease in adults. Children in this age group should get 1 hour of physical activity per day. By age 5, most children are ready to start learning in a school setting. The first few years focus on learning the fundamentals. In third grade, the focus becomes more complex. Reading becomes more about the content than identifying letters and words. An ability to pay attention is important for success both at school and at home. A 6-year-old should be able to focus on a task for at least 15 minutes. By age 9, a child should be able to focus attention for about an hour. It is important for the child to learn how to deal with failure or frustration without losing self-esteem. (*School-Age Children Development Information*, n.d.) Kids at this age need physical activity to build strength, coordination, and confidence — and to lay the groundwork for a healthy lifestyle. They're also gaining more control over how active they are. Kids who enjoy sports and exercise tend to stay active throughout their lives. Staying fit can improve how kids develop in school, build self-esteem, as well as prevent obesity, and decrease the risk of serious illnesses such as high blood pressure, diabetes and heart disease later in life. (Villa, n.d.) School-age kids should have many chances to do a variety of activities, sports, and games that fit their personality, ability, age, and interests. Through physical activities, kids learn about sportsmanship, setting goals, meeting challenges, teamwork, and the value of practice. Kids 6 to 8 years old are sharpening basic physical skills like jumping, throwing, kicking, and catching. Some enjoy doing this in organized sports teams, but non-competitive leagues are best for younger kids. Kids 9 to 12 years old are refining, improving and coordinating skills. Some become even more committed to a sport while others drop out as competition heats up and the level of play improves. (Villa, n.d.)

The primary school age also brings about changes in the languagerial abilities of the children. Early school-age children should be able to use simple, but complete, sentences that contain an average of 5 to 7 words. As the child goes through the elementary school years, grammar and pronunciation become normal. Children use more complex sentences as they grow. Language delays may be due to hearing or intelligence problems. In addition, children who are unable to express themselves well may be more likely to have aggressive behaviour or temper tantrums. A 6-year-old child normally can follow a series of 3 commands in a row. By age 10, most children can follow 5 commands in a row. Children who have a problem in this area may try to cover it up with backtalk or clowning around. They will rarely ask for help because they are afraid of being teased. (*School-Age Children Development Information*, n.d.)

As a result of cognitive development and brain changes, 11-13-year olds demonstrate an increased ability to look beyond literal interpretations and understand the metaphoric uses of language. They are able to comprehend proverbs and detect sarcasm. Vocabulary continues to expand, often in direct relation to the amount a child reads. While a child in first grade may have between 8,000-14,000 words, a high school graduate may have upwards of 80,000. By middle school, children use language functionally and adjust their choice of words or level of sophistication to suit the context. Fitting into their peer group takes on paramount importance, and children will select vocabulary based on cultural or other factors. Children this age are better able to read or anticipate the needs of their listeners. They are able to adjust their speech to correct for misunderstandings and can respond to the intent or tone of the communication, as opposed to the literal words. They can better contribute to and extend conversations, maintain interactions and participate more socially. Children's writing abilities at this age improve as well. They are able to write extensively to support their opinion or to formulate an argument. They can correctly use complex sentence structures in their writing, such as colons and semicolons. Cultural and educational background influence overall language development, with the differences being evident by kindergarten and remaining stable across development. (Anthony, n.d.)

Behavioural changes occur during the primary school age. Frequent physical complaints (such as sore throats, tummy aches, or arm or leg pain) may simply be due to a child's increased body awareness. Although there is often no physical evidence for such complaints, the complaints should be investigated to rule out possible health conditions. This will also assure the child that the parent is concerned about their well-being. Peer acceptance becomes more important during the school-age years. Children may take part in certain behaviours to be part of "the group." Talking about these behaviours with your child will allow the child to feel accepted in the group, without crossing the boundaries of the family's behaviour standards. (*School-Age Children Development Information*, n.d.) A very important part of growing up is the ability to interact and socialize with others. During the school-age years, parents will see a transition in their child as he or she moves from playing alone to having multiple friends and social groups. While friendships become more important, the child is still fond of his or her parents and likes being part of a family. (Villa, n.d.) Hence the age from 6 to 12, age during the primary schooling is very important for the growth of every child, which brings changes in different aspects of personality development.

2.2. Importance of learning primary school

Primary school education is an important phase in every child's life, as it includes significant physical, mental and emotional changes along with influencing his/her behaviour towards others through socialising. An effective primary education can build a solid foundation and open avenues for future success. With its profound implications on both the individual and society, primary education plays a crucial role in reducing extreme poverty and promoting social changes. The Sustainable Development Agenda acknowledges the importance of primary education in Goal 4 which stipulates that by 2030, the world should ensure inclusive and equitable quality education and promote lifelong learning opportunities for all, including a target on universal access to primary education. Though there are varying standards, primary education is typically designed for children 6 to 11 years of age. Significant progress has been made toward achieving universal primary education. Globally, the adjusted net attendance rate reached 87

percent in 2019, and about four out of five children attending primary education completed it. Additionally, over the past two decades, the number of out-of-school children was reduced by over 40 percent. However, there is still a long way to go: 58 million children of primary school age remain out of school, with the majority of them coming from marginalized groups. In addition, recent MICS results show that many children do not have foundational reading and numeracy skills, highlighting the massive challenge to achieving inclusive and equitable quality education for all. (*Primary School Age Education - UNICEF DATA*, n.d.)

Primary school can be considered as the first step for the children to knowledge and socialisation of their own. This helps them to be more independent and confident as the primary school education promotes the all-around development of the children. Children who have been to pre-primary schools tend to learn more rapidly through an organized curriculum, learning aids and by interacting with other children. The main purpose of pre-primary education is to prepare children physically, emotionally, socially and mentally for formal schooling and to prevent poor performance and early dropout. (R et al., 2011, 439,440) Primary Schools pave the path for traditional learning. Apart from the child learning basic physical and mental activities, primary schools focus on internal growth too. Primary schools will delve deep into the psyche of your child. As a result, the child matures to become a better human being. (//, n.d.)

The main objective is to make children think analytically; to achieve high living standards; to face challenges posed by technology; and advancement of citizenship and basic values. It provides an opportunity for students to make friends and develop communication skills. The future of a child is totally dependent on primary education. It can positively boost your child's self-confidence and offer the skills they need to achieve success in their lives. Working and learning with other children helps to develop a sense of respect for others, learning the difference between right and wrong, how to play with cooperation, the importance of sharing, solving disputes, following instructions and voicing opinions. Children who attend early years school that give a positive and nurturing environment are more stable than those who do not. Early

education offers a safe, happy and healthy environment where children can obtain a sense of self and explore new things which teach them about themselves. An absence of education can lead to illiteracy and various other negative effects which will harm their development and potential long-term. Children who get an education become more productive and skilled than those who don't get a fundamental education. (*Why Is Primary Education Important? - EDBlog*, n.d.)

2.3. Meaning of enhanced learning

Enhanced learning can be described as a learning experience with an improved or increased quality, value or desirability which in turn can help the children to be more achievable and capable than in an ordinary environment. Enhancement can be done in many aspects. By incorporating technology into a classroom, it can be called as a technology-enhanced learning experience. Likewise, by incorporating ergonomics we will get an ergonomically enhanced classroom. The application of ergonomics/human factors (E/HF) principles and practices, and the implementation of ergonomics programmes, have achieved proven success in improving performance, productivity, competitiveness, and safety and health in most occupational sectors. However, the benefits that the application of E/HF science might bring to promoting student learning have yet to be widely recognized (T. J. Smith, 2007, 1531).

Educational ergonomics relates education performance and educational design. The performance of students depends on the design of educational system. Ergonomic interventions and design improvements benefit students. The field is concerned with how and why design of the education process and system influence the performance of participants in the system as a whole (Darius, 2015, 22).

Smart Learning Environments (SLE) emerge as an optimal alternative to traditional teaching as, through ergonomics, an inclusive outlook which is bound to enhance the educational experience of every student is provided. The key role which ergonomics has with regard to the development of a Smart Learning Environment; however, it is deemed necessary to expand on the research, in order to create an optimal model which

conceives ergonomics as an essential component of SLE. In conclusion, the implementation of a smart environment from an outlook in which ergonomics is present in the educational activity will benefit teaching, research and innovation in any level and context, key aspects of any experience in the framework of Educational Technology (García-Tudela, 2020).

The word 'enhanced' means something different to each individual, each department, each institution. And a term with such subjective nature, especially with the potential for major impact, should be treated with a healthy level of scepticism. We should question the relationship between the terminology and the pedagogical application and consider the impact of the disconnection between the two (Herrera, 2021).

2.4. Impact of well-designed classroom

The basic unit of a school is classroom. The classroom, apart from satisfying the minimum requirements of space, fittings and furniture, shall be designed to meet the adequate functional and environmental requirements. The size of a classroom shall depend on the following:

1. Anthropometric dimensions of children and their space requirements;
2. Dimensions, arrangements of furniture and equipment and their incidence;
3. Number of students to be accommodated;
4. Types of activities to be carried out; and
5. Diverse seating arrangements are essential for these activities.

(*Indian Standard \ RECOMMENDATIONS FOR BASIC.. REQUIREMENTS OF SCHOOL BUILDINGS*, n.d., 5)

Research seems to show that how a class is arranged accounts for 16% of the impact on a student's learning. When arranging a classroom, teachers need to consider a number of environmental factors, including lighting, temperature, and even air quality and the colours used in the classroom. For many teachers, accounting for every single one of these factors may be impractical. However, the lesson to be taken away is that the design

of a classroom is important to maximizing academic outcomes among students (Loveless, n.d.).

Yet another study indicated that a classroom layout may have a 25% impact on learning, either positive or negative, depending on how the class is designed. With the appropriate classroom layout, concentration can be increased, behaviour can be improved, and teachers can support learning outcomes more effectively. Much like previous studies, researchers noted several factors that might influence academic outcomes. Classroom layout may impact acoustics, so teachers leaning heavily on a lecture format may want to arrange desks such that all students can clearly hear the instructor (Loveless, n.d.).

Essential Constructional Requirements for a classroom are as described as, Height of the classroom should not be less than 3'00 m measured at any point from the surface of the floor to the lowest point of the ceiling. The minimum headroom such as under the bottom of beams, fans and lights shall be 2’6 m measured vertically under such beam, fan or light. The proportion of the breadth (minimum dimension) to the length (maximum dimension) of the classroom should be not more than 1 : 1.5. Sill Heights — The sill height for classrooms with furniture arrangement should be not more than 800 mm measured from finished floor level and that for the classrooms with squatting arrangement should be not more than 600 mm. Rooms shall have, for the admission of light and air, one or more apertures, such as windows and fanlights, opening directly to the external air or into an open verandah. The minimum aggregate areas (see Note) of such openings excluding doors inclusive of frames shall be not less than 20 percent of the floor area in case such apertures are located in one wall and not less than 15 percent of the floor area in case such apertures are located on both side walls at the same sill level. The minimum clear distance between the chalk board and front edge of the first row of desks when chalkboard is in use, shall be 2200 mm. (*Indian Standard \ RECOMMENDATIONS FOR BASIC.. REQUIREMENTS OF SCHOOL BUILDINGS*, 1978, 6)

Classroom layout can impact academic outcomes in a number of ways. The design of a class influences how comfortable students feel, how much they engage with their instructors, and how easily they can engage with one another. For that reason, teachers

should consider classroom layout an important part of achieving their goals instead of a mere afterthought. How a classroom is designed can significantly impact academic outcomes, making classroom layout important to any teacher's instructional approach (Loveless, n.d.).

Table 1: Classroom Fittings

Sl. no.	*Fittings*	*Number of units*	*Area*	*Remarks*
1. Essential Fittings				
a	Chalkboard	1	1200mm* 2400mm	Its base should be 800 mm above the floor/platform level. The location of the chalkboards should be on the walls adjacent to the window wall and placed such that the mid-vertical line of the board lies between one half and two thirds the depth of the room. This is to ensure that the glare due to windows at students' seat area is minimized.
b	Cupboard	1	1.5 m2	Its depth should not be less than 450 mm. It would serve as space for storage of maps, display materials, etc.
c	Pinboard	-	-	There should be one or more near the chalkboard area or on the side walls to display maps, charts, students work, etc.
2. Fittings when needed				
a	Fans	3	1200mm	-
b	Light points	4	-	-

c	Students desks	Depends upon the number of seats to be provided and whether the desks are single or double		
3. Desirable fittings				
a	Wooden Picture Rail	1	Length = Length Of wall	The rail should be provided on the wall opposite to windows or opposite to chalkboard
b	Students' Lockers	1 for each student	-	A locker for each student may be provided in case such an arrangement in students' desks is not possible

(*Indian Standard \ RECOMMENDATIONS FOR BASIC.. REQUIREMENTS OF SCHOOL BUILDINGS*, 1978, 11,12)

2.5. Issues with ill-designed classrooms.

Researchers have said that space affects human behaviour in powerful ways. So, it is striking to realize that in education, empirical research on space is largely underutilized. A rectangular box with row-by-column seating in a double-loaded corridor building. The power of the design of this place has kept us from actualizing the learner-centred paradigm. Architects, designers, academics must all take responsibility for this lack of innovation. Unfortunately, it is often our students who suffer as learning becomes a chore. Educators can acknowledge and incorporate empirical research findings from cognitive neuroscience, learning research, environment behaviour and for support to change the physical design paradigm as well as the pedagogical one. It is important for architects and designers to help educate educators in terms of what is possible spatially; knowing what future practices can and should look like is important. Architects must educate themselves regarding this changing landscape as well as how empirical research should impact classroom design. They must back the full design. They must insist that the interiors and furniture are a part of the holistic design to ensure

the classroom emits the power of supportive, active learning environments (Scott, 2014).

The magnitude of mismatch between desk height and elbow height becomes lower with increasing age of the school children. As the desk height is too high for the lower grade school children, they are required to raise their shoulders during deskwork, which leads to the development of neckache and problems in the upper limbs. For the upper grade school children, the desk height becomes less high with respect to their elbow height, and therefore, the problems of neckache and upper limb discomfort are less prevalent. If the desk is raised too high, the shoulders must frequently be lifted up to compensate, which may lead to painful cramps in the neck and shoulders. Moreover, flat-type desktop surfaces in most cases cause a forward bend of the head of the school children. As an outcome, localized muscle fatigue/pain in the neck area occurs (Kroemer KHE, & Grandjean E., 2001)

Mismatches between the dimensions of school furniture and body dimensions might be the reason for the occurrence of discomfort/problems in various parts of school children's bodies. It can be concluded that an ergonomic intervention is required to redesign the classroom furniture for school children of different age groups in order to reduce furniture-related health complaints (Dhara et al., 2009)

2.6. Significance of creatively and ergonomically designed classroom interior

Designing classrooms creatively and ergonomically can enhance the learning process of the students. The harmony between interior design elements and students learning styles such as environmental, physical, psychological, aesthetic and emotional criteria can enhance thinking and creativity. There must be an interest in applied researches in class design in the field of primary schools by the educational buildings authority due to its importance in forming child’s character. Interior designs must be used to find non-traditional solutions to solve the drawbacks in classrooms in a way suitable for each school in order to have an attractive, safe and creative school

environment. Classrooms must be developed and provided with modern technologies to attract students and fulfil their educational needs. Students numbers inside the class must be decreased as the current situation limits the role of interior design in creating a creativity supportive educational environment (Dr. Alyaa Ezzat Hassan Morgham & Dr. Samar Salah Noaman Ibrahim, 2018)

While ergonomics is extremely important, classroom seating must also be flexible in terms of functionality. In other words, it has to complement the curriculum. Educators and designers feel that classrooms of today have become active learning environments. This requires portable (in weight and design) chairs that students of all age groups can quickly and easily move, arrange, stack and store. (Nair, 2019). School furniture is an environmental factor that is too often neglected considering the fact that it plays an important role in the effectiveness of a student's learning. This opens – up an opportunity for schools and educational institutions to improve students learning and engagement by focusing on proper classroom furniture. Institutions must take initiative to invest in customised school furniture solutions rather than conventional plug-and-play models. They must think beyond regular classroom design and encourage collaborative learning by creating an ideal learning space that suits every child's need (Nair, 2019).

Choosing furniture that meets the needs of students is a positive choice for everyone involved in the school environment. Administrators and architects should change their perspective on furniture costs and consider investing in high quality pieces from the initial phase of the project. Architects should also take into account the parameters of efficiency, ergonomics, and flexibility explained above, putting children at the center of school design. Therefore, in addition to providing spaces for free and guided movement, the school furniture of the future must be aligned with the needs of a more flexible didactic environment, which in turn must be durable and comfortable for all users (Migliani, 2020).

Chapter 3

METHODOLOGY

CHAPTER- 3

METHODOLOGY

Enhancing the learning environment for primary schools students can considerably impact their abilities and personality traits positively as this is a crucial age of an individual's life. The study **"Enhanced learning in Primary school education through creative and ergonomically designed interiors"**, is aimed to analyse the existing primary schools' environment and develop an ergonomically designed classroom for the students. The methodology used for the above study is discussed below.

The research methodology pertaining to the study comprised of two different phases as follows:

2.1. Phase 1 - Online survey among students and teachers of selected primary schools to study about the existing classroom interior facilities and a visit to the selected schools and observation of the researcher to get ore insight into the prevailing learning environment.

2.2. Phase 2 - Development of a creative and ergonomically designed classroom interior model for the purpose of enhanced learning.

3.1. PHASE 1 - Online survey among students and teachers of primary school to study existing classroom interior facilities.

Phase 1 of the study consisted of an online survey among the teachers and students of primary schools to get an insight into the existing classroom conditions, as they are key users. An online survey is conducted using a structured questionnaire that your target audience completes over the internet generally by filling out a form. Online surveys can vary in length and format. The data is stored in a database and the survey tool generally provides some level of analysis of the data in addition to review by a trained expert. (*Online Surveys*, n.d.)

Advantages include access to individuals in distant locations, the ability to reach difficult to contact participants, and the convenience of having automated data collection, which reduces researcher time and effort (Wright, 2017, 1). As a result of the COVID pandemic, internet use has tremendously increased among all age categories. Most schools have WhatsApp groups for each class consisting of the students and teachers in charge. Hence it was more convenient to do the online survey among the students and teachers of primary school.

The survey comprised of the following steps:

3.1.1. Selection of area

3.1.2. Selection of sample

3.1.3. Selection of tool

3.1.4. Collection, consolidation and analysis of data.

3.1.1. Selection of Area

The area selected for the study was Thiruvananthapuram district. Students and teachers of different life conditions, communities etc are living there. The area was selected mainly due to the convenience of the researcher.

3.1.2. Selection of sample

The sample included students (100) and teachers (20) from 5 government primary schools. The sampling technique adopted was convenience sampling. Convenience sampling is defined as a method adopted by researchers where they collect market research data from a conveniently available pool of respondents. It is the most commonly used sampling technique as it's incredibly prompt, uncomplicated, and economical. In many cases, members are readily approachable to be a part of the sample (Fleetwood, n.d.).

3.1.3. Selection of tool

Selection of tool is important for a stage in a study. Using a questionnaire for the data collection is a convenient way to collect and consolidate the data. A questionnaire is a research instrument that consists of a set of questions (or other types of prompts) for the purpose of gathering information from respondents through a survey or statistical study. A research questionnaire is typically a mix of close-ended questions and open-ended questions (*Questionnaire*, 2022.). Two seperate structured questionnaires were developed for the data collection from the students and teachers. For convenience, a Malayalam questionnaire enquiring general information and opinion about existing classroom facilities and learning environment was prepared for the students and an English questionnaire for the teachers to collect general information, their knowledge about ergonomics and their perceptions about ergonomic considerations experienced by students was prepared.

3.1.4. Collection, consolidation and analysis of data.

Data collection was done online. The researcher visited the selected schools and took permission from the authorities to conduct the survey. A KAP questionnaire was prepared in Google forms format. The questions included in the questionnaire were explained to the students in advance through a google meet and after that and it was sent to the WhatsApp groups of the students and teachers. Responses were collected and analysed using the statistical software, SPSS.

The researcher visited the selected schools, closely observed the existing learning environment, noted the faulty design features in the classroom and remarked on the observations.

3.2. PHASE 2 - Development of a creative and ergonomic classroom interior model for the purpose of enhanced learning.

Based on the responses from the survey, the researcher found the need of modifying the existing classrooms, incorporating the suggestions from teachers and students. The facilities to be added to the model were determined and the layout was drafted accordingly by the researcher using, the 2D drawing software, AutoCAD. The 3D model of the classroom was developed using the 3D modelling software, 3ds Max and rendered using Lumion.

RESEARCH DESIGN

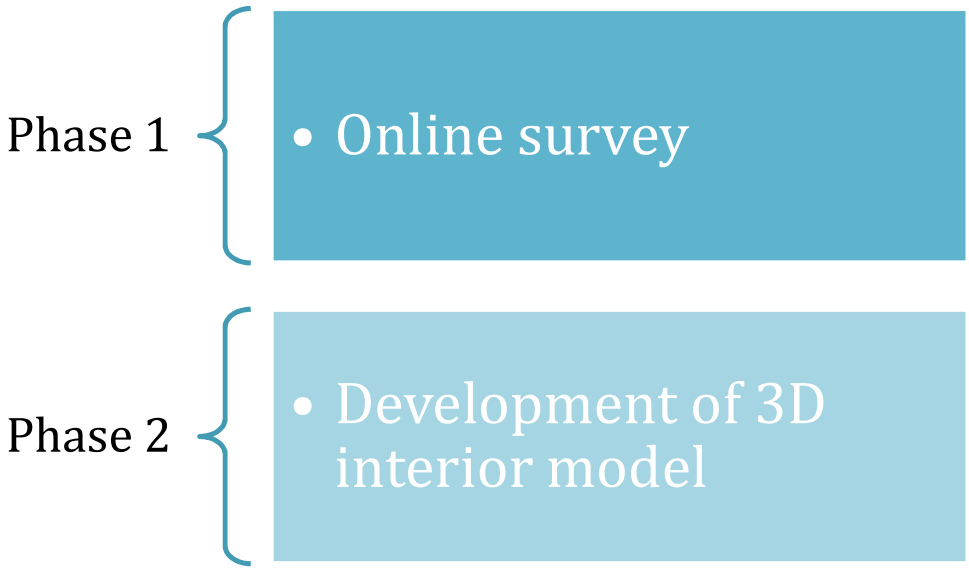

Figure 1: Research design- Major phases

Phases of research design

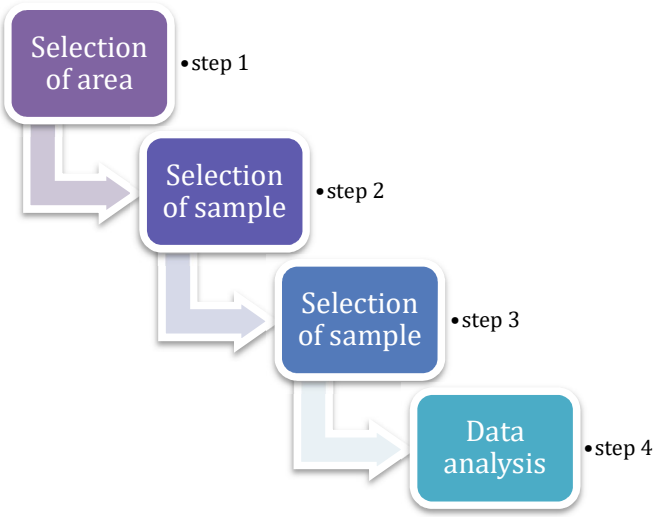

Figure 2: steps in phase 1

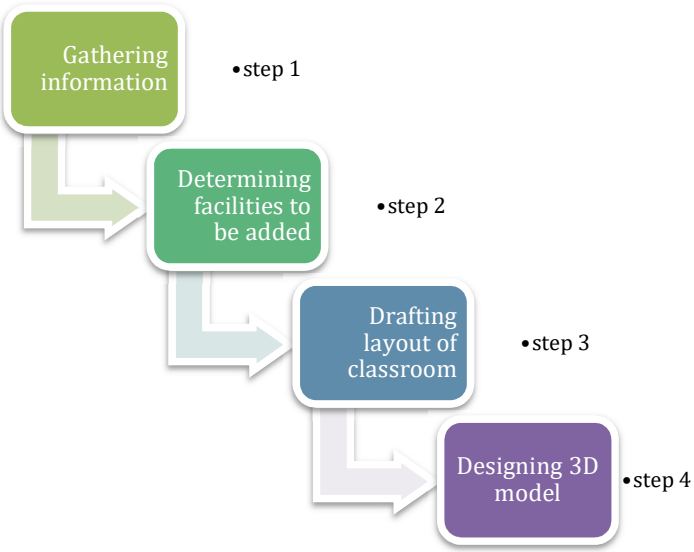

Figure 3: steps of phase 2

Chapter 4

RESULTS & DISCUSSION

CHAPTER- 4

RESULTS & DISCUSSION

The research was done to create an ergonomically designed classroom for enhanced learning for primary school children, by analysing the existing learning situation in selected schools and collecting necessary data from the students and teachers of respective schools. The result of the study entitled "Enhanced Learning through creative and ergonomically designed interiors" is discussed under the following phases:

I. Online survey among students and teachers of primary school to study existing classroom interior facilities.

II. Development of a creative and ergonomic classroom interior model for the purpose of enhanced learning.

PHASE 1 - Online survey among students and teachers of primary school to study existing classroom interior facilities.

The study included data collection from upper primary school students and their teachers, two separate questionnaires were prepared and distributed. Field visits and observations of the existing school learning conditions were also assessed. The phase 1 study analysis is discussed under the following headings:

4.1. Preliminary information about selected schools

4.1.1. Locale of the School

4.1.2. Profile of selected schools

4.1.3. Details of students and teachers

4.2. Students' responses about the existing classroom facilities and learning environment

4.2.1. Knowledge about the learning environment in the classroom

4.2.2. Attitude about the learning environment in the classroom

4.2.3. Practices about the learning environment in the classroom

4.3. Teachers' Knowledge of ergonomic considerations and impacts

4.3.1. Familiarity with ergonomic concepts

4.3.2. Basic knowledge of ergonomics and its applications in the classroom environment

4.4. Teachers' perception on ergonomic aspects like comfort, design and productivity experienced by students

4.1. Preliminary Information about selected schools

The preliminary information about schools selected for the study is discussed below. Responses from 20 teachers and 100 students were collected through an online survey using Google Forms. The collected data were analysed using statistical software called SPSS.

4.1.1. Locale of the School

Five government schools from the Thiruvananthapuram district of Kerala was selected for the purpose of data collection for the study. Three of them are integrated with higher secondary schools and two are solely upper primary schools. The schools selected for the study purpose are listed below:

- ➔ LMS UPS, Uriyacode
- ➔ Govt. H S S For Girls, Nedumangad
- ➔ G Karthikeyan Smaraka Govt. V&HSS, Vellanad
- ➔ Govt. UPS, Karakulam
- ➔ Govt. V. H. S. S. Veeranakavu

LMS UPS, Uriyacode is situated at the Poovachal panchayat and in the educational district of Neyyatinkara in Thiruvananthapuram in a rural area. It was established in 1917. Govt HSS for Girls, Nedumangad is situated in an urban area in the Nedumangad panchayat and in the educational district of Attingal. G Karthikeyan Smaraka Govt. V&HSS, Vellanad is in a sub-urban area of Vellanad panchayat and in the educational district of Attingal. It was established in the year of 1891.Govt. UPS, Karakulam is situated in a sub-urban area of the Karakulam panchayat and in the educational district of Attingal. Govt. V. H. S. S. Veeranakavu is also situated in the Poovachal panchayat and in the educational district of Attingal. It is a hilly area and rural.

4.1.2. Profile of selected schools

The LMS UPS, Uriyacode is situated in a hilly area. The total land area owned by the school is 3 Acre and 10 cents. The building type is pucca. The school has its own library, computer lab, rainwater harvesting system and waste management system. It also has an alive agricultural activity going on in the school and a garden. Govt HSS for Girls, Nedumangad has a total land area of 6.5 Acre and the building type is semi-pucca.

The school has facilities like a library, multi-media room, stationery store, a badminton playground, rainwater harvesting system, waste management system, biogas and incinerator facility.

G Karthikeyan Smaraka Govt. V&HSS, Vellanad has a total land area of 4 acres. The upper primary section is situated 350m to the south of the high school building on the other side of the road. The building type is pucca. The school is enriched by the facilities like a library, solar power, 35 smart classes, a first aid room, a stationery store, a rainwater harvesting system, an open auditorium and active agriculture. Govt. UPS, Karakulam has a total land area of 0.55 acres with a pucca building type. The school provides facilities like a library, smart classroom, first aid room, auditorium and agricultural activity. Govt. V. H. S. S. Veeranakavu has a total land area of 2.5 acres and is a pucca building. The school provides facilities like a library, smart classroom, stationery store, football playground, auditorium, incinerator facility and has agricultural activities.

Table 2: Locale details of schools.

Locale	*Number of schools (N=5)*
Urban	1
Sub-urban	2
Rural	2

4.1.3. Details of teachers and students

LMS UPS, Uriyacode is a solely upper primary school with grades five, six and seven. The total number of 5 teachers including the headmistress. They have both English and Malayalam medium classes. The total number of students in the upper primary is 94, among which 27 students are in 5th grade, 28 students in the 6th grade and 39 students in 7th grade.Govt HSS for Girls, Nedumangad is a higher secondary

school with primary, high school and higher secondary sections. They gave 59 teachers in total. The strength of students in 5th grade is 138, in 6th grade is 161 and in 7th grade is 244, which adds to a total of 543 students in the upper primary section.

G Karthikeyan Smaraka Govt. V&HSS, Vellanad is also a higher secondary school with primary, high school, higher secondary and vocational higher secondary sections. The total number of teachers in the school is 73. The total number of students in both the English and Malayalam medium of the upper primary is 666, of which 204 students belong to 5th grade, 208 belong to 6th grade and 254 students belong to 7th grade. Govt. UPS, Karakulam is an upper primary school with both upper and lower primary sections. They have a total of 17 teachers. The total strength of students in the upper primary section is 216 with 82 students in the 5th grade, 72 students in the 6th grade and 62 students in the 7th grade. Govt. V. H. S. S. Veeranakavu is a vocational higher secondary school with primary, high school, higher secondary and vocational higher secondary sections. They have a total number of 32 teachers. The upper primary has 70 students in 5th grade, 68 students in 6th grade and 81 students in 7th grade, with a sum of 219 students.

Table 3: Details of Students

Students' details	*Responses of students in percentage (%) (N=100)*
Grade	
5th-grade	18
6th-grade	31
7th-grade	51
Age	
9- 10	19
11- 12	62
13- 14	19

Medium of instruction	
English	72
Malayalam	28

The students of upper primary, that is from grades 5, 6 and 7 participated in the survey. The age group is between 9 and 14. The highest response (51%) is from the students in 7th grade. The strength of most of the classes (73%) was above 30. 27% of classes had students below 30.

Teachers from different age groups participated in the survey. The youngest was 29 years old and the eldest was 54 years old. The highest response (55%) was from the age group of 45 - 55 years.

4.2. Students' responses about the existing classroom facilities and learning environment

The data regarding existing facilities and learning environment were collected from hundred students belonging to five schools. The questionnaire was prepared to get more insight into the experience of students inside the classroom and of the existing facilities. A KAP questionnaire was prepared in the Google forms. The questions included in the questionnaire were explained to the students in advance through a google meet and the Google forms were sent to them. Responses were collected and analysed.

4.2.1. Knowledge about the learning environment in the classroom

Students' knowledge about the required facilities in the classroom was gathered during the survey. They were asked about the need for various facilities that should be present in the learning environment, to which they responded as follows.

Table 4: Knowledge from the students for the improvement of the classroom environment

Sl. No.	*Suggestions from students about facilities to be added*	*Responses of students in percentage (%) N= 100*	
		Yes	*No*
1	Proper ventilation is needed	43	57
2	Chairs with backrest are more comfortable	83	17
3	Separate table and chair for each student is more learner-friendly	59	41
4	Height adjustable chair and table are preferable	62	38
5	Shelves in every classroom are needed to keep bags, books and other study materials.	51	49
6	Need drinking water purifier in each classroom	46	54
7	More attractive, exciting and learner-friendly classrooms needed	71	29
8	Placement of a notice board in every class to know the essential information from the school	28	72
9	Mini library for the students	31	69
10	Overhead projectors and internet connectivity	44	56
11	Dry erase board instead of the black board and chalk dust	67	33
12	Slanted desks for better writing posture	53	47

13	Waste bin for a clean class and effective waste disposal	86	14
14	Need for more lights for better view of the board and teacher	32	68
15	Seating that enables students to have a clear sight of board	55	45
16	Attractive wall paintings as per the interest of students	74	26
17	Provide newspaper in classes so that the students would grow their habit of reading and at the same time improve their general knowledge	31	69
18	Smart classes for advanced learning	88	12
19	Computer accessibility in classroom	92	8
20	Noise proofed activity area to encourage creative activities	14	86
21	Desks with wheels for smooth movement as per the students' requirement	41	59
22	Enough space inside the classroom that facilitates all the activities done inside	56	44

The students' knowledge about the needs that they deserve for a better learning experience was reflected. The responses to the fact about ventilation have 57% no, which shows the ignorance of the students about the importance of proper air circulation. The same conditions go for the question about noise proofing. This gives us the idea the knowledge possessed by each student was different for which some need to be more educated about the good learning conditions.

4.2.2. Attitude to learning environment in the classroom

The students' attitude about their needs in the classroom they spend their day time was also analysed. It is evident from the responses that most of the students have noticed the difficulties they face while sitting in the classroom which made them think of better ideas to make it comfortable

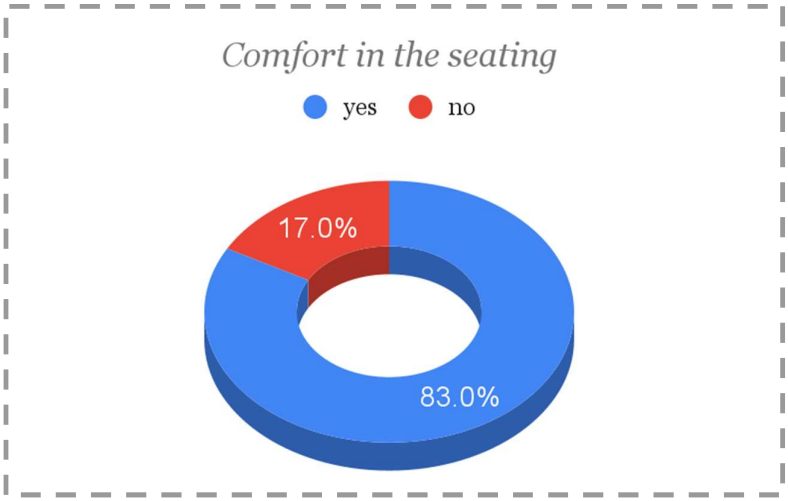

Figure 4: Ensured comfort in seating position

83% of the students adjusted in their seats to ensure comfortable seating. While 17% weren't much bothered about it.

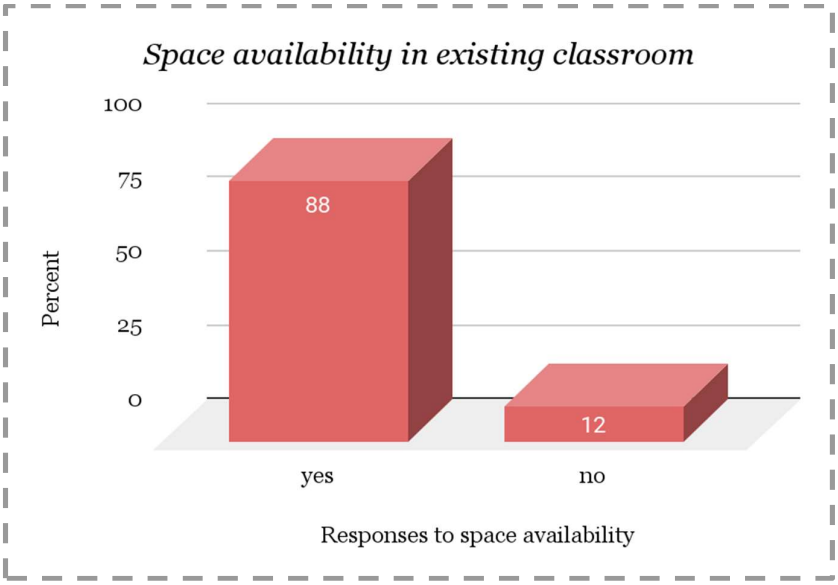

Figure 5: Make use of classroom space wisely

88 % of students claimed the effective use of available space in the classroom while 12% seems to be ignorant.

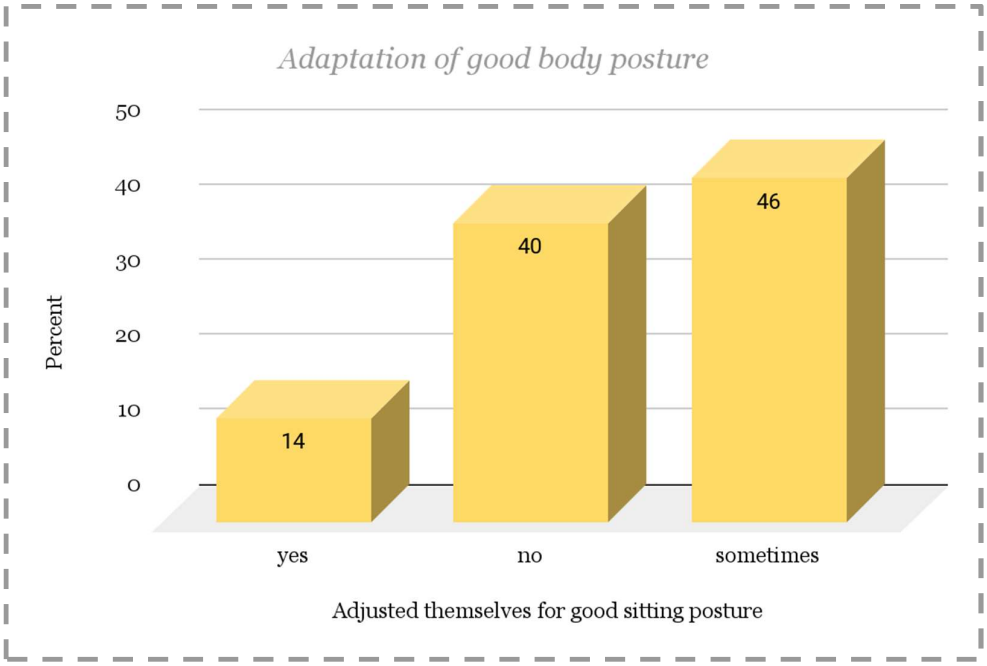

Figure 6: Adapting good body postures to reduce pain and other issues.

Improper design of a classroom can cause unnecessary body pain. 14 % of the students changed their sitting posture to relive body pain and 46% were not much bothered about it.

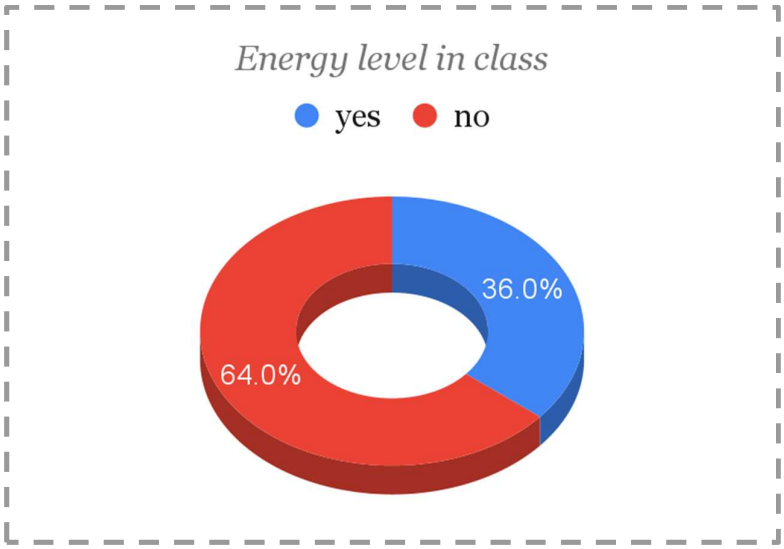

Figure: 7: Tried to be energetic in class

Among the students, 36% of the students tried to maintain their energy throughout the day while sitting inside the class. 64% of students don't seem to be bothered about it.

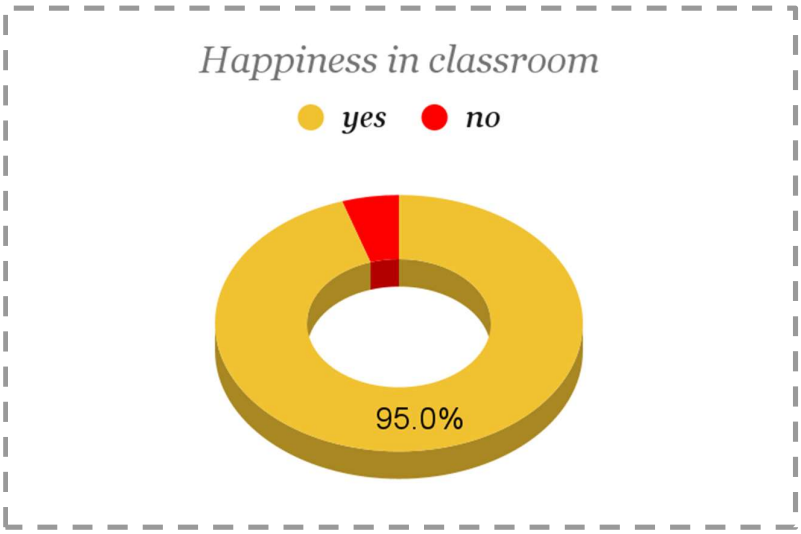

Figure 8: Be happy in the classroom

Cheerful educational system may provide innovation and new thinking and ideology of the world. As we know a considerable part of students' time spends in school and students need to be happy while in school. Happiness will make positive attitudes among students and may lead to higher academic achievement and eventually more active citizens. School authorities, therefore, need to revise their learning programs as well as physical possibilities implemented in schools. Therefore, it is necessary to pay more attention to these factors (Talebzadeh & Samkan, 2011, 1470). For an inquiry about being happy inside the classroom, 5% of the subjects stated that they don't care to be happy in the class. 95% of subjects seemed happy to sit in the classroom.

4.2.3. Practices about the learning environment in the classroom

The current practices inside the classroom were analysed using a set of questions.

Table 5: Details on the positioning of body parts

Sl. No.	*Variables*	*Responses in percentage (%) N= 20*	
		Yes	*No*
1.	Feet are fully supported by the floor at a 90-degree angle when sitting in the classroom	69	31
2.	Back is straight & supported by the chair when sitting in the classroom	15	85
3.	Elbows are bent at a 90-degree angle & supported by the desk height	64	36
4.	Adjusting chair and table to get a proper vision of the board and teacher	57	43
5.	Walk/ stand during break times to relax the body	93	7
6.	Ensure good relationships with friends in the classroom	87	13
7.	Always ensure hygiene in the classroom	56	44

The position of the feet, back and elbows of the students while seated inside the classroom are shown in table 5. Of the students, 31% say that their feet are not fully supported by the floor while sitting in the seats provided, this can be due to the mismatch of the furniture measurements with their body measurements. While 69% of students agree that their feet are fully supported by the floor at a 90- degree angle when seated in the classroom.

When placing hands on the desk provides, 36% of the students said that their elbows are not properly supported by the desk for purposes like writing. 64% are satisfied with the desk height and the position of their hand on them.

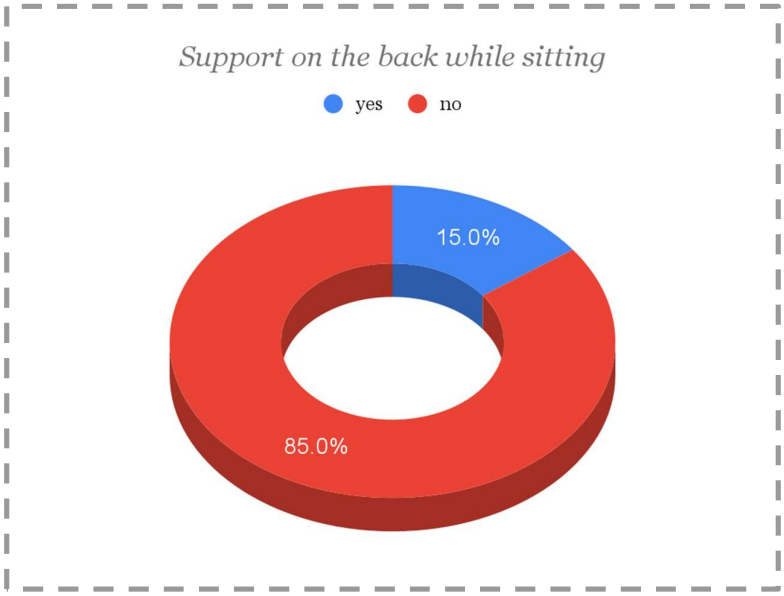

Figure 9: Back is properly supported

Data also shows that the students' backs are not supported and are not straight while sitting in the classroom. This can cause severe problems with their posture. Most of the classrooms have benches without a backrest which adds to this issue.

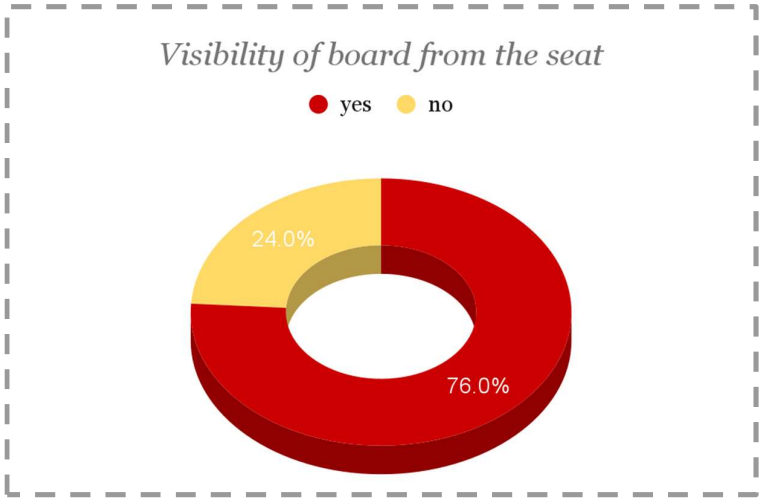

Figure 10: Visibility of board from the seat

From the data collected, it is observed that 24% of the students had issues with viewing the board clearly. Whereas 76% has no such issues and can see the board clearly from their seats.

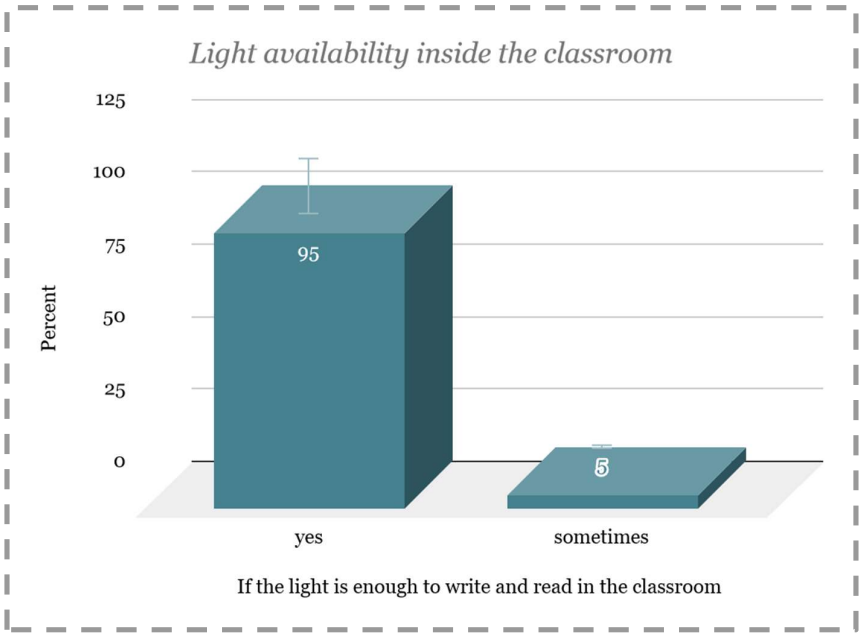

Figure 11: Light availability inside the classroom

Many students have suggested to add more light fixtures to the classroom on the survey. To give more lights for better visibility, and also to make sure the already installed light fixtures are maintained in case of any damage or issue. However, only 5% had expressed the need to have more lights than that are available in the classroom now. 85% were happy with the existing lighting.

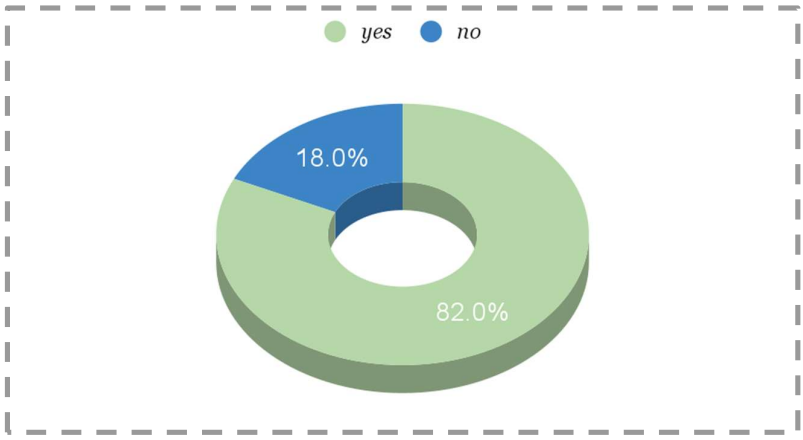

Figure 12: Availability of fan and enough air circulation

Fan and air circulation were another factor came on the survey, in which many students suggested to provide more fans to their class. Classes had enough ventilation pathways but a smaller number of fans. However, survey shows that 18% of the students are not satisfied with the current availability of fans in the classroom meanwhile 82% of students are satisfied.

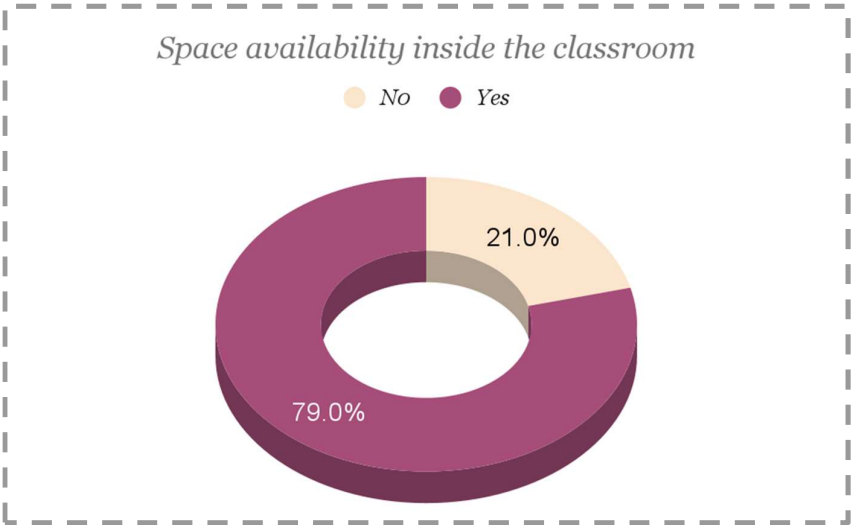

Figure 13: Space availability inside the classroom

Some of the students had mentioned about having more space inside the classroom on the suggestions. Here the survey shows that 21% of the students were not satisfied with the current availability of space in the classroom, meanwhile 79% was happy with the it.

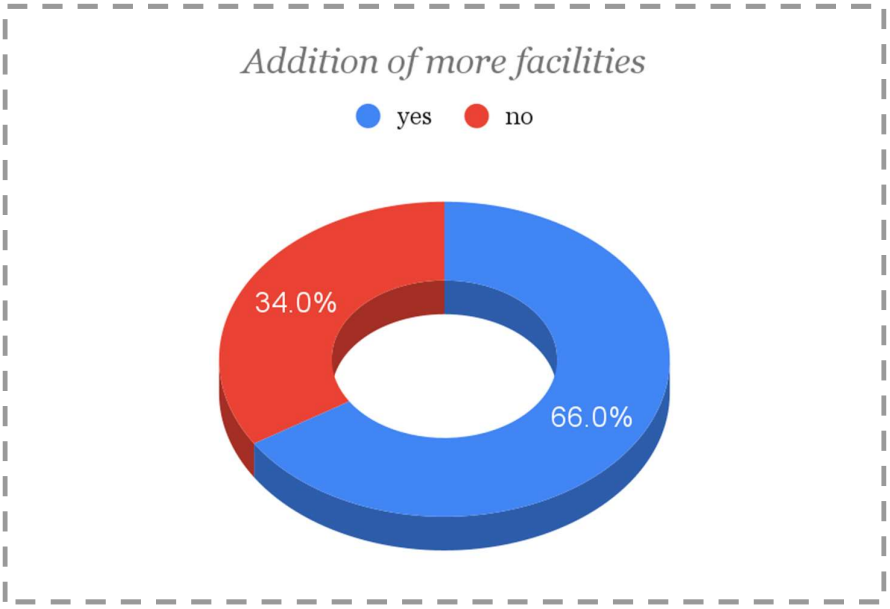

Figure 14: Need of more facilities

35% of the students had expressed the need to have more facilities in their classroom whereas 64% are satisfied with what they have now.

4.3. Teachers' knowledge on ergonomic considerations in practice

The extent of awareness of ergonomics among the teachers was analysed through the survey. The levels of knowledge from the fundamentals, to different aspects of ergonomics like comfort, design and productivity were analysed.

4.3.1. Familiarity with Ergonomics.

Among the 20 teachers, 70% of them were familiar with the term ergonomics. Among the responded teachers 10% claimed to have better knowledge about ergonomics and its applications in classroom for enhanced learning. 60% had negligible knowledge about the need of its applicability for enhanced learning

4.3.2. Fundamental knowledge of ergonomics and its applications in classroom environment

Ergonomics deals with the human body and its interactions with the system around it. 60% of the teachers knew about this fundamental knowledge. 20% didn't know about anything about ergonomics and its applications in classroom, 20% were doubtful because it's not a very familiar topic to them. The consideration of the environment around the subject was familiar to 45% of the teachers. Poorly designed working environment can create stress to the users. 45% of the teachers were aware of the stress due to improper design and 30% weren't aware of such facts.

Table 6: Details on awareness about ergonomics in teachers

Sl. No.	*Response*	*Response of teachers in percentage (%) N= 20*		
		Yes	*No*	*Maybe*
1.	Interaction with human body and system around it	60	20	20
2.	Environmental awareness	45	30	25
3.	Stress due to improper design	45	30	25

4.4. Teachers' perception on ergonomic aspects like comfort, design and productivity experienced by students

The teachers were asked questions about the comfort, design and productivity aspects of the existing classrooms in the upper primary section. In the section about comfort aspects, questions about the positions of the elbow, feet and back of children while they sit inside the class, grievances about any kinds of body pain, etc were enquired.

4.4.1. Comfort aspects
4.4.2. Design aspects
4.4.3. Productivity aspects

4.4.1. Comfort aspects

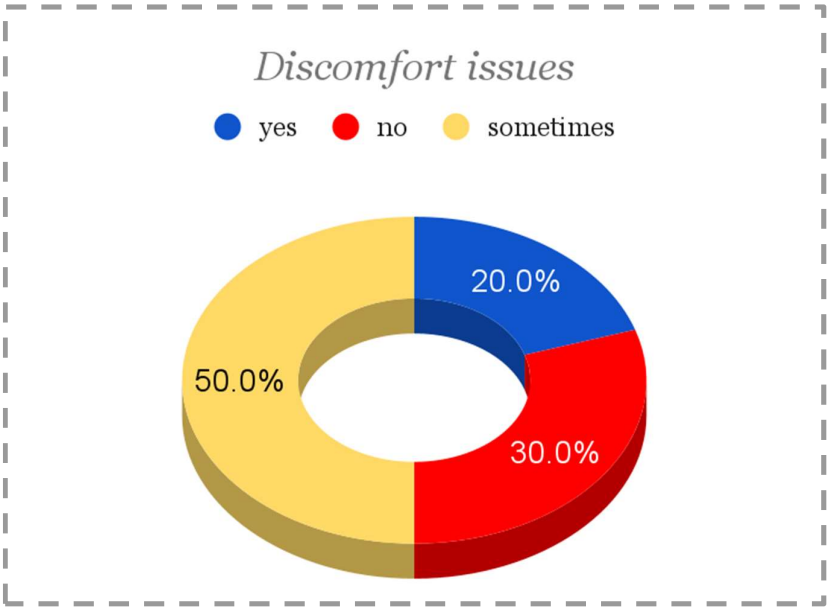

Figure 15: grievance about discomfort in classroom

The survey shows that students complained about the discomfort they feel while sitting in the class. 50% of teachers admitted that students occasionally complained about the discomfort.

The risk factors most significantly associated with back pain are primarily characteristics of the individual with less strong associations with factors present in the school environment. The majority of intervention studies undertaken in a school setting have focussed on the effect of school furniture on posture and comfort and were of short-term duration (F.C.Trevelyan & S.J.Legg, 2006, 44).

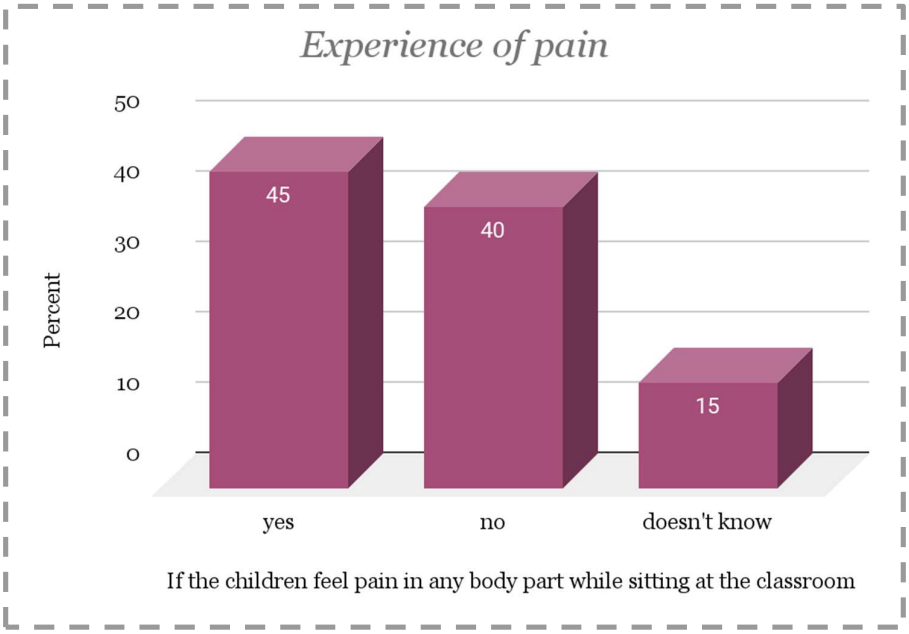

Figure 16: Experience of pain in various body parts

The occurrence of pain in the body parts of children while sitting was studied by teachers. From the responses collected, it is evident that 45% of teachers received a negative feedback from the students that they had different health issues like back pain, neck pain, arm, legs and knee discomfort etc, while sitting in the classroom. 40% of the teachers believed that the sitting position provided for the children is not suitable for them might be the reason for various discomforts and health issues among students.

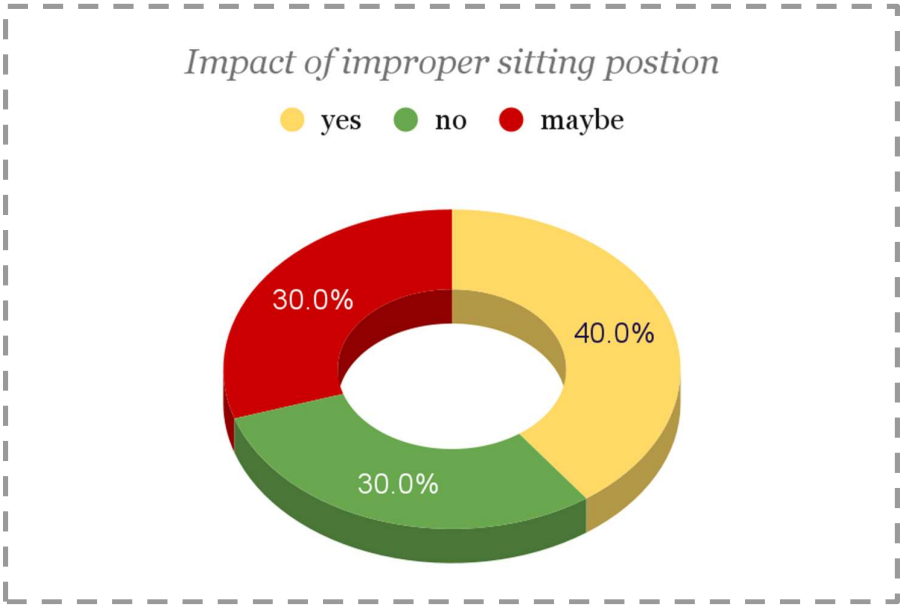

Figure 17: Difficulty for children due to improper sitting position

The support available for the body parts while sitting was analysed. 65% of the teachers' opined that due to usage of benches without backrests in the classroom, they followed very poor proper sitting posture. Students' were asked whether their elbows are bent at 90-degree and supported by the desk height, for which 30% of the students responded positively and the rest of the students disagreed or were not very sure about that aspect.

Table 7: Details on the comfort aspect

Sl. No.	*Observation of students' sitting posture in classroom*	*Responses in percentage. N= 20*		
		Yes	*No*	*Maybe*
1.	Their back is straight & supported by the chair	20	65	15
2.	Elbows are bent at a 90-degree angle & supported by the desk height	30	25	45

Appropriate sitting posture is significant for the health of the body. From the survey, 85% of the teachers knew this fact. 5% weren't aware and the rest 10% were not sure about this. Ergonomically designed furniture can contribute to an appropriate sitting posture, which reduces the body pain due to improper design. 60% of the teachers were aware of this fact. 15% weren't aware and 25% were not sure about it.

4.4.2. Design aspects

The interior design of the primary school classes is important to the mental and physical aspects of the children. According to the survey, the classroom interiors have been made interesting with colours and pictures from 55% of the teachers' responses. The design of furniture for the children is not done according to their body measurements in the opinion of 55% of the teachers. The furniture is said to be properly spaced by 75% of the teachers, allowing a proper view of the teacher and the writing board for the children seated on them.

The indoor temperature affects several human responses, including thermal comfort, performance in certain kinds of tasks and perceived air quality. Low ventilation in combination with high air temperature would most probably decrease productivity further (Zunjic et al., 2015, 85).

The environment analysis was also done during the survey. It shows that 100% of the subjects agree that the classrooms are properly ventilated providing a good air passage and circulation. The lighting is also done good according to the opinion of 55% of the teachers, facilitating a good view of the writing board for the children without the problem of glare. The details are given in table 8.

Table 8: Details on the design aspect

Sl. No.	*Parameters*	*Responses in percentage. N= 20*		
		Yes	*No*	*Maybe*
1.	The classroom interior is designed with interesting colours and pictures to excite the children	55	35	10
2.	The furniture is designed as per the body measurements of the children	30	55	15
3.	The furniture is spaced properly without disrupting the view to the teacher and the board	75	15	10
4.	The classroom is properly ventilated facilitating good air passage	100	-	-
5.	The lighting is properly done, facilitating a good view of the board for the children without the problems of glare	55	10	35

4.4.3. Productivity aspects

The classroom interior can affect the productivity of the children. This can be reflected in their academic performance and attentiveness while in the classroom. 60% of the teachers say that the children seem less interested to sit in the classroom rather than being in the playground. There is a chance that this may be an effect of improper classroom design. It is a known fact that an ergonomically designed classroom can increase the productivity of the children and it's been confirmed by 60% of the subjects. 10 % didn't know about this and 30% expressed uncertainty about the same fact.

Table 9: Details of the productivity aspects

Parameters	*Responses in percentage. N= 20*		
	Yes	*No*	*Maybe*
The children seem interested to sit inside the classroom rather than being in the playground	20	60	20
The teachers know that classrooms designed ergonomically can increase the productivity of the children	60	10	30

Ergonomically designed spaces are definitely needed for enhanced learning. 80% of the teachers participated in the survey trusted the need of ergonomically designed classroom interior for enhanced learning and a suggested more facilities in the classroom for improved learning.

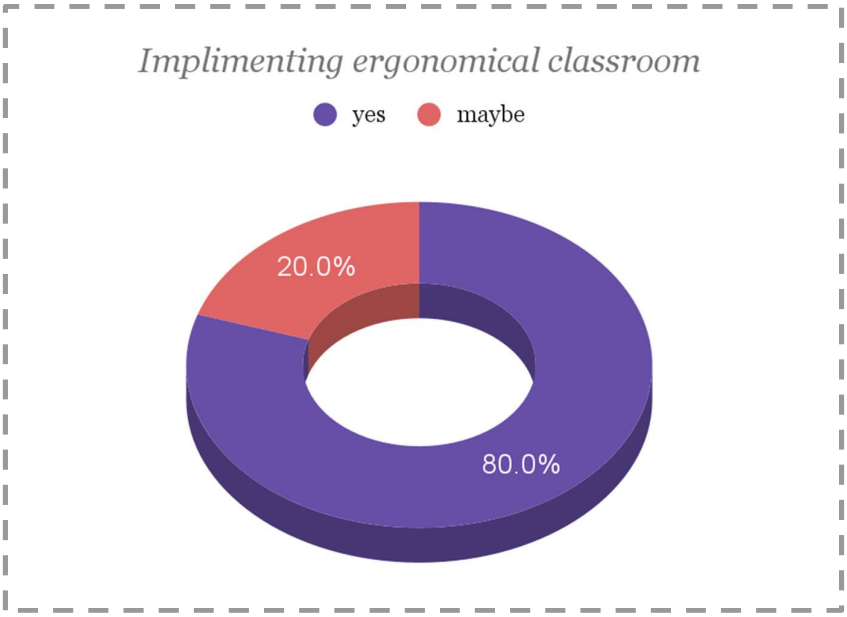

Figure 18: Interest to implement ergonomic classrooms

The suggestions given by teachers to improve the classroom learning environment are listed in table 10.

Table 10: Teachers' suggestions to improve the learning environment

Sl. No.	*Suggestions from teachers about facilities to be added*	*Responses from teachers in percentage (%) N= 20*	
		Yes	*No*
1.	Facilities to control Temperature, noise and dust	83	17
2.	Proper lighting inside classrooms	79	21
3.	Chairs instead of benches would be better	88	12
4.	Child-friendly & eco-friendly classrooms are needed	66	34
5.	Separate chair and table for each student	57	43
6.	Necessary digital facilities	61	39
7.	More spacious classrooms	52	48
8.	Installation of more fans	49	51
9.	Facilities for keeping students' school bags	71	29
10.	Chairs and desks can be adjusted according to the height of the children.	65	35
11.	Soundproofing to avoid unwanted noise from outside environments, especially the sound of vehicles and horns	53	47
12.	Eco-friendly and more green classes	66	34

PHASE 2 - Development of a creative and ergonomic classroom interior model for the purpose of enhanced learning.

From the inference of the data collection and analysis, the drawbacks of the existing learning conditions were found. To incorporating the suggestions given by students and teachers, a 3D model of a creative and ergonomically modified interior was developed. The step by step procedure of the 3D model design are given below.

Step 1: Gathering information about the standard classroom dimensions and students-teacher ratio

Step 2: Determining the facilities needed to be incorporated into the classroom design

Step 3: Drafting the layout of the classroom

Step 4: Designing the 3d model of the classroom

1. Gathering information about the standard classroom dimensions and students-teacher ratio

There are standard measurements for the classroom dimensions for every sections of a school, college or any other institution. As a student moves from nursery to higher levels, the process of imparting education becomes more and more involved. This demands addition of a number of facilities to the basic class room unit depending upon the level and nature of the school. At present, in the absence of any uniform standards, there is marked variation in the educational facilities between various schools.

Again, in view of the changes in educational pattern as well as teaching aids adopted, it is necessary to introduce the relevant requirements in a national standard. The standard is, therefore, intended to lay down optimum requirements for school buildings, subject however to local conditions. The purpose of this standard is not to offer design solutions for an educational facility but to lay down standards for both

spatial and environmental needs of the basic classroom and allied spaces. The standard is also recommended for the renovation or expansion of facilities of the existing school buildings (*Indian Standard \ RECOMMENDATIONS FOR BASIC.. REQUIREMENTS OF SCHOOL BUILDINGS*, 1978, 3).

As per the Indian Standard Recommendations for basic requirements of school buildings, the height of the classroom should not be less than 3m from the floor and the proportion of the length to breadth should not be more than 1: 1.5.

Under the Right to Education Act 2009, which covers children between 6-14 years of age, the stipulated pupil-teacher ratio for primary classes and upper primary classes is 30:1 and 35:1 respectively (Dutta, 2020). By considering the space and convenience, the classroom was designed for the strength of 25 students and a teacher.

2. Determining the facilities needed to be incorporated into the classroom design

There are some basic facilities that are to be present in any classroom. The rooms should have admission for the proper amount of light and air, an adequate number of fans, lights and ventilation should be provided. The essential elements that should be present in any classroom include a whiteboard, chairs and desks, cupboards, pinboards etc. most of the classrooms visited, don't have all these essentials. Instead of chairs, they were provided with benches that do not support good sitting posture. Also, the boards where chalk boards were used, which causes more dust and can possibly cause allergies and other respiratory issues. Digital facilities weren't present in most of the classes.

In the design, all of these essential requirements are added and also, from the insights of the survey more facilities were also added, which are listed below:

- Individual chairs and desks
- Whiteboards
- Projector and screen

- Space to keep school bags comfortably
- Adequate lighting fixtures
- Adequate fans
- Wall paintings
- Water purifier
- Cupboards for safekeeping of books
- Notice board
- Indoor plants

3. Drafting the layout of the classroom

The final layout of the classroom was done digitally using the 2D drawing software, AutoCAD. AutoCAD stands for Computer-Aided Design and is used for designing and drafting. It is most commonly used for creating and modifying 2D & 3D designs for professional drafting with detail measurement information about the conceptual design and layout of the product. (*Uses of AutoCAD | Basic Concepts About AutoCAD*, 2022). The dimensions taken are given in table 11 and the layout is as in figure 16 .

Table 11: Major dimensions of classroom

Sl. No.	*Parameters*	*Dimension in cm*
1	Length	730
2	Width	610
3	Height	500
4	Whiteboard length	240
5	Door width	100
6	Teachers platform height	30

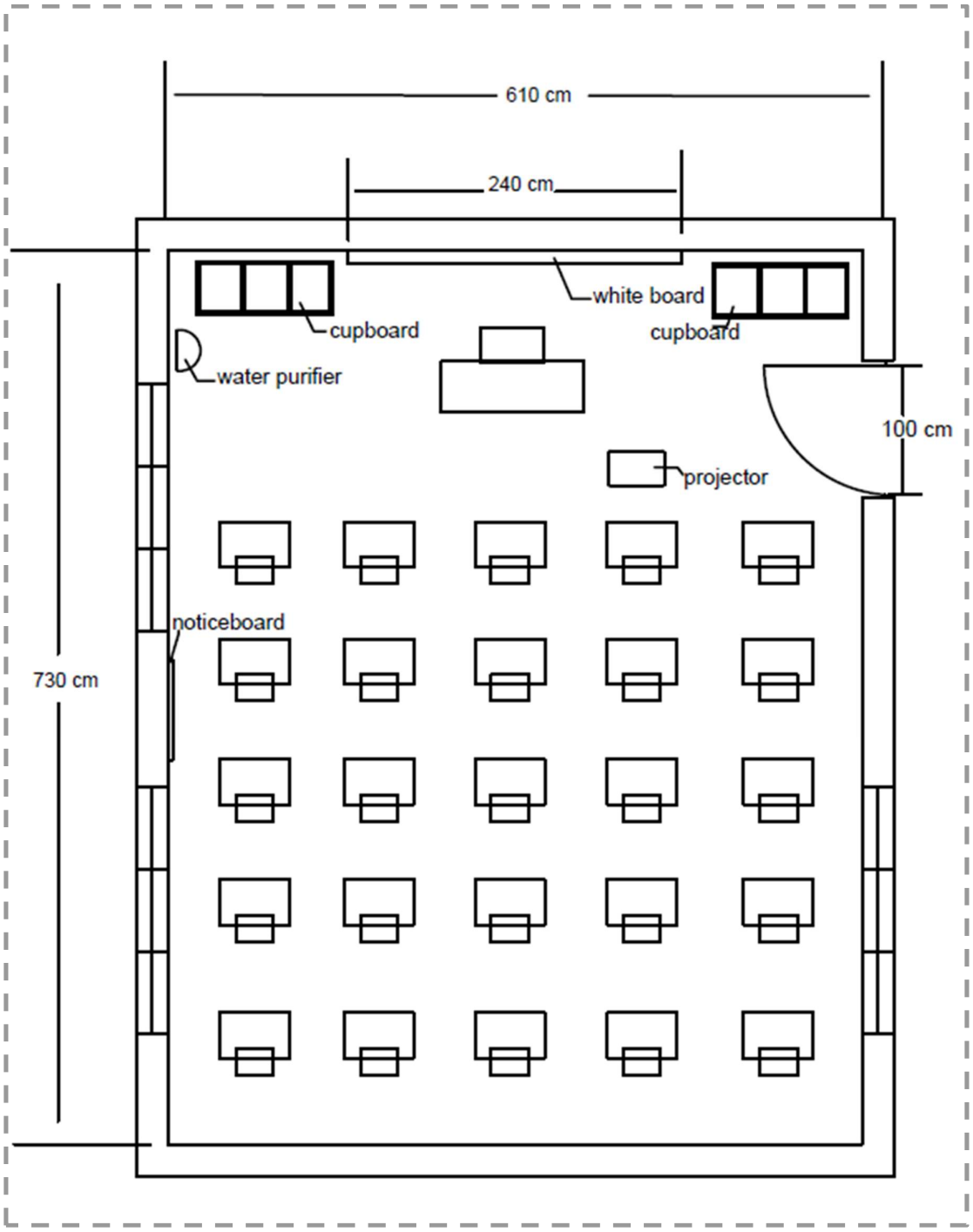

Plate 1: Layout of the classroom

4. Designing the 3d model of the classroom and rendering

The 3D model of the classroom was developed from the layout, exporting it to the 3D modelling software, 3ds Max. Autodesk 3ds Max is the most popularly used program for creating 3D models, games, and animations. 3D artists and developers widely use the program. It is used basically in the gaming and entertainment industry for editing and creating 3D artworks. One of the most useful uses of the 3D Max is in the architectural industry, where architects use the program to create 3D models of Interior and Exterior architecture to better understand the building or the object (*3ds Max Architecture | Create a House With Tools and Functions in 3D Max*, 2022).

The model was developed with the necessary facilities. It was rendered using a rendering software, Lumion. Lumion is 3D rendering software made specifically for architects. If you have a 3D model of your architectural design. Lumion conveys the beauty of your design by unveiling it in its full, detail-rich context, complete with shadows, lighting, rich and animated entourage, and all the other benefits of a Lumion environment (Chavanne, 2022). The images are as shown below:

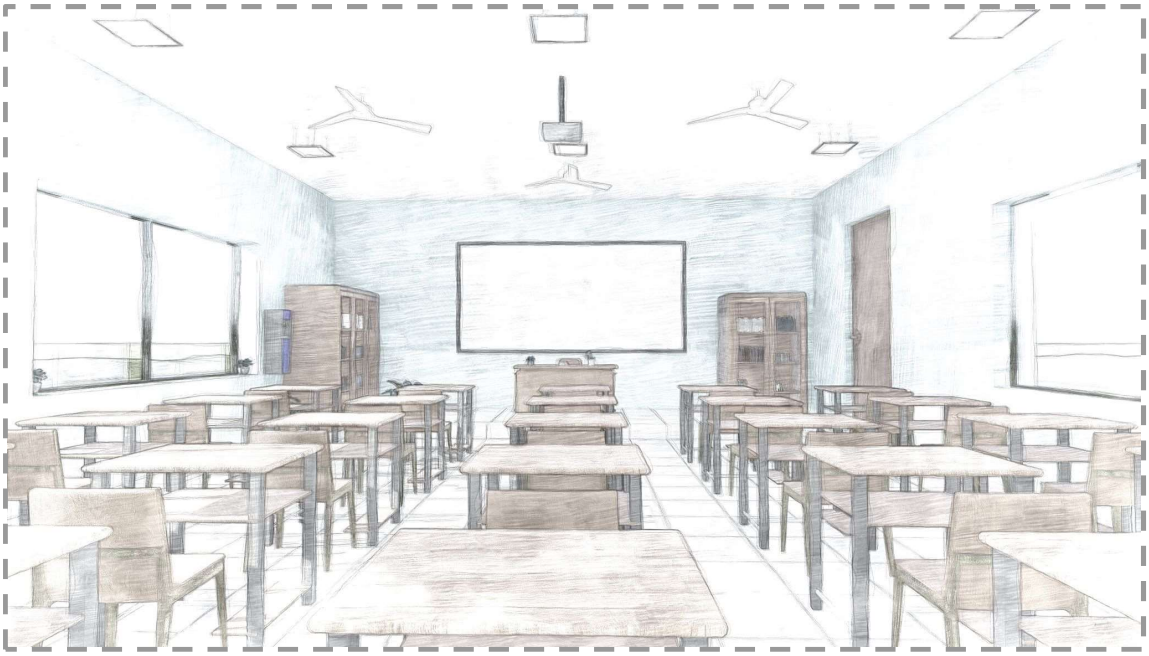

Plate 2: Sketch of the classroom interior

Plate 3: View of the classroom from the teacher's perspective

Plate 4: View from the other side

Plate 5: View from the platform

Plate 6: Creative design for the placement of school bag

Plate 7: Lights and fans

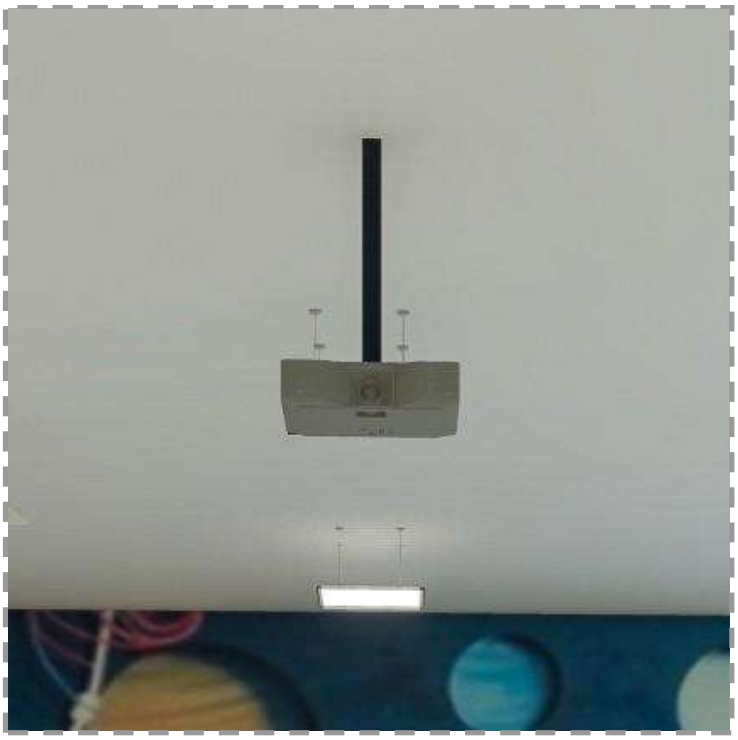

Plate 8: Overhead projector

Plate 9: Cupboards for book storage

Plate 10: Wall painting for an interesting atmosphere

Plate 11: Water purifier

Plate 12: Scan QR code to watch the walkthrough video of the Classroom

Chapter 5

SUMMARY & CONCLUSION

Chapter 5

SUMMARY AND CONCLUSION

Ergonomics, which is the study of people and their workspace, creates a space that fits for the user, by modifying or rearranging the factors around him in the workspace and environment to make it more comfortable for the task and reduce the risk of injury. The same condition can be applied to the students who spends hours inside the schools and colleges, sitting inside the classroom for a lion share of the time spend there. So, if the classroom environment is not designed properly, it may affect the physical health of the students due to prolonged sitting in the ill designed space. This has the potential to seriously affect their body posture and cause musculoskeletal diseases. Hence to design the classrooms ergonomically is the need of the hour.

The study entitled "Enhanced Learning in primary school children through creative and ergonomically designed interiors" was conducted to assess the existing primary school learning environment and suggest an ergonomically modified classroom interior for enhanced learning.

The assessment of classrooms was done on selected five government schools of Thiruvananthapuram district. A field visit and survey was conducted among selected sample of students and teachers in the upper primary classes, to assess their knowledge about the basic needs that should be provided in the classroom, it's current availability and the problems they face in the classrooms. Through the field visit is was found that not all the basic facilities have been provided in the existing classrooms.

A KAP questionnaire was prepared to get more insight into the experience of students inside the classroom and of the existing facilities. Their knowledge, attitude and practices in the existing learning environment was gathered and assessed. A mixed response was received from the students regarding the knowledge about the existing learning conditions. Some of the students seemed ignorant, on the same time the others appear to be aware about the needs they should ne provided within the classroom for a better learning environment. The attitude of the students to the existing learning

environment was different from person to person, majority of the students had a positive attitude, which made them to adjust themselves comfortably into the provided facilities. Some of them had grievances about the existing conditions, like body pain, inefficient air circulation and temperature control, light availability, visibility of board, space availability etc.

The survey among the teachers analysed the extent of their awareness of ergonomics, levels of knowledge from the fundamentals, knowledge on ergonomic considerations in practice etc were analysed. Teachers' perception about ergonomic aspects like comfort, design and productivity experienced by the students were also gathered.

The major problems faced by the students from the insight of survey is listed below:

1. 60% of the teachers had fundamental knowledge of ergonomics and 45% of the teachers were aware of the stress due to improper design
2. Among the students, 80% agreed that the benches provided in the classroom do not have backrest and the teachers opined that 50% of the students had grieved about having discomfort while sitting in the class.
3. The basic facilities like fan and light, for proper temperature regulation and visibility was less than the necessary number of units.
4. The benches provided in the classroom for the students do not support the sitting posture which has the potential to affect their physical health.
5. The digital learning aids like projectors were absent in most of the classes.
6. 51% of the students have grieved about not having enough storage space inside the classroom

All these drawbacks were assessed and solutions were concluded creatively and ergonomically, which was used to develop an ergonomically fit classroom interior digitally using the softwires, AutoCAD for drafting the 2D layout of the classroom and 3ds Max for the development of it’s 3D model.

The model was developed including the following details:

- Individual chairs and desks
- Whiteboards
- Projector and screen
- Space to keep school bags comfortably
- Adequate lighting fixtures
- Adequate fans
- Wall paintings
- Water purifier
- Cupboards for safekeeping of books
- Notice board
- Indoor plants

In the process of designing, a two-dimensional layout of the newly designed classroom was drafted manually incorporating the necessary facilities and then it was drafted digitally. Then this layout was transformed into a three-dimensional interior model and rendered for better output.

CONCLUSION

The study was conducted in small scale and have the potential to be conducted extensively in a large scale. From this study it is found that the existing school environments are not ergonomically planned or designed. It was revealed that, the selected government schools in Thiruvananthapuram district, lacked the basic facilities needed for a proper learning environment for the upper primary students. Both the teachers and students have faced the difficulties due to the poorly designed classroom interior, which can possibly affect their learning and physical health. The students were found to have back pain due to prolonged sitting in the benches, which do not have backrest to support their back. They also faced difficulties due to lack of essential digital amenities, proper lighting, storage space etc. In order to enhance the learning environment in schools, ergonomics should be implemented from the beginning stage of the construction process of schools.

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APPENDICES

APPENDIX- I

A SURVEY ABOUT THE CLASSROOM INTERIORS OF UPPER PRIMARY SCHOOL AND RELATED ERGONOMICS

*Required

1. Email *

Personal Information

2. Name *

3. Age *

4. Gender *

- Male
- Female
- Transgender
- I prefer not to say

General Information

5. Name of school *

- Govt. UP School, Vellanad
- Govt. Town UPS Nedumangad
- LMS UPS Uriyakode
- Govt. UPS Karakulam
- Govt. HSS Aruvikkara

6. Locality where school is situated *

- Urban
- Sub urban
- Rural

7. Capacity of students in upper primary *

About Ergonomics

8. Have you heard the term 'ERGONOMICS' ? *

- Yes
- No

9. How well do you know about Ergonomics ? *

- Very well
- Very little
- Nothing

10. Do you know that ergonomics deals with human body and its interaction with the system around? *

- Yes
- No
- Maybe

11. Do you know that ergonomics also considers the environment around you? *

- Yes
- No
- Maybe

12. Do you know that the ergonomics reduce stress due to improperly designed working environment ? *

- Yes
- No
- Maybe

Ergonomics & comfort

13. While sitting in the class, have any of the students complained about having discomfort ? *

- Yes
- No
- Sometimes

14. Do they feel any pain (in back, neck, arms, legs, knees) when sitting at the classroom ? *

- Yes
- No
- Doesn't know

15. Do you find it difficult for the children to sit during the class, because the sitting position is not suitable for them ? *

- Yes
- No
- Maybe

16. Are their feet fully supported by the floor and at a 90 degree angle when sitting in classroom ? *

- Yes
- No
- Maybe

17. Are their back straight & supported by the chair when sitting in classroom ? *

- Yes
- No
- Maybe

18. Are their elbows bent at a 90-degree angle & supported by the desk height ? *

- Yes
- No
- Maybe

19. Do you know that appropriate sitting posture is an important element in prevention of musculoskeletal symptoms ? *

- Yes
- No
- Maybe

20. Do you know that an ergonomically designed furniture can reduce body pain related to improper sitting position ? *

- Yes
- No
- Maybe

Ergonomics & design

21. Is the classroom interior designed with interesting colors and pictures to excite the children ? *

- Yes
- No
- Maybe

22. Are the furniture designed as per the body measurements of the children ? *

- Yes
- No
- Maybe

23. Are the furniture spaced properly without disrupting the view to the teacher and the board ? *

- Yes
- No
- Maybe

24. Is the classroom properly ventilated facilitating good air passage ? *

- Yes
- No
- Maybe

25. Is the lighting done properly, facilitating a good view of the board for the children without the problems of glare ? *

- Yes
- No
- Maybe

Ergonomics & Productivity

26. Do the children seem interested to sit inside the classroom rather than being in the playground ? *

- Yes
- No
- Maybe

27. Do you think that the classroom is designed to provide a positive and comfortable classroom experience to the children ? *

- Yes
- No
- Maybe

28. Do the children seem to lose their energy so fast while sitting in the classroom ? *

- Yes
- No
- Maybe

29. Are the children enthusiastic enough as per their age, when seated inside the classroom ? *

- Yes
- No
- Maybe

30. Do you know that ergonomically designed classrooms can increase the productivity of the children ? *

- Yes
- No
- Maybe

31. Would you like to implement ergonomically designed classroom for enhanced learning ? *

- Yes
- No
- Maybe

32. Do you think any more facilities to be included in the classroom ?

- Yes
- No

33. If yes, suggest your opinions . *

APPENDIX- II

പ്രൈമറി ക്ലാസ്റൂമിലെ പഠന അന്തരീക്ഷത്തെക്കുറിച്ച് ഗവേഷണ സർവേ

---

*Required

പൊതുവിവരം

1. വയസ്സ് *
   - ◯ 9
   - ◯ 10
   - ◯ 11
   - ◯ 12
   - ◯ 13
   - ◯ Other:

2. ജെൻഡർ *
   - ◯ പുരുഷന്
   - ◯ സ്ത്രീ
   - ◯ ട്രാൻസ്ജെൻഡർ
   - ◯ ഞാൻ പറയാൻ ഇഷ്ടപ്പെടുന്നില്ല

3. നിങ്ങൾ ഏത് ക്ലാസ്സിലാണ് പഠിക്കുന്നത്?*

- അഞ്ചാം ക്ലാസ്
- ആറാം ക്ലാസ്
- ഏഴാം ക്ലാസ്

4. നിങ്ങളുടെ സ്കൂളിന്റെ പേര്*
   - GKSG V&HSS, വെള്ളനാട്
   - ഗവ. എച്ച്എസ്എസ് ഫോർ ഗേൾസ് നെടുമങ്ങാട്
   - എൽ.എം.എസ്.യു.പി.എസ്. ഉറിയകോട്
   - ഗവ. യുപിഎസ് കരകുളം
   - ഗവ. വി.എച്ച്.എസ്.എസ്. വീരണകാവ്

സ്കൂളിനെക്കുറിച്ചുള്ള വിവരങ്ങൾ

5. നിങ്ങളുടെ ക്ലാസ്സിൽ എത്ര വിദ്യാർത്ഥികളുണ്ട്?*
   - 15 ൽ താഴെ
   - 15 - 30
   - 30 ന് മുകളിൽ

6. ക്ലാസ്സിൽ ഇരിക്കാൻ മതിയായ ഇടമുണ്ടോ?*
   - ഉണ്ട്
   - ഇല്ല
   - ചിലപ്പോൾ

7. നൽകിയിരിക്കുന്ന സീറ്റുകളിൽ ഇരിക്കുന്നത് നിങ്ങൾക്ക് സൗകര്യപ്രദമാണോ?*

- അതെ
- അല്ല
- ചിലപ്പോൾ

8. ക്ലാസ് മുറിയിൽ ഇരിക്കുമ്പോൾ നിങ്ങൾക്ക് എന്തെങ്കിലും വേദന (പുറം, കഴുത്ത്, കൈകൾ, കാലുകൾ, കാൽമുട്ടുകൾ) അനുഭവപ്പെടുന്നുണ്ടോ? *
   - ഉണ്ട്
   - ഇല്ല
   - ചിലപ്പോൾ

9. ക്ലാസ് റൂമിൽ ഇരിക്കുമ്പോൾ നിങ്ങളുടെ പാദങ്ങൾ 90 ഡിഗ്രി കോണിൽ തറയിൽ നിന്ന് പൂർണ്ണമായി പിന്തുണയ്ക്കുന്നുണ്ടോ?*
   - ഉണ്ട്
   - ഇല്ല
   - ചിലപ്പോൾ

10. ക്ലാസ്സ്റൂമിൽ ഇരിക്കുമ്പോൾ നിങ്ങളുടെ പുറം നിവർന്ന് കസേര കൊണ്ട് താങ്ങി നിർത്തുന്നുണ്ടോ? *
    - ഉണ്ട്
    - ഇല്ല
    - ചിലപ്പോൾ

11. നിങ്ങളുടെ കൈമുട്ടുകൾ 90 ഡിഗ്രി കോണിൽ വളയുകയും ഡെസ്ക് ഉയരം പിന്തുണയ്ക്കുകയും ചെയ്യുന്നുണ്ടോ?*

- ഉണ്ട്
- ഇല്ല
- ചിലപ്പോൾ

12. ക്ലാസ് മുറിയിൽ ഇരിക്കുമ്പോൾ ക്ഷീണം തോന്നുന്നുണ്ടോ? *

- ഉണ്ട്
- ഇല്ല
- ചിലപ്പോൾ

13. നിങ്ങളുടെ ഇരിപ്പിടത്തിൽ നിന്ന് ബോർഡ് വ്യക്തമായി കാണാൻ കഴിയുമോ?*

- ഉണ്ട്
- ഇല്ല
- ചിലപ്പോൾ

14. ക്ലാസ് മുറിയിൽ എഴുതാനും വായിക്കാനും മതിയായ വെളിച്ചമുണ്ടോ? *

- ഉണ്ട്
- ഇല്ല
- ചിലപ്പോൾ

15. നിങ്ങളുടെ ക്ലാസ് മുറിയിൽ ഫാനും നല്ല വായു സഞ്ചാരവും ഉണ്ടോ? *

- ഉണ്ട്
- ഇല്ല
- ചിലപ്പോൾ

16. ക്ലാസ് മുറിയിൽ സ്ഥലം കുറവാണെന്ന് നിങ്ങൾക്ക് തോന്നുന്നുണ്ടോ?*
    - ഉണ്ട്
    - ഇല്ല

    ചിലപ്പോൾ

17. നിങ്ങളുടെ ക്ലാസ് മുറിയിൽ ഇരിക്കുന്നതിൽ നിങ്ങൾക്ക് സന്തോഷമുണ്ടോ? *
    - ഉണ്ട്
    - ഇല്ല
    - ചിലപ്പോൾ

18. നിങ്ങളുടെ ക്ലാസ് മുറിയിൽ കൂടുതൽ സൗകര്യങ്ങൾ ഉൾപ്പെടുത്താൻ നിങ്ങൾ ആഗ്രഹിക്കുന്നുണ്ടോ? *
    - ഉണ്ട്
    - ഇല്ല

ഉണ്ടെങ്കിൽ, നിങ്ങളുടെ ആവശ്യങ്ങൾ നിർദ്ദേശിക്കുക.

Sl. No.	കൂട്ടിച്ചേർക്കേണ്ട സൗകര്യങ്ങൾ	*Yes*	*No*
1	ശരിയായ വായുസഞ്ചാരം ആവശ്യമാണ്		
2	ബാക്ക് റെസ്റ്റ് ഉള്ള കസേരകൾ കൂടുതൽ സൗകര്യപ്രദമാണ്		
3	ഓരോ വിദ്യാർത്ഥിക്കും പ്രത്യേകം മേശയും കസേരയും കൂടുതൽ പഠിതാ സൗഹൃദമാണ്		
4	ഉയരം ക്രമീകരിക്കാവുന്ന കസേരയും മേശയുമാണ് അഭികാമ്യം		
5	ബാഗുകൾ, പുസ്തകങ്ങൾ, മറ്റ് പഠനോപകരണങ്ങൾ എന്നിവ സൂക്ഷിക്കാൻ എല്ലാ ക്ലാസ് മുറികളിലും അലമാരകൾ ആവശ്യമാണ്.		
6	ഓരോ ക്ലാസ് മുറിയിലും കുടിവെള്ളം പ്യൂരിഫയർ വേണം		
7	കൂടുതൽ ആകർഷകവും ആവേശകരവും പഠിതാ സൗഹൃദവുമായ ക്ലാസ് മുറികൾ ആവശ്യമാണ്		
8	സ്കൂളിൽ നിന്ന് ആവശ്യമായ വിവരങ്ങൾ അറിയാൻ എല്ലാ ക്ലാസിലും ഒരു നോട്ടീസ് ബോർഡ് സ്ഥാപിക്കുക		
9	വിദ്യാർത്ഥികൾക്കായി മിനി ലൈബ്രറി		

10	ഓവർഹെഡ് പ്രൊജക്ടറുകളും ഇന്റർനെറ്റ് കണക്റ്റിവിറ്റിയും		
11	ബ്ലാക്ക് ബോർഡിനും ചോക്ക് പൊടിക്കും പകരം ഡ്രൈ ഇറേസ് ബോർഡ്		
12	മികച്ച എഴുത്ത് പോസ്ചറിനായി ചരിഞ്ഞ മേശകൾ		
13	വ്യത്തിയുള്ള ക്ലാസിനും ഫലപ്രദമായ മാലിന്യ നിർമാർജനത്തിനും വേസ്റ്റ് ബിൻ		
14	ബോർഡിന്റെ മികച്ച കാഴ്ചയ്ക്ക് കൂടുതൽ ലൈറ്റുകൾ ആവശ്യമാണ്		
15	വിദ്യാർത്ഥികൾക്ക് ബോർഡിന്റെ വ്യക്തമായ കാഴ്ച ലഭിക്കാൻ സഹായിക്കുന്ന ഇരിപ്പിടം		
16	വിദ്യാർത്ഥികളുടെ താൽപ്പര്യത്തിനനുസരിച്ച് ആകർഷകമായ ചുമർചിത്രങ്ങൾ		
17	ക്ലാസുകളിൽ പത്രം നൽകുക, അതുവഴി വിദ്യാർത്ഥികൾക്ക് അവരുടെ വായനാശീലം വളരുകയും അതേ സമയം അവരുടെ പൊതുവിജ്ഞാനം മെച്ചപ്പെടുത്തുകയും ചെയ്യും		
18	ഉന്നത പഠനത്തിന് സ്മാർട്ട് ക്ലാസുകൾ		

19	ക്ലാസ് മുറിയിൽ കമ്പ്യൂട്ടർ പ്രവേശനക്ഷമത		
20	ക്രിയേറ്റീവ് പ്രവർത്തനങ്ങൾ പ്രോത്സാഹിപ്പിക്കുന്നതിന് ശബ്ദ പ്രൂഫ് ആക്റ്റിവിറ്റി ഏരിയ		
21	വിദ്യാർത്ഥികളുടെ ആവശ്യാനുസരണം സുഗമമായ ചലനത്തിനായി ചക്രങ്ങളുള്ള ഡെസ്കുകൾ		
22	ക്ലാസ് മുറിക്കുള്ളിൽ മതിയായ ഇടം ഉള്ളതിനാൽ ഉള്ളിലെ എല്ലാ പ്രവർത്തനങ്ങളും സുഗമമാക്കുന്നു		

APPENDIX- III

FEW CLASSROOMS VISITED FOR STUDY


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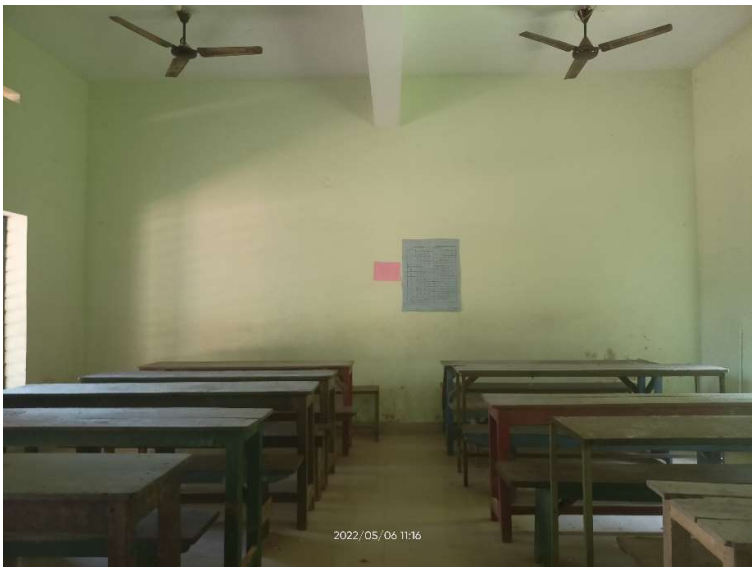
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