CHAPTER I

INTRODUCTION

1.0.0 THEORETICAL FRAMEWORK

Learning Environment is created for desirable learning outcomes by the use of teaching strategies and tactics, which can help the learners, improve their performance. This environment can be physical, cognitive and social. In the classroom the learning environment should be such to promote acoustic communication. The scheduled activities should be according to the lay out of the class. So that the learners can have the personal space and are able to follow the pattern of social communication and interaction. Moreover the equipment learning, tool and materials should be such as to support the functioning in a classroom. These media should be employed in ways that can synchronize with simple human physical process. However, in limited media enabled learning situation, the design plays an important role in the classroom environment. Guidelines are required that enables the teacher to create learning environment that need recognizing both human resource functioning and how available instructional tools are used. The science that investigates such matters is called ergonomics and knowledge from this science is needed for those who enterprise educational facilities.

‘Ergonomics term means a body of knowledge about human resources abilities, human limitations and human characteristics that are in line to the design of tools, system, tasks and environment for safe, comfort and effective human use’ (Alphons, 1991). This means that the learning should proceed such as to maximize learning effectiveness. As such, ergonomics found its origin in the world of industrial production and in technology- aided activities including physical work spaces (offices, production lines), process and work organization schemes (working hour, organization of a firm’s department). In IEAEC 2010, Canas & Borris stated,

Ergonomics is the scientific discipline concerned with the understanding of the interactions among human and other elements of a system, and the profession that applies theory,

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1 Alphonse, C, 1991. To Communicate the Human factors message you have to know what the message is and how to communicate it. Pg.2
principles, data and method to design in order to optimize and matching physical and psychological demands of workplace to the capabilities and limitation of the worker.²

As such specialists of ergonomics and ergonomists add to the strategy and appraisal of tasks, professions, yields, surroundings and structures to suit them with the requirements, skills and limits of people which is shown in figure1.

![Figure1, Human centered Ergonomic Design](image)

Ergonomics assist equipment that link with people in terms of their prerequisite, capacities and limitations. Practicing ergonomists must have an inclusive understanding of the complete scope of the subject. That means ergonomics encourages a common approach in which considerations of physical, cognitive, social, organizational, environmental and other relevant factors are taken to rationalize. Ergonomists often work in certain economic areas or practical domains. Practical domains are not commonly discrete where new ones are created and old ones take on new perspectives, such as educational ergonomics.

### 1.1.0 EDUCATIONAL ERGONOMICS

Educational ergonomics is that field of human issues concerned with the collaboration of educational enactment and educational strategy. The principle of educational ergonomics improves students’ success. Ergonomic intercessions are directed at strategy improvements to bring enhancement in education. Educational

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² Canas, J, J, et. al. 2000, Human Factors and Ergonomics. Pg. 1
ergonomics covers the entire area of education. The range of educational ergonomics incorporates all approaches and levels of outcome-strategy interaction that may occur in an educational setting. Scientifically, educational ergonomics field is concerned with how and why intention of the educational process and method that effect variability in outcome amongst participants and the structure as a whole. In the broadest sense the strategy of the educational process refers to strategies of instructional materials such as textbooks, audiovisual materials, physical environments such as school classrooms and buildings and technologies such as computer hardware and software. The schemes of different skills, tasks; lessons of knowledge, and courses are targeted for improved students learning. For desirable learning, the interactions of participants with one another (student-teacher-staff-management relationships) continues. Students’ performance has a strict scientific meaning as cognitive, motor or physiological performance and also a real-world meaning that can be generalized. Thus, it can be said that performance in a classroom is enhanced when teaching learning process, classroom design, content in the corresponding task, the strategy of physical and motoric interface and the whole design is according to ergonomics.

There exist domains of specialization within the discipline. It represents deeper competencies in specific human characteristics. Domains of specialization within the Ergonomics discipline are broadly Physical Ergonomics, Cognitive Ergonomics & Organizational Ergonomics.

**Physical Ergonomics** is related to human anatomical, anthropometric, physiological and biomechanical characteristics as they concerned with physical activity such as working postures, handling the material, movements which are repetitive, musculoskeletal disorders, layout and safety at workplace, and health.

**Cognitive Ergonomics** is related to mental processes, such as awareness, retention, intellectual, and motor response, as interactions among humans and other elements of a system such as mental workload, decision-making, skilled performance, human-computer interaction, human reliability, work stress and training are affected because these relate to human-structure design.
Organizational Ergonomics is associated to enhancement of social systems, including organizational structures, guidelines, and procedures which comprises communication, human resource management and work design. It is also linked to design of working duration, teamwork, hands-on design, community ergonomics, cooperative work, fresh work paradigms, virtual platforms, telework, and quality administration.

Physical, cognitive and organizational factors of ergonomics at any place are a study of human media, strategy and human resource interaction within a healthy environment. Though ergonomics is not so popular, it is an important area in the field of education for efficient learning. The focus of Educational ergonomics is that teacher has to design methods that can satisfy students’ need in terms of their capability. Educational ergonomics environment and design creates the appropriate learning environment in which students are safe and motivated to participate and can perform better. Thus, educational ergonomics is very important for better performance of students as the performance need satisfactory environment for learning. In comfortable environment students, are minimum stressed and learning is enhanced to maximum effectiveness.

For the betterment of learning, in a classroom, a teacher plans according to their feasibility of the resource and work according to the learner’s need and education design. He/she arranges the classroom activity and task as per the need. The task fulfillment in a classroom is carried out through the collaboration of components (teacher, students) and working environment with the work object. Any task takes place under the influence of the functional environment such as the acoustic, visual and surrounding conditions. The teachers acts as a controller where they communicate via their sensory and motoric system with the learners, followed by continuously receiving information about the work task and performance of students either via direct observation or through monitoring. These influences control elements, tools, and classroom via their physical motor skills after response variance between framed objectives and learning outcomes. An optimal output can only be achieved if the technical- organizational design elements are according to the students’ capabilities and as well as the resource. Ergonomics workplace design must be according to the guidelines human sense organs, limitations and the brain’s (central nervous system)
capacities. Likewise, the classroom environment and every task in a classroom should be designed according to the students’ capabilities for betterment in their performance.

Educational ergonomics has its scientific origins in an extensive body of differential learning in perspective of performance-design interaction. Much of the variability in performance, development and refinement is a primary focus of education is attributable to specific design features of the learning environment. This learning environment can incorporate critical thinking. Thereby critical thinking can be enhanced through ergonomics as a healthy part of Cognitive ergonomics.

Role of ergonomics in critical thinking can be seen through cognitive ergonomics. Cognitive Ergonomics is an applied science. Knowledge, methods, techniques, and strategy from human sciences are applied towards problems of human use of objects. The origins of cognitive ergonomics start from the concepts of mental work and cognitive products or the tool. Through cognitive system with the use of knowledge about create design in areas of task, the mental work is performed. The cognitive processes such as perception and learning play a critical role in the interaction with artifacts and they must be considered to explain the cognitive tasks that people perform. The cognitive ergonomics is a domain of ergonomics that study the cognitive process at task competition with an emphasis on the consideration of the situation and the sustainable performance. In cognitive ergonomics the word cognitive is taken as a label which indicates the human knowledge and their understanding at task. The consideration of cognition always occurs during curative and envisioning the design. Either trying to assists to the users of resources in handling the problems related to its operation or in designing the tools that fit to the cognitive capabilities and requirements. Though, in this manner cognition is narrowly interpreted. So the understanding of aspects related to behavior, emotions and acceptance should be considered. Furthermore, it’s essential to understand the cognition in a wider sense than the psychological meaning of the concept. Cognitive ergonomics mainly focused on information technology, information system. Recently, it also emphasizes on multimedia as core resource of the artifacts. It differ from the Classical Ergonomics which apprehensive with the quality of working. Moreover, the attention of cognitive ergonomics is on the human at task which focuses on the physical aspects of work and human capabilities such as force, posture, and repetition. So the cognitive ergonomics...
also concerned with the quality of work to focus on the outcome or artifact, which results from the efforts of the work itself and system as a whole.

The focus of cognitive ergonomics is on the mutual influence amongst work and mind. Though cognitive is very common in cognitive psychology and it detailed described also. But the cognitive ergonomics purpose how human cognition affects task and is affected by task rather to describe how human cognition affects work and is affected by work. The representative topic areas of cognitive ergonomics comprise modeling of systems & users, learning and system design specially the design of automation, user interface design, problem solving, co-operative task design.

1.2.0 ERGONOMICS ENABLED PROBLEM SOLVING

Problem solving through ergonomics means sighting the variability in students monitoring competences when choosing, scheming or modifying equipment, tools, work environment and work task so that task can proceed with maximum effectiveness. Due to the differences in students’ strength, age, gender, physical condition and other factors, implementation of any task may vary. The teachers have to focus on these limitations of the students. According to ergonomics theory, in a classroom the teachers have to keep in mind aspects of the students’ better performance in problem solving for developing critical thinking with that does not take away concentration or well-being. Motivation during the task is required because it increases their pace of work. The physical condition of students also should be kept in mind during the task. Task should not be repetitive or too much lengthy. Learners should feel comfortable and with no extra stress during the task. During the activity, facility should be provided by the teachers as- proper arrangement of sitting plan and proper learning material (audio, video and handouts, textbooks). During problem solving, choices in selection of problems also should be given. Thus ergonomics doctrines and strategies are beneficial to lead the potential work by preventing students’ fatigue and stress. In education ergonomics, designing task is made fit for the students and not forcing the students to fit the task. Thereby problem solving is a goalmouth sequence of cognitive procedures. Ergonomic enabled problem solving process encompasses these steps which are as follow;
1. Searching the Right Problems

Ergonomic problem solving approach is reactive. Firstly in these seven problem solving steps, we should promoter taking an active tactic that includes searching the problems to solve that are essential and valuable. The actual preliminary point of problem solving process is to find a right problem to solve.

2. Defining Problem

It is very important to highlight the next step which is defining the problem. Define the problem by combining problems which are valuable to solve. It determines that what is needed to search. A definite definition of problem should be in mind what is the area of problem, each and every detail related to the problem should be gathered that can intensely improves the improve the effectiveness of the problem solving process. Defining the problem is actually about the outlook of learner. It means trying to get each problem as a chance.

3. Analyzing Problem

Analysis of problem means process of detection of facts and evidences. It all about what one knows about that situation. During analyzing the problem the complexities regarding problem breaks down and stripping away the artificial and get the causes.

4. Developing Opportunities

The next step after analyzing the problem is developing the opportunities. Means there is always many ways more than one to solve a problem. So, one should develop many creative ways and possibilities to solve a problem.

5. Selecting Best Solution

This step is related to the previous one. In this step selection of best solution is taken up. Selecting is about creating choices. By doing this one need to evaluate the challenging worth difficulties of the various alternatives produced in the previous step.
6. Implementation

Implementation decides whether the solution is good or not. This stage requires management of process and a purpose to provide the outcomes essential to solving the problem that was initially defined.

7. Evaluation and Learning

To implement the solution or to solve the next problem, the steps should be remembered. Two areas such as ‘how we carried out the seven step problem solving process and the effectiveness of the solution we implemented’ should be evaluated. Was it according to the outcomes expected?

The Problem based activity to be seen as significant learning, can be related to realistic situations or everyday life. Lateral thinking technique is included in Problem solving which is objective-directed series of cognitive operations. The environment in which the learners solve the problem as a class task needs to be designed according to ergonomics. Ergonomic enabled problem solving task can make the students interested in a task & thereby make them use their cognitive skill and think critically.

A particular apprehension is the existence of situations that may adversely affect the outcome of work. Cognitive ergonomics should assist in reducing the chance for such situations to occur and to develop the opportunity of compensating them or reducing their effect when they happen. In this particular area cognitive ergonomics recognizes or expects the situations where problems may arise; to define the situations that may either be the cause of the problems or have a noteworthy effect on how the circumstances develop; and to recommend the means by which such situations can either be avoided or their impact minimized.

Cognitive ergonomics is associated to how the human mind. But searching problems is a task for cognitive psychology than cognitive ergonomics. The purpose of cognitive ergonomics is to develop structural design with the characteristics of the cooperative cognitive system (the hand and the machine/computer). Cognitive ergonomics is concerned with the use of tools, with the design of the work condition as a whole and its application on thinking.
1.3.0 CRITICAL THINKING

The ability of thinking in which a person uses intellectual skills and strategies that increases the chances of desirable outcome is called critical thinking. Critical thinking is a complex process of reflection, which encompasses a varied range of skills and attitude. It’s the skill to appraise, compare, scrutinize, criticize and combine information and assessing conclusion by logically and methodically scrutinizing the problem. “The ability to think critically is a way to find meaning in the world in which we live” (Dewey, 1997). Critical thinking is purpose, logical and objective directed which is very vital and is required for success.

Development of critical thinking ability should be a major aim of education. In fact, learning how to think has been a major objective in formal education. Critical thinking helps a learner in moving away from his individual opinions, biases, and feelings to sort out the facts and discover the truth. It represents a challenging thought process, which leads a learner to novel paths of knowledge and understanding. Critical thinking involves getting deeper meaning of problems, keeping an open mind about different methods and viewpoints and determining what to do or believe. Critical Thinking is required for problem solving, framing inferences, calculating probabilities, and making judgments.

Proper learning environment is desirable for the development of critical thinking. It can help learners to improve their critical thinking ability, and increase their inclination to use such skills. Though his ability is less used in usual classroom settings, can be used at times. Factors of ergonomics such as stimulating students’ interest, creating meaningful discussion, exposure to thoughts and fostering a trusting and supportive atmosphere can be helpful for the development of critical thinking. Through a problem-oriented approach to learning the students’ attention and interest can be captured. On arousing learners’ interest they can then be directed to think critically and develop their self-confidence in their own capability to examine and solve problems. ‘For developing critical thinking three things must come together in the classroom; one student must reason (a bridge from their present thinking to the new thinking what a teacher is looking for), two, student must reason about the content (the new way a teacher want them to think), and three, they must be a hook

3 Dewey 1910. How We Think, Pg.9
(recognition of students present thinking) so that students will be willing to be the first two’ (Buchanan, 2011). Meaningful dialogue is essential to keep students’ interest. In addition, students to build mental structures necessary for critical thinking during the questioning and debates that take place. Exposure to contesting viewpoints helps students to realize their own assumptions and egocentric views. It also helps them to learn to reason from several perspectives. Finally, to let go of learners’ biases and to make them try out new ways of thinking an atmosphere of trust and support is essential. Then all students irrespective of age can think critically but the teachers have to provide the opportunity. In a classroom, teacher can provide cognitive trainings in analysis, problem solving and reasoning through curriculum lessons. Further the classroom atmosphere, tasks and practices needs to support such type of learning.

Critical Thinking process is made up of some important steps. These steps provide a arrangement to the procedure, which if merged make convincing, open and helpful in verbal communication. Moreover, it extremely affects other’s point of opinion and message acceptance. The constituents of critical thinking are inference, assumptions, deduction, interpretation, evaluation of arguments which are given below in detail.

1. **Inference** is considered to be the manner in which individual receive, interpret and translate experience. Inference provides an important filtering system.

2. **Assumptions** tend to be implied, where persons often rest on the notion that some ideas are obvious and is carried out consciously. They tend to make individuals contented with their present belief, shutting down out any options.

3. **Deduction** refers to an argument in which the ground of truth assures the certainty of its conclusions. The fundamental focus in deductive argument is that it must be impossible for the grounds to be true and the decision to be false. Another way to think of deductive reasoning is to contemplate of it as moving from general premises to a specific premise.

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4 Buchanan, Anne. 2011; Integrating Critical Thinking Skills into Classroom, Access Excellence, Pg.16
4. **Interpretation** means to give own notion a place in the context of one’s familiarity, perceptions, point of view, interpretation which is notable from the facts, the evidence, and the situation. The best explanation accounts most evidence where in the light of new evidence interpretations are reconsidered. All learning involves personal understanding, since whatever we learn; we must incorporate into our own thinking and act.

5. **Evaluation of Argument** is used to persuade that to some degree is (or is not) true or must (or must not) be done. An argument contains three basic elements; (i) a question (ii) one or more causes or grounds (iii) one or more decision. An argument can either be usable or worthless based on its organization. Evidences and decision are reached, which can be either true or false. Benefit of critical thinking is to implement a thorough argument which has both an effective or proper organization of grounds based on true premises.

Critical thinking skills bring many benefits such as its enhanced attention and reflection on more engrossed reading. It also improves the ability to identify the vital points in a text or message rather than becoming diverted by less significant material. It not improves the skill to react to the suitable points in a message even understanding of emphasizing owns point across is accessed more easily. Critical thinking skills can be applied it in a variety of accessible situations.

A well cultured critical thinker raises important questions, problems, and frames them critically and accurately. They even collect and evaluate pertinent information using abstract ideas to deduce it efficiently and finally come to well-reasoned decision and explanations, testing them against applicable principles and standard. A nurtured critical thinker thinks open minded within alternative methods, identifying and judging as required, its effects, and practical consequences. Similarly they communicate efficiently with others, in figuring out solutions to simple problems.

Hence, critical thinking is, in short, self-directed, self-disciplined, self-monitored and self-corrective thinking. It assumes approval to demanding standard of excellence and knowledge of their use. It involves effective communication and
problem solving abilities and an obligation to overcome natural self-centered and sociocentric issues. Therefore it is very important and required for learners.

For the development of critical thinking amongst learners, a teacher should have knowledge about the factors that can affect the critical thinking. Other than ergonomics enabled environment, factors that can affect the critical thinking of students are; academic-motivation, emotional intelligence, risk taking behavior as well as their academic traits i.e. academic stress, intelligence, academic adjustment. Critical thinking is highly valued but difficult to apply effectively. In the present scenario critical thinking are less inducted due to requirement of completing the course, variation of learners’ cognitive ability, class duration, and sometimes a teacher’s slackness of doing extra task, and sometimes learners hinder from availing such opportunity. Therefore, much motivation is needed to induce critical thinking.

1.4.0 RATIONALE OF THE STUDY

Management of ergonomics in classroom learning environment can enhance learners’ performance. But ergonomics can be focused in learning experiences only when stakeholders of institutions are familiar with its usage. Understanding of ergonomics may help the learner to manage both the equipment and the physical surround better to promote and attain learning objectives. Therefore, familiarity with educational ergonomics is the need of the day. This gives way to queries to find out how Ergonomics usage in a classroom can enhance learning. Whether school climate factor has any impact on implementation of ergonomics needs to be found out. Do learners’ psychological factors influence ergonomics usage for critical thinking? Which type of task can promote through science of ergonomics? Moreover, how critical thinking can be developed and enhanced through ergonomics needs to be studied. These queries led to find out the relevance of Ergonomics Interventions in classroom and its effect on critical thinking, the following study was undertaken. This study would in course highlight the importance of educational ergonomics in enabling critical thinking and enhanced learning down the lane.
1.5.0 STATEMENT OF PROBLEM

Cognitive process moves in upward direction. This process takes a long time and improves with age. But this process can be enhanced through specific techniques. In life other than timely decisions students studying in senior secondary standard have to decide selection of academic streams in which they want to pursue their future. But selection needs to be carried out critically. For this they need to be effective decision makers. This requires the classroom environment to be such as to promote opportunity to think critically. Classroom environment encompassing ergonomics can promote critical thinking amongst learners and learning to be comfortable, effective as well as time earning by reducing the steps involved in a task. But how these ergonomic interventions can enhance the possibilities of improving the critical thinking amongst the XI grade students became the ground to frame this research problem.

1.6.0 TITLE

*Impact of Educational Ergonomics Programme [EEP] on Critical Thinking amongst Students of XI Grade*

1.7.0 OBJECTIVES

The following are the objectives of the study.

1. To study the effectiveness of Educational Ergonomics Programme (EEP) in terms of Critical Thinking amongst students of XI grade.

2. To compare the mean scores of Critical Thinking of Educational Ergonomics Programme (EEP) Group with Conventional Method Group by considering Pre scores as co-variate.

3. To study the effect of Treatment, Academic Stress and their interaction on Critical Thinking of students by taking Pre scores as co-variate.

4. To study the effect of Treatment, Risk Taking and their interaction on Critical Thinking of students by taking Pre scores as co-variate.
5. To study the effect of Treatment, Group Intelligence and their interaction on Critical Thinking of students by taking Pre scores as co-variate.

6. To study the effect of Treatment, Academic-Motivation and their interaction on Critical Thinking of students by taking Pre scores as co-variate.

7. To study the effect of Treatment, Emotional Intelligence and their interaction on Critical Thinking of students by taking Pre scores as co-variate.

8. To study the Change in Reaction towards Educational Ergonomics Programme (EEP) of the students.

1.8.0 OPERATIONAL DEFINITIONS

The operational definitions of using terms in this study were as follows.

1. Educational Ergonomics Programme [EEP]
   Here ergonomics refers to the physical, cognitive and organizational techniques provided while conducting problem solving.

2. Critical Thinking
   Critical thinking here refers to participants’ conceptual course of vigorously and competently abstracting, applying, examining, combining, and appraising information related to problem statement.

3. Academic Stress
   Academic Stress here is the mental distress (the effect of unpleasant and undesirable stressors) of students with respect to schools situations and event.

4. Risk Taking
   Risk taking here refers to the behavioral trait of an individual to engage in school related activities, examination, travelling driving performance when carried out for the first time.
5. Intelligence

Intelligence here refers to effective adaptation to collaborative learning in which students at various performance levels work together in groups during classification, analogies, arithmetic reasoning, vocabulary, comprehension, and selection of best answers to be successful.

6. Academic-Motivation

Here academic motivation refers to extrinsic and intrinsic motivation towards success in academics in school.

7. Emotional Intelligence

Emotional Intelligence here refers to students’ ability of acceptable depth of sentiment, adequate consciousness and control of feeling and ability to function with feelings as well as the ability to manage with complications of sentiment and reinforcement of positive sentiments separately and as a whole.

1.9.0 DELIMITATIONS

The delimitations of the study were as follows.

1. The present experiment study was conducted on XI grade students of Government Girls Inter College affiliated to U.P. Board situated in Muzaffarnagar, U.P.

2. Apart from Educational ergonomics, critical thinking, stress, risk-taking, intelligence, academic-motivation, emotional intelligence were the independent variable.

3. All 22 exercises were given at the rate of one exercise per day. The total duration of treatment was almost for 34 hours.

4. The study was conducted after the regular teaching session.

1.10.0 SIGNIFICANCE OF STUDY

This thesis considers the ways in which Ergonomics could contribute to the Critical Thinking development and thereby bring improvement in quality of education. The results of this research pertaining to classroom ergonomics area would provide a good starting point that will allow the creations of appropriate ergonomic solutions aimed at solving the existing classroom problems. Moreover this study
would allow combining educational ergonomics with any academic settings in order to support the learners. The results will allow the educators to be more flexible in how they design course work and meet the problems related to the students. This benefit is not just at the level of detection of problems. By understanding ergonomics and its assistive techniques, the academic challenges not only would be identified, in course it would promote inclusion and enhance the students’ ability to focus on learning. Other than this the educators would be able to engage students for longer time. Even the learners would be aware of the impact of physical, cognitive and organizational ergonomics and this belief would result in effective academic performance and would result in academic success. Thereby this study will help both the teachers and students to make the most of the classroom experience.