


# COMPUTER ERGONOMIC ISSUES IN LEARNING INSTITUTIONS IN KENYA: CASE STUDY OF KIRINYAGA COUNTY

***Shikhuyu, J. and Mwangi, E.G.***
*Kisii University, P. O. Box 408-40200, Kisii*
*Email: ahingula@yahoo.com, egmkuc@gmail.com. Tel.: 0722461507, 0723814846.*

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## ABSTRACT
Learning institutions are emphasizing computer hardware and software, while neglecting computer hardware compliance with ergonomics. Since non-compliance to good ergonomic practices is not a onetime effect, users are not usually aware of the negative impact on their being until too late. The question of ergonomics is very sensitive during this era when the government is championing use of ICT in all learning institutions. The health-risks that come with non-compliance cannot be underestimated. This study investigated computer ergonomic issues and problems that face students when using computers as tools of learning in selected primary, secondary and university institutions in Kirinyaga County. Purposive sampling was used to select the institutions. Stratified sampling was used to pick the sample size. In each stratum, random sampling was adopted. Total sample size was 350. Closed ended questionnaire was constructed and self-administered to collect information about computer related ergonomic issues and habits of students. Data were analyzed and presented using SPSS V20. Most of the institutions don't have ergonomic furniture. Laboratories and computer screens were poorly lit. Most institutions used older machines that produced noise and emitted a lot of heat. Laboratories were poorly ventilated and respondents were not aware of ergonomic practices and habits and the risks that come as a result of non-compliance. Learning institutions lack knowledge on the importance of computer ergonomics. Thus stakeholders need to intensify campaigns on computer ergonomics in learning institutions.
**Key words:** *ICT, Laboratories, Learning institutions, Health-risks, Habits*

## 1. INTRODUCTION
The foundations of the science of ergonomics appear to have been laid within the context of the culture of Ancient Greece. A good deal of evidence indicates that Hellenic civilization in the 5th century BC used ergonomic principles in the design of their tools, jobs, and workplaces. One outstanding example of this can be found in the description Hippocrates gave of how a surgeon's workplace should be designed and how the tools he uses should be arranged (Marmaras, et al., 1999). It is also true that archaeological records of the early Egyptians Dynasties made tools, household equipment, among others that illustrated ergonomic principles. Ergonomics is the science of designing user interaction with equipment and workplaces to fit the user. Proper ergonomic design is necessary to prevent repetitive strain injuries, which can develop over time and can lead to long-term disability. According to the International Ergonomics Association (IEA) ergonomics is employed to fulfill the two goals of health and productivity. It is relevant in the design of such things as safe furniture and easy-to-use interfaces to machines.

Ergonomics emerged as a scientific discipline in the 1940s as a consequence of the growing realization that, as technical equipment became increasingly complex, not all of the expected benefits would be delivered if people were unable to understand and use the equipment to its full potential. In 1949, at a meeting of distinguished physiologists and psychologists at the Admiralty, the term ergonomics was coined from the Greek roots (ergon [work] and nomos [natural laws]). Later that year this same body of scientists, together with some like-minded colleagues formed the Ergonomics Research Society which became the first such professional body in the world.

According to Occupational Safety and Health Act (2007), ergonomics at workplace is paramount and must be put in considerations when designing buildings, fixtures, machinery, equipments, tools and workstations. In Kenya the Act is circulated in all governmental and non-governmental agencies and department to ensure adherence. The concern is that most of the institutions ignore this Act in their day to day operations and they end up compromising human health safety. Learning institutions in Kenya are keeping pace with the technological advancements; putting more emphasis on the acquisition of hardware and software while ignoring the aspect of ergonomics. This paper is an investigation of computer ergonomic issues and problems that face students when using computers as a tool of learning in selected primary schools, secondary schools and universities in Kirinyaga County.

## 2. LITERATURE REVIEW

### Ergonomic Computer Workstation Considerations for Library Staff

Rodrigues (2010) addresses work place ergonomics for library employees with an aim of promoting and protecting health through ergonomically sound practices. Adeyemi (2010) observed that library staff sit for long hours carrying out their daily routines, and as such every workstation should be designed with both the worker and the task in mind so that work can be performed comfortably, smoothly and efficiently. She emphasized the need for general workstation ergonomic instructions to be taught in library schools and that University Commissions should include ergonomic measures, plans and education as parameters for measuring quality of academic libraries; this would engender competitiveness and compliance with the resultant effect in the promotion of staff health and welfare. The paper addresses ergonomic computer workstation furniture; highlighting issues on: correct work station height, top, leg room, thickness of work surface among other issues. This paper does not address ergonomics in computer laboratories in learning institutions considering that in some, like in primary schools, the size of pupils is small and therefore the measurements given in this paper cannot best suit the small children.

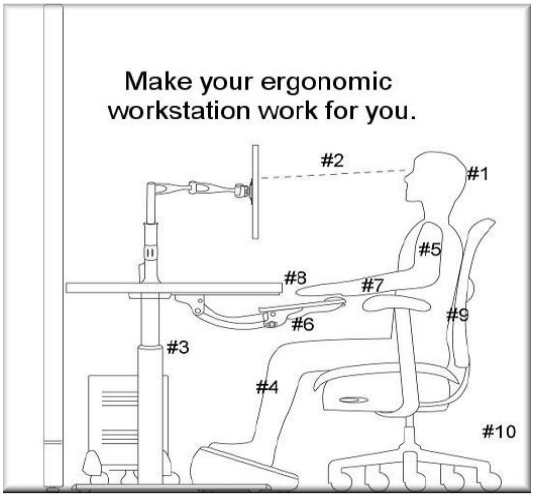


**Figure 1: Source: http://www.opraxmedical.com/Accessories/Digital/Funiture/ (Mayo, 2010)**

### Ergonomic Aspects of Implementing Computer Technology into School

This paper addresses the issue of implementing computer technology into educational settings from an ergonomic point of view. Effective ergonomic implementation of computer technology should address the following five phases in Figure 2.

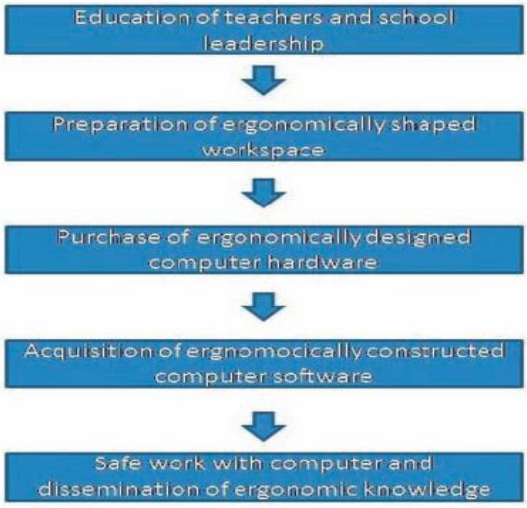


**Figure 2: Model of ergonomic implementation of computer technology in a school environment (Samo and Uros, 2009)**

The paper emphasizes on education of teachers and school leadership in connection with ergonomic implementation of computer technology into educational settings which include: ergonomic aspects of quality computer hardware, elements of ergonomically constructed computer software, work with computer from an ergonomic point of view, information about ergonomically shaped workspace and understanding of ergonomic burdening on children's school work (Samo and Uros, 2009). The research generally proposed a Model of ergonomic implementation of computer technology into school environment but did not specify how this knowledge will reach a wide range of students. Also the paper does not have a mechanism of ensuring the information disseminated is followed to the latter. This paper will recommend ways of how the knowledge should be disseminated in Kenyan learning institutions.

**Improving Products' Ergonomic Value Using Intelligent Decision Support System**

The paper presents a knowledge base, containing ergonomic design knowledge specific for hand tools design. A pneumatic hammer handle design was used as a case study to show how ergonomic design knowledge built in the system was used to improve the ergonomic value of the product (Fain, 2010). Product ergonomics applies theory, principles, data and methods to optimize human well-being and overall system performance. The ergonomic quality of a product can be defined by a match between anthropometric data and formal attributes. However, the quality of ergonomics is not only based on anthropometrics, as the field of human factors has been realizing over the past thirty years (Kroemer, 2001) Cognitive and experiential processes play a major role in deciding whether a design is usable, efficient, satisfying, easy to use, or comfortable.

The researcher developed a prototype of an intelligent advisory system Oscar, based on expert design knowledge management. Du et al. (2009) proposed logical frame on ergonomic knowledge management at Computer-Aided Industrial Design and Conceptual Design conference which was used with improvement in aesthetic appearance of the product. The knowledge built in the prototype of the intelligent system named Oscar was structured in the form of different classes interconnected with various attributes and their values at the input side, the output of the system allowed (re)design recommendations leading to achievement of certain design goals that can improve the ergonomic value of the product (hand tool) being developed. The intelligent decision support to the ergonomic design process represented added value to the existing ergonomic CAD tools that enable various ergonomic analyses, but failed to provide engineering advice on how to improve the ergonomic value of a design candidate that is the subject of ergonomic evaluation. The paper emphasizes on intelligent CAD tools for designing ergonomic products which are not affordable in Kenya, since most schools depend on government funding.

**Principles for the wise use of computers by children**

Children tend to use computers more at home than at school (Moseley et al. 2001, Kerawalla and Crook 2002, Kent and Facer 2004). The paper reviewed the current exposure data and the evidence for positive and negative effects of computer use by children. The case for child specific evidence-based guidelines for wise use of computers was presented based on children using computers differently to adults, being physically, cognitively and socially different

to adults, being in a state of change and development and the potential to impact on later adult risk. The paper broadly addresses effects of use of computer by children from home to school and the duration of exposure. The case under study is more relevant to developed countries where children are exposed to computers from a young age to maturity. In developing countries, interaction with computers is mostly experienced in middle ages when most students join high school and colleges. Many studies in addition to the above, including Sawyer and Penman (2011) on ergonomic and computer use in rural secondary schools students and Castellucci, Goncalves and Arezes (2010) on ergonomic design of school furniture: Challenges for the Portuguese schools; have been conducted but none of them have addressed the issues of computer ergonomics in Kenyan learning institutions.

## 3. METHODOLOGY

The study targeted five primary schools, ten secondary schools and one university (Kirinyaga University College) in Kirinyaga County. Purposive sampling was used to select the institutions that use computers in teaching and learning. Stratified sampling was used. In primary schools only class eight students were considered, in secondary schools only form four computer students were considered and in the university, computer science and information technology second year undergraduate students were considered. In each stratum, random sampling was adopted. The sample size was picked as follows: 10 respondents from among class eight pupils in every primary school totaling to 50, 20 from among form four students in every secondary school totaling to 200 and a 100 students from Kirinyaga University college. Total sample size was 350. Closed ended questionnaire was constructed and self administered to collect information about computer related ergonomic issues and habits of students. Copies of questionnaire entitled "Questionnaire to Capture Information on Computer Ergonomic Practices" were administered to selected sample sizes. Observation schedule was used to complement the questionnaire. Data was analyzed using IBM SPSS statistics V20 and results presented.

## 4. DATA ANALYSIS RESULTS AND DISCUSSIONS

From the 350 questionnaires that were distributed, 305 were returned which is 87.14% which is a sufficient percentage for analysis (William et al, 2012). The questionnaire addressed the following objectives: to determine whether learning institutions' fraternity is aware of computer ergonomic issues, to assess the extent to which ergonomics practices are being followed in our learning institutions and to identify problems that learners face for not adhering to ergonomic practices while using computers; under the following headings:

### 4.1 MACHINES

#### 4.1.1 Anti-glare screen

The study sought to establish whether monitors of computers being used were fitted with anti-glare screens. 2.4% of the respondents agreed that their computers had anti-glare screens while 87.8% disagreed. 9.8% did not respond. From observation, the study established that all the institutions chosen had no anti-glare screens fitted on the student machines. The 2.4% who agreed could be as a result of not understanding what anti-glare screens are.

#### 4.1.2 Adjustable brightness

The study sought to find out whether the computer screens brightness and contrast could be adjusted. A total of 82.9% of the respondents agreed with the item, while 14.7% differed. 2.4% did not respond. Most of the machines both CRT and TFT monitors have mechanisms for adjusting brightness and contrast and most of the students had been taught and shown how to perform this. The study observed that even with this feature, most of the students had put very bright coloured screen savers on the monitor screen and the screens were too bright combined with the artificial lighting in the computer laboratories.

#### 4.1.3 Noise

The item sought to establish whether computer and accessories produce disturbing noise while functioning. 47.1% of the respondents concurred, while 50.5% were of the contrary opinion. 2.4% did not register their responses. From observation, and also data analysis, most of the responses on this item came from primary schools which get free computer donations from people who dumb e-waste in Kenya in the name of helping digitize education.

#### 4.1.4 Keyboard and mouse design

The respondents were to give their views on whether the keyboard and mouse design allowed appropriate arm postures. Majority of the respondents did not have problems with the keyboard and mouse designs. 50.7% agreed, 44.4 disagreed while 4.9 did not respond. The results could be attributed to the fact that all keyboards and mouses are standard and the designs do not take into consideration the various needs of users.

### 4.1.5 Adjustable computer screen

The study wanted to find out the respondents opinions on whether computer screens were adjustable at a comfortable eye height level. 17.1% of the respondents were in agreement while 73.1% did not agree. 9.8% did not respond. The 17.1% responses could be because of respondents inability to distinguish between tilting with adjusting. These results were backed up by the study observation results that none of the institutions under study had acquired adjustable computer screens.

## 4.2 FURNITURE

### 4.2.1 Adjustable chair height to table

The study required the respondent to give views on whether the height of chair was adjustable to match with the height of the table. 2.4% of the respondent were in agreement while 97.6% did not. The few that agreed to this item could be the technicians in the only university college who had chairs adjustable to the height of the table. The majority of the respondents were sitting on wooden chairs which were not even comfortable with studying.

### 4.2.2 Adjustable chair for feet and back rest.

Using this item, the study looked for views of respondents on whether height of chair was adjustable to allow feet and back rest. 19.5% concurred while 80.5% had different opinion. This is due to the fact that all the primary and secondary schools had very poorly done furniture which were not even suitable for normal sitting. The 19.5% respondents could have come from the only university in Kirinyaga where the study observed that some slightly decent comfortable chairs had been procured specifically for the two computer laboratories though the chairs were not adjustable.

## 4.3 WORK ENVIRONMENT

### 4.3.1 Shielded computer screen

On whether computer screens were shielded away from direct sunlight, respondents gave the following responses. 34.1 % agreed while 65.9% disagreed. These results indicate that most laboratories in the institutions under study were not initially designed to host computers and therefore the positioning of furniture and computer accessories versus the direction of the sun becomes a challenge. Also, a few of the institutions had gone an extra mile to put translucent glasses and curtains.

### 4.3.2 Artificial lighting in Laboratories

The item sought to establish if the respondents were comfortable with artificial lighting in computer laboratories. 73.2% agreed while 24.4% disagreed. 2.4% did not respond. Majority of the respondents agreed that they were comfortable with the artificial lighting in the laboratories because most of the institutions under study had installed only one bulb or fluorescent tube per laboratory which is not much light while using computers. Although the lighting was as per majority of responses it was evident that the lighting wasn't enough as per the expected computer laboratory standards.

### 4.3.3 Heat generated by computers

The study sought opinions of respondents about heat generated by computers in the laboratories. 34.1% reported being uncomfortable with the heat generated while 65.9% were comfortable. The 34.1% are those institutions that had been given donations by some non-governmental organizations and computer for schools Kenya. These computers are old versions with inferior circuitry systems and components hence emitting a lot of heat. Most of the laboratories were congested, with some housing over 30 machines in small rooms hence poor circulation of air.

## 4.4 KNOWLEDGE

### 4.4.1 Frequent Breaks

The study sought to establish whether the respondents were encouraged to take break offs from computer use. 31.1% agreed while 68.9% did not agree. Primary and secondary school lessons take a maximum of 80 minutes. The students automatically break before they are fatigued. In the university, lessons can go up to 5 hours. This is the reason for the 68.9% of the respondents who felt that they are not encouraged to take breaks. Some of them were just not aware that they needed frequent breaks depending on the level and age of the students. Due to the nature of curriculum both at secondary and university level, it is difficult to incorporate breaks after every 30 minutes which translated to a higher number of respondents' disagreeing.

### 4.4.2 Health issues awareness

The item sought to establish if the respondents were aware of the health issues associated with poor computer usage. 53.7% of respondents agreed while 46.3% were of the contrary opinion. The results indicated that majority of the respondents were aware that there are health risks associated with use of computers and accessories.

### 4.4.3 Ergonomic best health practices

The study required the respondents to disclose on presence of health practices guides in the computer laboratories. 19.5% admitted presence while 75.6% were of the contrary opinion. 4.9% did not respond. The results of the study indicate that majority of the institutions had not displayed computer health practices guides and guidelines in the computer laboratories and therefore many of the responses did not know how to conduct themselves while interacting with computers and accessories. The study observations also indicated that majority of the students were not keen on reading and/or adhering to the health practices put in place.

## 4.5 HEALTH SYMPTOMS

**Table 1: Health symptoms associated with continuous use of computers and accessories**

| No. | Symptoms | % Response |
|---|---|---|
| 1. | Backache | 79.4% |
| 2. | Shoulder ache | 49.3% |
| 3. | Arm pain | 46.8% |
| 4. | Neck pain | 63.1% |
| 5. | Wrist pain | 24.3% |
| 6. | Headache | 41.5% |
| 7. | Eye strain | 75.4% |
| 8. | Weakness | 14.3% |
| 9. | Tension | 17.1% |

The above results indicate that eye strain and backache are highest health symptoms associated with bad computer ergonomic practices at 75.4 % and 79.4% respectively, followed by neck pain at 63.1%. Backache could have been caused by poorly designed chairs and tables. Eye strain could be attributed to the fact that most of computer screens do not have anti glare screens thus direct radiations from computer screens affecting user vision causing headache (41.5%) at the end of the day. Neck pains and shoulder pains were as a result of students straining due to poor anthropometric designs of laboratory furniture.

## 5. CONCLUSION

The aim of the study was to assess computer ergonomic issues in learning institutions in Kenya: case study of Kirinyaga County. Objectives of the study were to determine whether learning institutions' fraternity is aware of computer ergonomic issues; to assess the extent to which ergonomics practices are being followed in our learning institutions; to identify problems that learners face for not adhering to ergonomic practices while using computers and to propose best ergonomic practices to be adopted in learning institutions. The study found out that majority of respondents were aware of computer ergonomic issues surrounding usage of computers and associated devices in a computer laboratory but were not keen to adopt better ergonomic practices. The most visible causes of ergonomic problem as indicated by the respondents are poorly designed seats, awkward posture, exposure to computer screens on a regular basis without screen protectors, sitting in the same position for continuous long hours, frequent repetitive motion tasks and lack of break offs. To ensure best ergonomic practices are adhered to in learning institutions, the study proposed a framework of ICT ergonomic implementation in education sector.

## 6. RECOMMENDATIONS

Ergonomics is the science and practice of designing jobs, tools, equipment and environments to match the capabilities and limitations of the human body. Ergonomics studies emphasize on how to best make the work environment fit the worker.

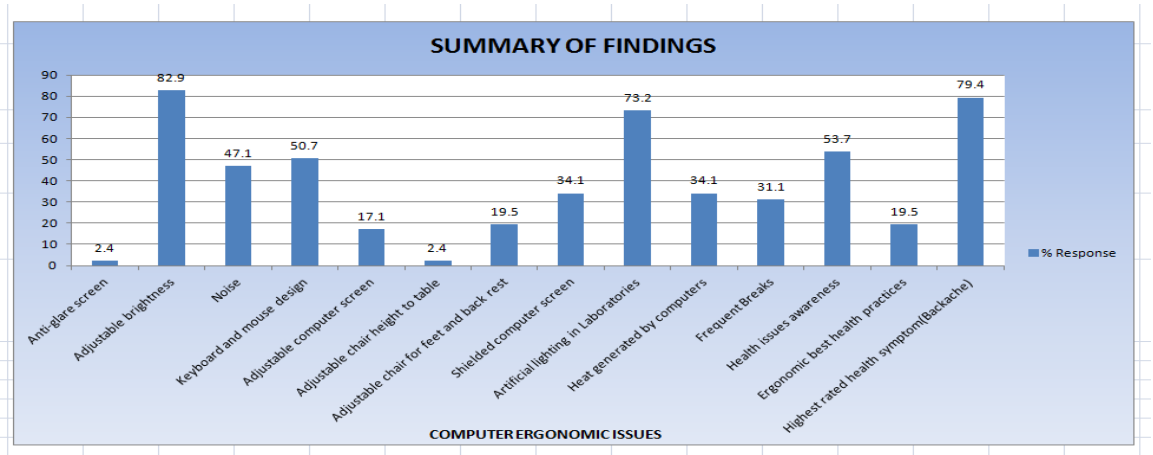


**Figure 3: Summary of Findings**

Ergonomics help prevent injury and increase comfort and productivity. When ergonomic principles are applied in the computer laboratories, visual and musculoskeletal discomfort and fatigue can be significantly reduced. Peter et al., 2014 in the study on benefits of laptop computer ergonomics education to graduate students concluded that still after a sensitization on computer ergonomics and a series of follow ups, some graduate students still made no changes to how they interacted with machines and laptops. This means that ergonomics is not a one day lesson to warrant change. That is why this study took the initiative of choosing study subjects from primary to university to be able to establish the levels and impact of ergonomic education. The study made the following recommendations:

i) The government should fund educational institutions to ensure that besides acquiring computers for teaching and learning, institutions are also in a position to lay ergonomic infrastructure for the acquired computing devices. Most schools in Kenya are public schools and therefore funded by the government and partly by the parents. Kenya being a developing country, the GDP is below the international standards (average earning less than a dollar a day). Meaning that matters of computing in education are given second priority after basic necessities have been catered for.

ii) When institutions are acquiring computing devices, sizes that conform to age and size of user should be considered. For instance, computing devices for primary school pupils should be smaller in size compared to the ones for university students. In addition, furniture acquired should also be designed to match the size of acquired devices.

iii) Ergonomic education should be introduced at early stages of education (primary level) to inculcate a culture of good health practices in future while interacting with computer technology. Studies show that effects of continuous unhealthy use of computers and accessories manifest later in life.

iv) Government should consider researches that inform policies and decisions concerning ICT implementation in education sector. This will enable well informed strategies on how to roll out sustainable ICT programmes in education sector.

v) Management of institutions and stakeholders should be discouraged from receiving donations in form of ICT devices that do not meet ergonomic standards. The study found out that most of the primary and secondary schools under study had acquired computers through donations of which most of them were e-waste from other countries. Most of these computers are of lower versions with ever malfunctioning parts, producing hazardous emissions which are harmful to human health.

vi) Considering the environment at home, students should be encouraged to work with computing devices only while at school. This is because majority of Kenyan households do not have furniture that are computer ergonomically fit.

vii) Education institutions are encouraged to adhere to a computer to student ratio of 1:3; this will ease congestion in most of the schools which has translated to ergonomic problems. The study found out that in majority of schools under study, one computer was being shared by ten students.

viii The recommends that all learning institutions adopt the framework of ICT ergonomic implementation in education sector in figure 3 below.

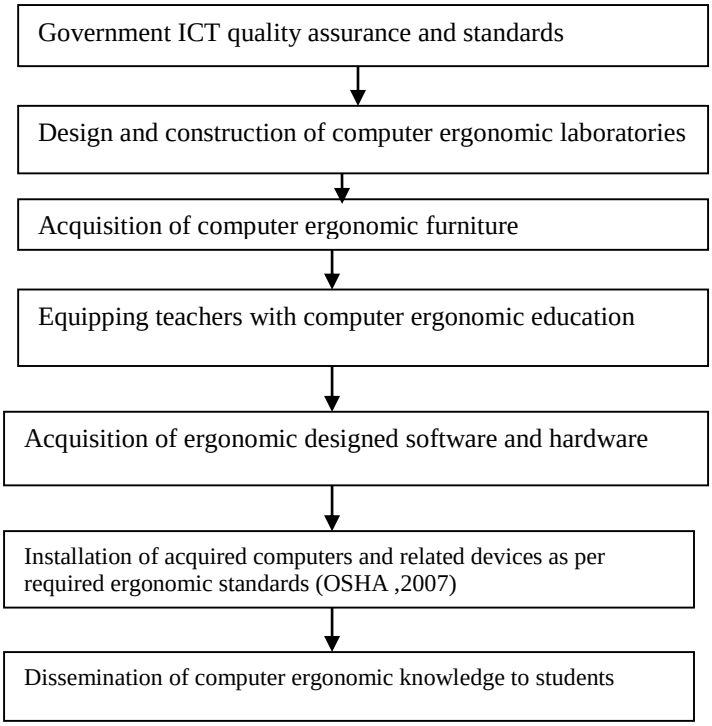


**Figure 4: Framework of ICT ergonomic implementation in education sector (Researchers, 2014)**

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