A STUDY ON THE EFFECTIVENESS OF A PLANNED TEACHING PROGRAMME TO IMPROVE THE KNOWLEDGE REGARDING “Ergonomics For Computer Use” AMONG SELECTED STAFF OF MAJAN COLLEGE – MUSCAT – SULTANATE OF OMAN

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Abstract— This paper describes a study conducted to evaluate the effectiveness of a teaching programme on “Ergonomics for Computer use” among the staff of Majan College. A pre experimental research design was used to conduct the study. Thirty samples who met the study criteria were selected using convenience sampling technique. The knowledge level of the staff was assessed using a pretest questionnaire. The subjects were then exposed to a planned teaching programme. The teaching programme included power point presentation with multimedia clippings, demonstration of exercises regarding ergonomics of computer use. The post test questionnaire was administered to the staff, to determine whether there is a gain in knowledge due to the exposure of the subjects to the teaching programme. The results of the experiment showed that there was an increase in the pretest (m=9.36, s=3.91) and the post test mean (m=15.99, s=3.09) scores. Paired “t” test, proved that there was a significant difference in the pre and the post test scores (t29 = 11.466) at 5% level of significance. This difference was due to the intervention in the knowledge of the subjects. The practical application of this intervention would create health awareness to all computer users, thus improving quality of work environment.

Index Terms—Computer Ergonomics

I. STATEMENT OF THE PROBLEM

In 2015 the worldwide sales of PCs are projected to reach almost 517M units—up from 372M PCs in 2011. It had taken 27 years to reach 1 billion computers in use and market researchers say it will take only 5 years to reach the next billion.[2] The movement of body and limbs is inescapable in human-computer interaction (HCI). Whether browsing the web or intensively entering and editing text in a document, our arms, wrists, and fingers are at work on the keyboard, mouse, and desktop. These continuous movements cause Repetitive Strain Injury. Reports of studies have suggested clearly the likelihood of pupils or staff suffering health problems linked to computer use is related to the amount of time spent using them and also lack of knowledge related to computer ergonomics.[16] According to dictionary.com, “Ergonomics is the applied science of equipment design intended to maximize productivity by reducing operator fatigue and discomfort”. The important question is whether the alleged planned teaching program on “Ergonomics for computer use” will be effective on the level of knowledge employees.

2. RELEVANCE OF THE PROBLEM

As computer technology is becoming an integral part of the education curriculum, careful considerations need to be given regarding the ergonomic design of computer workstations matching with the anthropometric factors of growing children. There is scientific evidence that the computers can adversely affect different parts of the human body. Both the educators and the students need to be aware of the importance of correct working postures and appropriate work-rest ratios in using computers.[14] Most companies blindly follow ergonomics recommended by American or European countries, ignoring that the body stature are different across the world. Studies done by Dawood Slaiman Al-Faris regarding the development of Anthropometric data for Omani male population of age group 18 – 60 indicate that the Omani male population in statistical terms are shorter 8 cm compared to many European Industrial or Manufacturing nations. Moreover review of literature reveals that most of the studies on computer users are done in developed countries, very few are done in Oman. Therefore the present study was an attempt to fulfill this gap by making an investigation in this area in Omani context.

3. Fields of application of the proposed research results

The study results will help many organizations of various fields to create an awareness of the basic principles of computer ergonomics, which may help in reducing the risk of computer related health disorders, thus improving the work performance and creating a healthy atmosphere in their work field.

4. Review of literature and other existing information

Increased risk of forearm pain was associated with the use of a mouse device for more than 30 hours a week and a
keyboard more than 15 hours a week.[19] A study reported that people who work with computer have shown an increased output of 20 to 25% due to ergonomic improvement in workstation layout. [5] The computer workers who received screen alerts to take breaks were 13% more accurate in their work than those who did not as reported by Hegde (2001). [6] According to Shikdar and Al-Kindi(2007)[12], 90% of the employees used computers more than 4 hrs a day, 45% of the employees adopted bent and unsupported back postures and the major problems reported were eyestrain (58%), shoulder pain (45%), back pain (43%), arm pain (35%), wrist pain (30%), and neck pain (30%). Narayana (1999) stated that there were health risks associated with spending much time in front of a computer. [7] Sheady (1999) reported that 50-90% of computer users experienced the symptoms of computer Vision Syndrome. [8] Chaffin and Anderson (1991) considered that the seat alone is insufficient for stabilization and the use of the legs, feet and back in contact with other surfaces, as well as muscular forces are necessary to produce equilibrium.[9] New York State United Teachers developed a health and safety fact sheet to decrease computer-related health hazards and measures that can be taken to reduce or eliminate, the chance of suffering from pain, discomfort or a disabling condition due to extensive computer use.[12] A participatory approach was used to create computer ergonomics workshop for college students for solving computer workstation ergonomic problems and adopting healthy computing behaviors. The results of the study justify formal controlled trials of this intervention in university students, who will become tomorrow’s workers.[11] Thus on the basis of comprehensive literature review, it can be concluded that computer is a marvelous tool and the only solution to the information need. However, using it for a long time has become tomorrow's workers. Therefore it is advisable for video terminal users to create their own comfortable environment.

5. Statement of objectives:
   i. To assess the level of knowledge regarding health issues and precautionary measures related to computers use.
   ii. To evaluate the effectiveness of a structured planned teaching programme on the knowledge of Majan College staff.
   iii. To examine the differences in effectiveness of the program across the study subjects of selected variables.

6. Variables
   a. Sex.
   b. In-service training given to staff on computer ergonomics.
   c. Years of experience.
   d. Number of hours spent on a computer per day.

7. Statement of research Hypothesis
   \( H_1 \): The post test level of knowledge will be higher than the pretest knowledge.
   \( H_2 \): There is an association between pretest level of knowledge and the selected demographic variables.

8. Research Methodology

   A. Summary of Methodology
   The study was conducted to:
   i. Determine the knowledge of the Majan college staff regarding computer ergonomics.
   ii. Develop and validate a structured PTP on computer ergonomics.
   iii. Examine the effectiveness of a planned teaching programme on employees’ level of knowledge computer ergonomics

   Based on the availability of the samples, we take the
   Sample Size : 30
   Sampling Technique : Convenience Sampling
   Setting : Majan College
   Inclusion Criteria : Staff using the computer more than 3.5 hours a day
   Exclusive Criteria : IT staff and staff using the computer less than 3.5 hours a day

   B. Selection of Research Strategies
   A pre experimental single group study design was adopted for the study.

   i. Description of the tool
   The study was carried out by using a structured knowledge questionnaire and the planned teaching programme. The questionnaire consisted of two parts. Tool-1 consists of demographic performa and Tool-2 consisting of 21 questions related to knowledge, knowledge of practice on computer ergonomics and the most likely health hazards related to long term usage of computer. Each respondent was asked whether they had any information related to these issues, the period elapsed since they began operating with the computer and the time they spent on computers on daily basis. They were also asked if they were involved in little or extensive usage of computers and if they had any knowledge about breaks taken in between, wrist and arm positions while typing, maintaining user monitor distance, positioning of eyes against computer screen, changing body positions while working on computers, chairs with wheel supported legs, sitting postures. Precautionary measures to be taken related to health hazards were among the aspects of interest to the researchers. The planned teaching programme was a power point presentation which consisted of demonstrations and multimedia clippings related to health hazards and ergonomic behaviors. It helped in motivating the staff to follow the ergonomic positions while using the computers, and practice some exercises during their breaks.
Validity
The content validity of the tool was done by experts from the department of Ergonomics, Ophthalmologist and Computer Science. The modifications and suggestions were incorporated in the final presentation of the tool.

Reliability
The reliability of the questionnaire, determined by split half technique was 95%.

Ethical Consideration
1. Permission was obtained from the Dean of Majan College.
2. The staff were briefed on:
   i. The knowledge questionnaire.
   ii. Purpose of the study.
   iii. Selection criteria for subjects.
   iv. Planned teaching programme.

Short Description of Planned Teaching Programme (PTP)
A planned teaching programme on ergonomic behaviors was given to the staff. The PTP was a power point presentation educating the users on the possible health risks associated with computer use and some respective precautionary measures against it could definitely make a difference and result in “Healthy Computing”.

Description of Data Collection
Recruitment of samples: The investigator selects subjects who work on the computer for more than 3.5 hours a day. The target was 100% coverage of the staff satisfying the inclusive criteria. But due to various reasons the target sample could not be reached. The questionnaire was administered to 59 subjects. Out of which 30 samples were able to participate in the study. Their knowledge was assessed by the structured knowledge questionnaire.

Graphical representation of samples on basis of demographic variables.

Fig. 1
Among the respondents (33%) were males and (67%) were females.

Fig. 2
“Fig. 2” represents, 30% of the respondents had more than 15 years of work experience, and 26.67% had less than 5 years and between 11 to 15 years of experience. Whereas 16.67% of the respondents had 6 to 10 years of work experience.

Fig. 3
The pie chart in “Fig. 3” shows that a majority of 60% of the subjects spend 3.5 to 6.5 hours on the computer on a daily basis. Many studies have reported that people working on the computer for 3.5 hours a day are exposed to health disorders due to lack of knowledge of safe ergonomic behaviours. 23.33% spend between 6.5 to 9.5 hours and 16.67% spend more than 9.5 hours a day.

The total score (pre-test) of each respondent was calculated and their level of knowledge was interpreted as follows:

a. Inadequate knowledge \((x - 1\sigma) < \text{Total score} < x\)

b. Moderately inadequate \(\text{Total score} = x\)
c. Adequate knowledge \( \bar{x} < \text{Total score} < (\bar{x} + 1\sigma) \)

Then the planned teaching programme (PTP) was given to the subjects. On completion, the investigators again assessed the knowledge by administering the same questionnaire and thus calculating the total score (post-test) and interpreting their level of knowledge in the same way as the total score of the pre-test.

**Short Description of Analysis and Interpretation of Results**

Data processing was be aided by Statistical Package of Social Sciences software.

**Statistical Analysis:** Analysis of data was done by descriptive and inferential statistics. Descriptive statistics of frequency and percentages were used to summarize the sample characteristics.

**TABLE I**

<table>
<thead>
<tr>
<th>Level of Knowledge</th>
<th>Pretest scores</th>
<th>Post test scores</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>%</td>
</tr>
<tr>
<td>Inadequate</td>
<td>18</td>
<td>16</td>
</tr>
<tr>
<td>Moderately Inadequate</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>Adequate</td>
<td>6</td>
<td>20</td>
</tr>
</tbody>
</table>

% =Percentage

**TABLE I** indicates that the number of staff with adequate knowledge had increased in the post-test compared to the pre-test scores which descriptively proves the effectiveness of the planned teaching programme. The zero percent in the number of inadequate level of knowledge is a clear indication that all the staff have benefited from the planned teaching programme.

A Comparison of the individual pre-post test scores of the samples was observed. It concluded that a total of the twenty nine samples (96.67%) showed an increase in the post test scores compared to the pre test scores. However the pre and post test score of one sample (3.33%) remained the same. And these results were definitely due to the experiment of the planned teaching programme. Thus proving that the planned teaching programme may be recommended to educate the staff to improve their knowledge on the ergonomic issues related to computer use[11].

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Fig. 4

“Fig. 4” shows the pre-test scores, where 62% of males and 61% of females had inadequate knowledge, 19% males and 22% females had inadequate knowledge, whereas only 19% of males and 17% of female had adequate knowledge. The pre-test level of knowledge clearly indicates a need to educate the staff on the basic ergonomic issues related to the computer which supports our comprehensive literature review[11]. This proves our first objective that there are majority of subjects with inadequate level of knowledge. All our literature reviews indicate that most of the health problems are related to extensive computer use.

According to Shikdar and Al Kindi (2007), people who work on the computer for more than 4 hours a day had inadequate knowledge of ergonomic positions that are to be maintained while working on the computer and this resulted in many health problems. Hence they recommended the need for ergonomic training to the employees of different organizations. Many countries have made interventions like conducting workshops/seminars and introducing health safety fact sheets to increase the knowledge of computer users and have succeeded to a certain extent to reduce the health risks associated with the computer use. The increased number of computer users in Oman indicated to the researchers that there is a need to conduct this study. They decided to examine the effectiveness of the intervention in the knowledge of the visual display terminal users regarding ergonomic behaviors and precautionary measures related to health. The planned teaching programme would be an effective approach to increase the level of knowledge of the staff of Majan College, who are working on the computers for more than 4 hours a day.

The planned teaching programme resulted in a comparison table of the pre and post test scores.
Fig. 5

The graph in “Fig. 5” highlights that, the post-test scores of each subject is relatively higher than the pre-test scores, which is an indication that the staff were able to gain knowledge from the planned teaching program. Thus proving that PTP conducted by the researchers had a positive impact on the level of knowledge of the respondents.

Fig. 6

In “Fig. 6”, the post-test level of knowledge shows 100% of males had adequate knowledge, whereas 35% of females had moderately inadequate knowledge and 65% had adequate knowledge. This increase in the level of knowledge was due to the experiment of the planned teaching programme.

Fig. 7

The graph in “Fig. 7”, indicates that the percentage of staff with adequate knowledge was higher compared to moderate level of knowledge irrespective of the years of work experience. This proves that the planned teaching programme was effective in increasing the knowledge of the staff.

Fig. 8

The “Fig. 8” shows that staff with adequate knowledge was higher compared to moderate knowledge and there were relatively no staff with inadequate knowledge irrespective of the number of hours they spent on the computer. This also proves our objective that the planned teaching programme was effective on increasing the post-test level of knowledge.
The box plot in “Fig. 9” indicates a comparison of maximum, upper quartile, median, lower quartile and minimum of the pre and the post test scores. It shows that the above scores of the post-test are higher than the pre-test which is a clear indication that the average level of knowledge of the staff has increased due to the intervention of the planned teaching programme.

Fig. 9. Box plot for Pre-test and Post-test Scores

Comparing the error bars in “Fig. 10”, we conclude that there is an increase in the post test mean compared to the pretest mean.

Inferential statistics was used to examine the effectiveness of the planned teaching programme. Paired "t" test was used for analyzing the difference between the means of the pre and the post test.

![Error graphs of Pre and Post test](image)

Table III reveals the difference in the means, standard deviation and the paired “t” value of the knowledge scores regarding the effectiveness of the planned teaching programme. The test proved to be significant at \( p = 0.0001 \). Hence our research hypothesis \( (H_1) \) is accepted. In the pre-test 60% of staff have inadequate knowledge, 20% have moderately adequate knowledge and 20% have adequate

Fig. 10

In the pre- test mean (9.36) and post- test mean (15.9) in TABLE II shows that the mean of post- test scores are higher than that of the pre- test score. A comparison of the mean, median, mode, minimum, maximum and the quartiles are given.

### TABLE II

Statistics of Pre and Post Test Scores

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Notation</th>
<th>Pre-test Score</th>
<th>Posttest Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Samples</td>
<td>( n )</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Median</td>
<td>( M )</td>
<td>8.5</td>
<td>16</td>
</tr>
<tr>
<td>Mean, Standard deviation</td>
<td>( \bar{X}, \sigma )</td>
<td>9.36, 3.91</td>
<td>15.9, 3.09</td>
</tr>
<tr>
<td>Mode</td>
<td>( Z )</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>Minimum</td>
<td>Min</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>Maximum</td>
<td>Max</td>
<td>18</td>
<td>21</td>
</tr>
<tr>
<td>Quartiles</td>
<td>( Q_1 )</td>
<td>6</td>
<td>12.5</td>
</tr>
<tr>
<td></td>
<td>( Q_2 )</td>
<td>8.5</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>( Q_3 )</td>
<td>13.5</td>
<td>18.5</td>
</tr>
</tbody>
</table>

The increase in the pre-test mean (9.36) and post-test mean (15.9) in TABLE II shows that the mean of post-test scores are higher than that of the pre-test score. A comparison of the mean, median, mode, minimum, maximum and the quartiles are given.

In the pre- test 60% of staff have inadequate knowledge, 20% have moderately adequate knowledge and 20% have adequate knowledge. The test proved to be significant at \( p = 0.0001 \). Hence our research hypothesis \( (H_1) \) is accepted. In the pre-test 60% of staff have inadequate knowledge, 20% have moderately adequate knowledge and 20% have adequate knowledge.
knowledge, whereas in the post-test 0% have inadequate knowledge, 23% have moderately adequate knowledge and 77% have adequate knowledge. These pre and post test scores shows that there is an increase in the percentage of adequate level of knowledge from 20% to 77%. One tailed paired sample’s t test revealed that the post- test level of knowledge (m =15.9, s =3.09), is higher than the pre-test level of knowledge(m =9.36, s =3.91). The overall improvement mean score of 6.5667 with t(29) = 11.466 was highly significant at p =0.0001. The 95% confidence interval in the TABLE III indicates a significance difference in the means. Thus concluding that post test mean is greater than the pretest mean.

The chi square test results showed no association between the pre-test level of knowledge and the selected demographic variables. Hence, we had to reject the research hypothesis H2.

CONCLUSION

There was a significant difference in the pre-test and the post-test means. The pre-test mean = 9.36 with a standard deviation of 3.91 and the post-test mean = 15.9 with a standard deviation of 3.09. Therefore we can conclude that the planned teaching programme was effective in increasing the knowledge of the staff. The results of the research supports literature reviews, [9][16] that there is a need to educate the people by conducting computer workshops/seminars on safety issues related to health due to extensive computer use. Health and Safety Fact sheet, related to health hazards of computer use is a publication of New York State United Teachers (NYSUT) has conveyed that they have set up various regional training centers for ergonomic training. Thus many literature reviews supports the result that the planned teaching program conducted by the researchers has made a significant difference in the knowledge of the staff in the research study.

Very few studies have been done on intervention of knowledge on this subject. The application of these results will create health awareness among the adult and the young generation of computer users in Oman. The planned teaching programme and presentations in different academic institutions and organizations would definitely motivate the staff to get acquainted to the ergonomic behaviors and precautionary measures to develop a healthy computing environment.

Further research can be done by educators with larger samples. A Comparative study can be conducted with an experiment and control group resulting in mass preventive educative program to be given to computer users/professionals to form a healthy community. A similar study can be recommended on students and also employees of other organizations to educate them with the ergonomic guidelines used to prevent work related problems due to extensive computer use.

Limitations:
The investigators could not include a control group in the study. Samples could not be randomized.

Recommendations:
a) Similar study can be conducted using a larger sample.
b) Similar study can be conducted using a control group.
c) Similar study can be conducted on students and other firms to improve their knowledge on “Computer ergonomics”.
d) Many organizations can train their employees by conducting workshops/ in-service educational programmes on ergonomics and health issues related to extensive computer use.

REFERENCES

[10] New York State United Teachers Health and Safety Fact Sheet, Health Hazards of Computer Use
