Ergonomic Design of IT Teaching Laboratories

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Abstract

African Universities and especially Historically Disadvantaged South African institutions use the traditional "chalk-and-talk" method of delivering practical computer lessons which are instructor led sessions conducted in laboratories. The design of laboratories has to be conducive to learning. Laboratories that are designed using ergonomic principles tend to be more user-friendly and facilitate the learning process. This raises the question: are University computer teaching laboratories ergonomically designed for the comfort of the student? In order to answer this question, this study was conducted at the University of Kwazulu Natal-Westville campus in the Department of Information Systems and Technology. A convenience sample of one hundred first year students was used. A simple questionnaire covering the main constructs of the study was administered to the students. It was found that there were a number of significant relationships between the design of the laboratories and student discomfort, some students who were exposed to previous computer training found the University facilities better, although not significantly. Students found lighting, positioning of the screens, ventilation and the direction that they had to face as some of the poor design features of the laboratories. A number of recommendations were made in order to ensure that the design of new laboratories took a learner centric and ergonomic approach which included: students facing the instructor and a projection screen, use of Smartdesks® , tiered floors and instructors should have control of lighting and room temperatures. Implementing the recommendations requires large investments. However,

providing a quality learning environment is bound to produce quality graduates.

Keywords

Information systems, teaching laboratories, ergonomic design, student perceptions, computer-based training

Introduction

In order to keep pace with globalisation and belonging to the Global Information Society (GIS), Computer Education is growing in importance in South African schools and tertiary institutions. Information Systems and Information Technology are important subjects forming the basis of new curricula. Computer classrooms and laboratories are springing up in these institutions to cater for the demand. Often, it is not possible to build new facilities; hence existing premises are being revamped to cater for computer equipment. However, many of the existing premises were originally designed for something else and don't easily lend themselves to effective computer teaching facilities. In essence it is like "fitting a square peg into a round hole". The learning environment has a major impact on learner's productivity and could be a promoter or inhibitor of success. This study asks the question "are university computer facilities properly designed to promote learning?" In order to answer this question, this study is comprised of a literature review that examines issues in computer room design which is supported by an empirical study that describes the situation in the Department of Information Systems & Technology at the University of Kwa-Zulu Natal (UKZN) in South Africa.

Human Computer Interaction and Ergonomics

The lengthy periods of time that individuals spend using computers at school, at home and at work have necessitated the study of their interactions with the technology as it has serious implications for their productivity and health. Human Computer Interaction (HCI) can be defined as the study of the interactions between humans and their computers (Dix *et al.* 2003). The

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purpose of studying HCI is to understand the impact of computers on individuals, groups and organisations in order to create effective, usable and enjoyable experiences with technology. HCI traditionally examines the computer interface such as the screen, keyboards, mouse and peripheral technologies used in computing. However, in order to create effective, usable and enjoyable experiences with computers, the subject goes beyond just the technology, but also extends to the physical environment in which computers are used.

According to Stair and Reynolds (2005), computer usage may affect employee effectiveness, employee stress and physical well being. They further state that medical and legal claims relating to repetitive motion disorder caused from using computers and other equipment are on the increase. Some of these problems stem from the design of the environment in which computers are being used. Ergonomics which is the study of how people use tools to do their work (Lengel 2003), examines the physical environment in which the human computer interaction takes place. According to Dix *et al.* (2003), Ergonomics is an established field closely related to but distinct from HCI. Stedman (in Jermolajew and Newhouse 2003) defines Ergonomics as a branch of ecology dealing with human factors in the design and operation of machines and the physical environment.

The study of Ergonomics especially Environmental Ergonomics is important as it deals primarily with performance (Dix *et al.* 2003). This is supported by Stair and Reynolds (2005), who are of the view that work stressors caused by a poorly designed environment can severely limit productivity and performance. According to Pheasant (in Jermolajew and Newhouse 2003), studying the computer users environment is intended to change things for the better by improving performance, productivity, health, safety and the users overall work experience.

Key Issues in Ergonomics

It is evident from the foregoing that the key issues addressed by Ergonomics are performance, health and computer user satisfaction. It is important to understand these issues in greater detail.

Productivity

Productivity and employee performance are essential components in achieving a competitive advantage. The automation of processes in itself increases organisational productivity and performance. Processes that are still performed by people have been enhanced by computers leading to productivity and efficiency (Stair & Reynolds 2005). However, computers themselves are not enough to enhance productivity and performance, the work environment and proximity to all the necessary tools such as printers, fax machines, and consumables are equally important. Networked printers and fax machines make no sense in organisations where people have to walk to collect printing or send faxes from communal facilities. Besides the delay in having to walk to collect work, bottlenecks often occur when others are sending work to the same machine. A person who has left his/her workspace may have to wait for his/her job to be processed. Furthermore, communal facilities encourage social gatherings which add to the time spent away from one's workplace. Therefore, an individual's workspace needs to be designed in such a way that all tools required for the job are easily available.

Health

Computer use may affect physical health as well (Stair & Reynolds 2005). Repetitive stress injury (RSI) is a condition that occurs due to repeated stress being placed on a joint and the muscles and tendons surrounding it Starr (2001). The physical impacts of computer usage can be classified into two groups namely musculoskeletal and vision problems.

Musculoskeletal

According to Starr (2001), common musculoskeletal injuries include:

- Tendonitis which is an inflammation of tendons that causes sharp pains in the fingers making it difficult to hold objects
- Carpal tunnel syndrome which is a condition caused by compression of the median nerve in the hand and wrist which causes wrist pain and a tingling numbness also making it difficult to hold objects

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- Thoracic outlet syndrome, a condition caused by compression of nerves and blood vessels in the neck and shoulders resulting in neck and back aches.

According to Stair & Reynolds (2005), RSI's can be caused by excessive use of computer keyboards, the mouse and other equipment. However, according to Szabo & King (2000), undue reliance on Ergonomics to treat musculoskeletal disorders to the exclusion of proper diagnosis and treatment to other medical and health risk factors may adversely affect patients. In essence, poor ergonomics may not be the root cause of RSI's.

Vision

According to Verma (2001), some of the symptoms associated with excessive use of computers include: frequent headaches, blurred or double vision, burning eyes, excessive tearing, dry eyes and frequent blinking and squinting. According to Dhawan (2005), computer related eye problems are mostly as a result of users bad habits. He states further that computer screens do not emit harmful rays; it is merely the fixed focus on the monitor and low blink rates that causes the problems. The effects of the digital age are taking their toll on workers (Blessingame 2001). According to Catz (in Blessingame 2001), the eyes lead to the body and if vision is impaired, soon other functions will also be impaired. According to Blessingame (2001) and Dhawan (2005) there is no wonder cure available to solve the problem. However, simple adjustments such as monitor distance, lighting and a comfortable work environment will help in eye care (Blessingame 2001).

Computer User Satisfaction

According to the Communications Workers of America (2004), job demand stressors which included poor ventilation and heating, poor lighting, poor workstation design and poor training were contributors to workers stress resulting in poor physical and emotional well being. Simple creature comforts can make a job a satisfying experience. Clean and comfortable surroundings add to the ambience and add value to a workers day. A workstation that is well laid out with all the necessary tools in close proximity reduces unnecessary repetitive movement thereby saving a worker

time and effort. Goldstein (2003) found that playing simple computer games may help personal productivity and make people feel better about their jobs.

It is evident that Ergonomics is not merely about creating the perfect physical environment; it is also about creating a healthy and safe environment as much as it is about creating a psychologically ideal environment. The issues discussed thus far are pertinent to organisations and worker productivity, but what link does it have with the computer classroom?

Teaching with Technology

Due to the information age in which we live, computers are being used more and more for instructional purposes and also to teach computing skills. Learners are exposed to learning environments that should also follow Ergonomic principles in its design to ensure productivity (which is represented by the learners grades), health (learners should also be protected from stressors in the computer classroom), and user satisfaction (learners should enjoy working in the computerised environment). In modern Universities of the Western World, teaching of computer courses such as computer literacy, applications software, and introductory programming, are fast becoming computer based themselves. Students are provided with step-by-step manuals that are accompanied by CD's that contain exercises, and audio visual presentations that guide the learner to perform certain tasks. Some of the CBT (computer based training) packages include self test exercises to reinforce learning and provide the learner with instant feedback on their competence to use a particular product. In developed countries this is possible as University students are exposed to computers and computer education at school, furthermore, their understanding of English, which is the medium of most computer based instruction, makes for easy comprehension and thus application of the instructions being provided. In African Universities, the CBT approach is hampered due to the digital divide that exists in Africa, one of the causes of which is language (Singh 2004). For most African University students, their first encounter with electricity, let alone computers, only takes place at the age of about eighteen when they enter the halls of academia. It is a daunting experience for the student to have to teach himself/herself to use a computer and to follow instructions in

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English, which in many cases is not the student's home language. Furthermore, this becomes more challenging when the audio instructions are provided in a foreign accent. It is against this background that African Universities and especially Historically Disadvantaged South African institutions use the traditional "chalk-and-talk" method of delivering practical computer lessons which are instructor led sessions conducted in laboratories. Therefore, the design of laboratories has to be conducive to learning immaterial of what teaching methodology is used.

Designing the Digital Classroom

Design is the construction of the user experience and it covers many quarters, sometimes multiple and even invisible quarters (Dykstra-Erickson *et al.* 2001). This is supported by Dix et al (2003) who state that the Ergonomic design of computer environments should be conducted by multi-disciplinary teams. These teams could be comprised of Ergonomists, Lectures, Tutors, Network Specialists, Furniture Designers, Building Contractors and last but not least, the Learner.

Drivers of Classroom Design

According to the British Educational Communications and Technology Agency (Becta 2001), there are two forces that drive the effective design of the digital classroom namely pedagogy and financial resources.

Pedagogy

Pedagogy refers to the strategies, techniques, and approaches that teachers can use to facilitate learning. Teachers could take a learner centric or teacher centric approach to teaching. There is no single pedagogy that is best, that is, the debate between learner centred or teacher centred, what is being taught will determine the pedagogy (Lengel 2003). Teaching practical computing skills lends itself to the teacher centric model where the teacher stands in front and projects his activities on a large screen and the learners follow on their computers. According to the Coastal Carolina University (CCU) (2003), the ergonomic design of the classroom reflects the preferred

pedagogy and impacts significantly on learner attitudes and achievement. Therefore, pedagogy must drive design.

Financial Resources

According to Becta (2003), effective Ergonomics is expensive and incurs both capital and running expenses. Therefore, learning institutions must have sufficient resources to maintain and support an ergonomically designed computer classroom.

Factors to Consider When Designing the Computer Classroom

According to the Whole Building Design Guide of 2004, training facilities for adult learners must be flexible, technologically advanced, safe, healthy, comfortable, aesthetically pleasing and accessible. When reading popular literature around this topic, one will find extremely long lists of guidelines where different "experts" (mainly marketing people) make claims for their products. In order to provide an objective list the guide provided will address the following issues: accessibility, lighting, visibility, ventilation, desktops, floor layout and seating.

Accessibility

According to Jermolajew and Newhouse (2003), the needs of disabled and semi-disabled students need to be catered for. The room must be designed for wheelchairs and a row of seats needs to be dedicated for wheelchair bound students and students with walking devices. Desktops should have adjustable heights to park different sized wheelchairs under them and the desktop should be able to slide back and forth for easy access to the keyboard and mouse.

Lighting

As mentioned earlier, poor lighting affects vision (Blessingame 2001). There should be no windows behind users as the light from the windows will reflect on the screen making reading difficult (Lengel 2003). Similarly,

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writing boards should not be used for projection as it reflects a bright blinding light into the eyes of the audience.

Visibility

High visibility is high priority (Coastal Carolina University 2003), the less learners need to adjust their seats the more likely they are to remain focused. Therefore, corridor style layouts are very effective. Furthermore, the key to effective work is a natural neck and easy eyes (Lengel 2003). Learners who follow the teacher's instructions that are projected at a comfortable height where the neck and the eyes are not straining will be more relaxed and can concentrate on the lesson rather than on aches and pains.

Ventilation

Most computer classroom windows are sealed shut to prevent theft. However, this prevents the flow of fresh air into the classroom. Combined with the heat generated from the computers and the heat from the users, computer classrooms are an ideal breeding ground for germs. According to Becta (2001), the ideal temperature in a computer classroom should be 18-24 degrees Celsius. Therefore air conditioners should be standard equipment. WBDG (2004) recommend that air conditioners should be adjustable to accommodate varying occupancy rates.

Desktops

Becta (2001) recommends that desktops should be high enough for users to put their legs under comfortably. However they should not be so high as to lift monitors to a point where they obscure the users line of sight of the lecturer and projected images. SMARTdesks ™ offers two desktops that allow for clear vision. The SR series uses a standard monitor that is sunken into the desktop allowing for greater visibility and a relaxed posture as illustrated in Figure 1.

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Figure 1: SMARTdesk™ SR Series

The SMARTdesk™ SS series is illustrated in Figure 2.

Figure 2: SMARTdesk™ SS Series

The SS series has a sub-surface mounted monitor that provides clear forward visibility, but could affect posture dependent on the size of the user. Furthermore, the monitor takes up leg room which could be very uncomfortable for bigger people.

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Floor Layout

Floor layouts are always a contentious issue especially when old classrooms are being converted into computer classrooms. Most organisations in order to get the most mileage for their money cram in as many workstations as they can. This compromises comfort, health, user satisfaction and productivity. The most space efficient floor layout is the Piers layout illustrated in Figure 3.

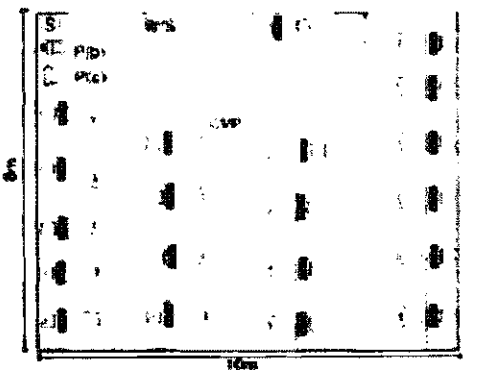

Figure 3: Piers floor layout. Adapted from: British Educational Communications and Technology Agency. 2001.

In the Piers layout, learners have to turn away from their computers to focus on the teacher/lecturer and projected images. The turning of the neck and back could result in repetitive stress injuries.

The Rows or Corridor layout as illustrated in Figure 4, is less space efficient. However, it allows for a more natural posture and line of vision.

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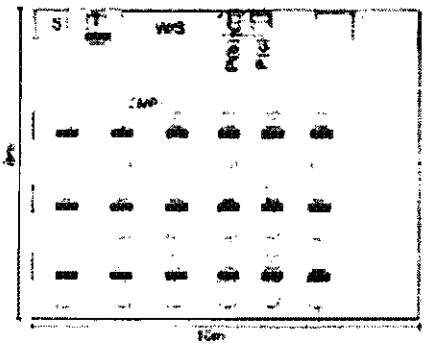

Figure 4: Rows/Corridor floor layout.
Adapted from: British Educational Communications and Technology Agency. 2001.

The Corridor layout usually has excellent viewability (Coastal Carolina University 2003). According to Becta (2001), long thin rooms are more difficult to teach in, therefore, when new rooms are being constructed, they should be more square which reduces the distance between the lecturer and the learner.

Seating

The correct chairs are the key to healthy comfortable computing (Lengel 2003). According to Becta (2001) chairs should complement the desk height and they should be stable, maneuverable, and adjustable. Learning institutions must recognise that comfort is an important factor of student satisfaction and should obtain quality chairs (Coppola & Thomas 2000).

The list of factors that should be considered in the effective design of computer classrooms is much longer. However, the factors discussed warranted a detailed discussion as they impact on productivity (uncomfortable students are less likely to concentrate on lessons), health (learners facing the wrong directions could strain their necks and backs making adjustments to see the lecturer and projection screen), and learner satisfaction (learners are more likely to complain if their work environment is aesthetically displeasing).

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Methodology

Motivation for the Study

The computer practical teaching classrooms also known as laboratories at the Ex-University of Natal and the Ex University of Durban Westville were poorly designed. There was no evidence of consultation with learners to develop ergonomically sound teaching venues. Due to the merger of the two institutions into the University of Kwazulu Natal, this study was carried out as a means to motivate for ergonomically designed computer teaching rooms.

Sampling and Sample Size

A convenience sample of 100 first level Information Systems and Technology students was used for the study. The sample size constituted 8.5% of the first year population. However, due to the timing of the study, which was during the examination period, it was not possible to get a larger number of respondents.

Data Collection Tool

A simple questionnaire was designed by the author. The questionnaire was comprised of demographic questions followed by Likert Scale type questions where respondents had to make a choice of options ranging from strongly disagree to strongly agree. Only two open ended questions were asked to get input from respondents about what they would like to see in the design of their classrooms. The questionnaires were handed out to students who attended revision lectures.

Results

The data was analysed using SPSS (Statistical Program for the Social Sciences). A number of frequencies, correlations and cross tabulations were generated and are presented as follows.

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Sample Demographics

Race and Age Distribution of Respondents

The sample consisted of 73% African, 25% Indian and 2% Coloured respondents. This is illustrated in Figure 5.

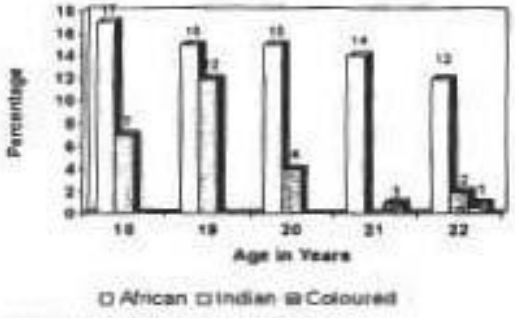

Figure 5: Race and age distribution of respondents

The majority of the respondents (27%) were 19 years old.

Previous Exposure to Computer Training

The majority of the respondents (57%) had been previously exposed to computer training as illustrated in Figure 6.

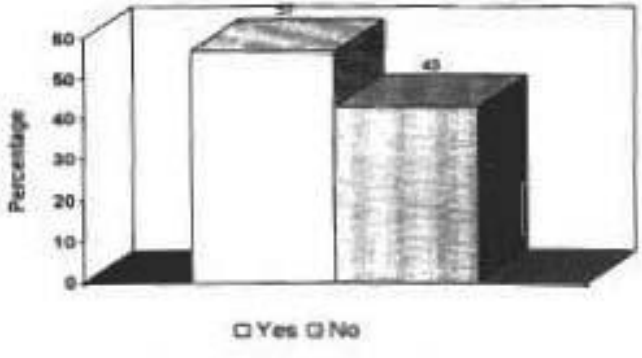

Figure 6: Previous Exposure to Computer Training

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Respondents with previous training could provide valuable feedback comparing previous facilities with those of UKZN.

UKZN Computer Facilities Compared to Other Facilities

Of the respondents who studied computers previously, the majority (27%) received computer training at school as illustrated in Figure 7.

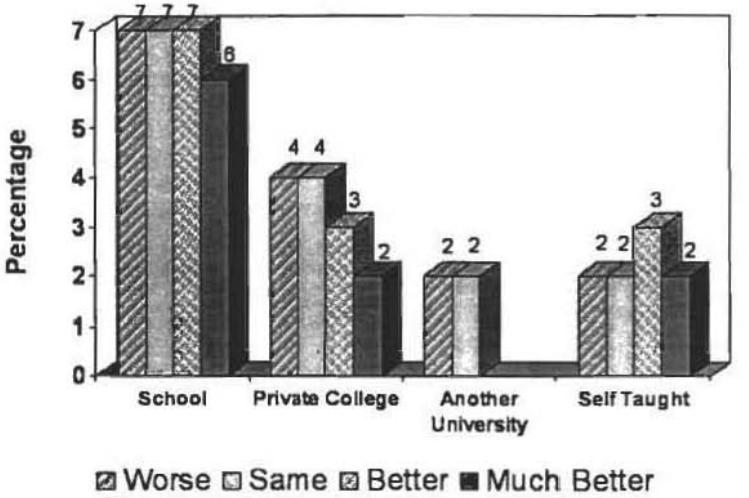

Figure 7: Comparison of UKZN computer facilities in relation to other facilities

There is no significant indication of how the UKZN computer facilities compared with previous facilities. However, 13% felt that the University had better facilities than their Schools. Only 7% felt that their Schools had better facilities.

Laboratory Design

Student Perceptions of Laboratory Design

Only 55% of the respondents said they disliked the design of the UKZN

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computer laboratories. Figure 8 illustrates the issues that respondents did not like about the laboratory design.

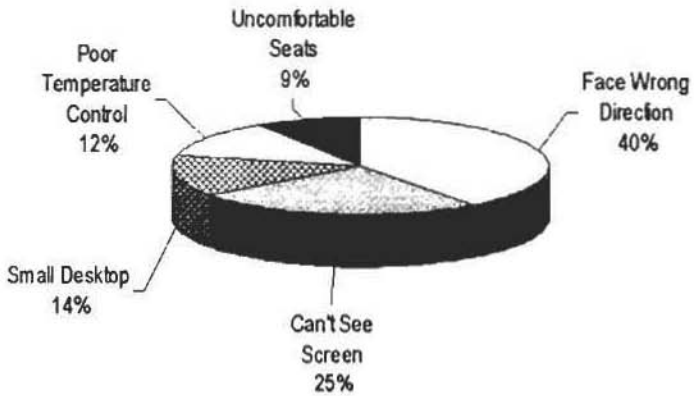

Figure 8: Problems associated with UKZN laboratory design

It is evident that the most pertinent issue related to the laboratory design was the direction which students faced. Forty three percent (43%) felt that the seats faced the wrong way. Many of the respondents (27%) could not see the projection screen. The desktop space (15%), temperature control (13%) and uncomfortable seats were the other issues raised. These findings tie in very closely with the issues raised in the literature review namely desktop design, ventilation, visibility, seating and floor layouts.

Floor Layouts

Placement of Seats

The majority of the respondents (49%) strongly agree that the seats should face the screen and tutor, whilst 33% agreed, as illustrated in Figure 9. This would support the Rows/Corridor layout recommended by Becta (2001).

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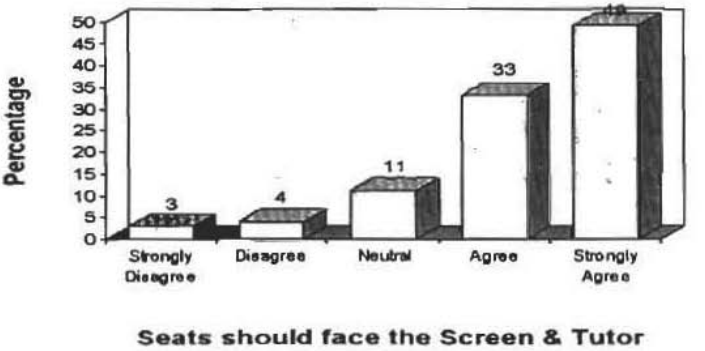

Figure 9: Seating Position

Only 7% of the respondents did not agree that seats should face the screen and tutor.

Tiered Floors

A large number of respondents (52%) felt that the laboratories should be tiered as illustrated in Figure 10.

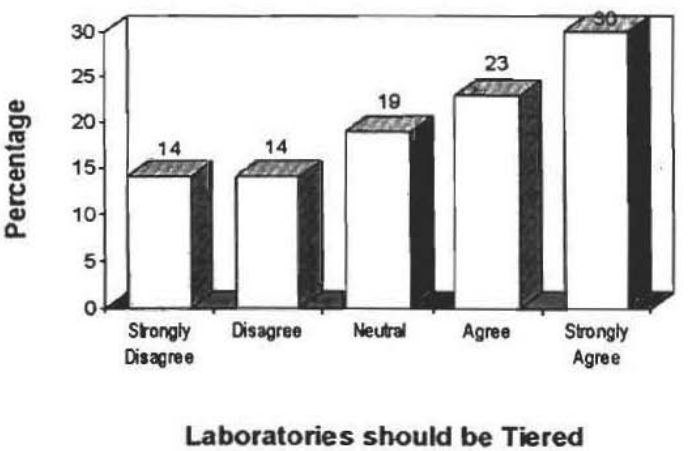

Figure 10: Tiered Floors

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It is significant that 28% did not support tiered floors. This could be attributed to the fact that the question may have led them to believe that the rooms would be large, with large numbers of students. The reason for this is that to explain what tiered floors were the questionnaire described one of the large, one thousand seat venues at the university with which the respondents were familiar.

Repetitive Stress Injuries

The majority of respondents (93%) felt that they should not have to turn their necks to see the board or screen. Table 1 illustrates the relationship between students with stiff necks and those who felt they should not have to turn their necks to see the board or screen.

		Regular Stiff Neck					
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total
Should not have to turn necks	Strongly Disagree	2	1	0	0	1	4
	Disagree	0	1	0	0	0	1
	Neutral	1	0	1	0	0	2
	Agree	1	5	5	8	4	24
Strongly Agree	0	7	8	21	33	69	

Table 1: Relationship between neck problems and neck movement

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Of the respondents who felt that they should not have to turn their necks to see the board or screen, 66% also complained of regular stiff necks. Although it is difficult to develop a causal relationship without proper diagnosis, there is prima facie evidence that respondents suffer from thoracic outlet syndrome as a result of repetitive turning to see the board or projection screen. However, on conducting a two tailed Pearson correlation it was found that a strong relationship existed between respondents suffering with stiff necks and regular neck movement. Since the floor layout in the computer laboratories follows the Piers arrangement (Becta 2001), it can be concluded that the floor layout has an impact on user health.

Miscellaneous Issues

Ventilation

As mentioned earlier, air conditioning plays a part in a computer user's comfort. Very often air conditioning works from a central plant and either runs too warm or too cold, therefore, Becta (2001) recommended that air conditioning should be adjustable. The respondents in the study strongly support this notion as evidenced in Figure 11.

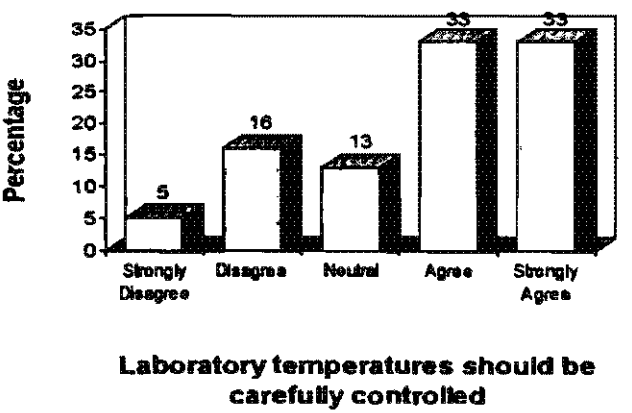

Figure 11: Laboratory temperatures should be carefully controlled

The majority of the respondents (66%) were of the opinion that laboratory temperatures should be adjustable.

Seats

Although comfortable seating is important for healthy comfortable computing (Lengel 2003), the respondents were not overwhelmingly in favor of tilt and height adjustable chairs as evidenced in Figure 12.

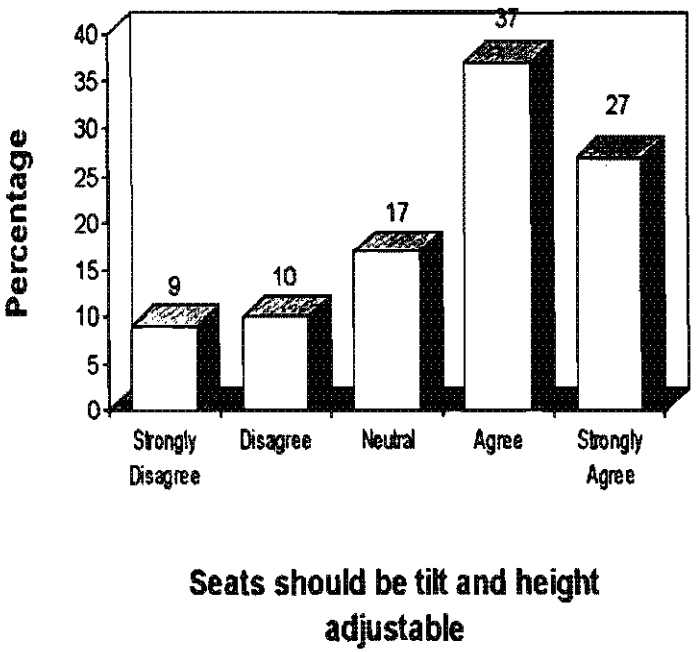

Figure 12: Seats should be height and tilt adjustable

One could assume that the 19% of respondents who did not agree to have height and tilt adjustable seats either did not know what they were, or they were satisfied with what was available.

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Desktops

Sunken desktops provide greater visibility and allow users to sit at a comfortable angle. Besides being ergonomically friendly, they look extremely modern. However, respondents did not jump at the prospect of having something 'cool' in their laboratories (Figure 13)

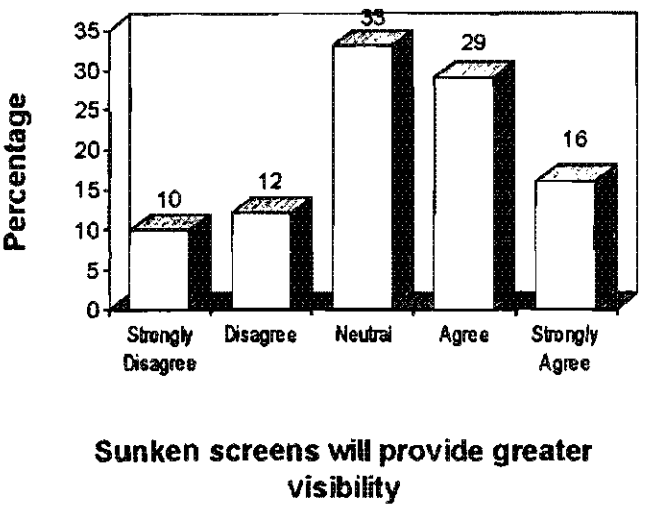

Figure 13: Desktop design - sunken screens

Only 45% of the respondents were in favor of sunken screens, of which, only 16% were strongly in favor. What is important is that 33% were neutral suggesting that they were not sure of what benefit it could offer, alternately, they could not visualise the desktop.

Differently-abled Students

There were only four respondents who were differently-abled. These respondents were all in agreement that the facilities adequately met their needs.

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The presentation of data shows that there are design deficiencies in the computer teaching laboratories at the University of Kwazulu Natal which need attention.

Recommendations

Making recommendations based on the data would suggest a major overhaul. However, there are major cost implications which requires both capital expenditure and running expenses, both of which the University in its transition phase can't afford. Therefore, the recommendations will be made as short term and medium/long term recommendations. The main assumption being made is that the pedagogy of teaching computer practicals will not change.

Short Term

Ventilation

The issue of ventilation requires a minor set of modifications to the current air conditioner system. Being ducted air conditioning running from a central plant, a "one size fits all" approach is used where learners freeze in some rooms whilst others sit in stifling heat. Ducts that open into the rooms should have air flow regulators that can be operated with remote controls by the lecturer. By regulating the airflow into the rooms, temperatures can be maintained at a comfortable level based on the conditions within individual rooms.

Visibility

Projection screens are poorly placed and need to be moved and mounted permanently. Placement should be done with a full class of learners in attendance in order to find a position that offers optimal visibility for all. Unfortunately, due to the poor design of existing computer rooms, there will be blind spots as some students will be seated behind pillars.

Medium/ Long Term

The School of Information Systems & Technology at UKZN needs to develop strategic building plans where they can translate ergonomics into

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their planning. One of the options is to take a clean slate approach and build computer teaching classrooms from the ground up in an area dedicated to the School and its growth plans. Existing laboratories could be used as walk-in labs. However, this may not materialise for the next ten to fifteen years. Therefore, alterations to existing facilities are required.

Visibility

Existing laboratories as mentioned have pillars in them that obscure the view of the board and projection screen. The rooms could be reduced in size in order to incorporate the pillars into the walls. However, this will leave large areas of unused open space and rooms that accommodate smaller groups. Small groups are better to teach. However, this would require additional staff, which is a grey area in light of the merger.

Floor Layout

Some of the better and newer labs could be realigned in a Corridor style configuration ensuring that learners face in one direction towards the lecturer and projection screen. SMARTdesks™ or any generic could be built where screens are embedded into the desktop. This will ensure that shorter learners don't have to crane their necks or look around their monitors to see the projection screen. Proper floor layouts will ensure that repetitive stress injuries are reduced or eliminated entirely, especially if learners are facing the correct direction without having to keep turning or altering their posture.

Seats

The existing seats are padded. However, they are stationary and non-adjustable. Furthermore, the chairs are the stacking type and break easily. Rather than repairing or writing off the broken chairs, the School could gradually replace them with proper height adjustable seats.

Teaching Technology

The School could change its pedagogy and move towards a learner centric model. Learners could be given detailed manuals which they could follow

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and teach themselves, alternately, they could be provided with Computer Based Training software that teaches them step-by-step. Should the School continue to use a teacher centric approach, then software such as NetOPs School could be used where the learners screen is split in two, the learner can view the teachers screen and his/her own screen. The teacher teaches from just about anywhere and the learner follows step-by-step on his/her screen. Using the latter approach will require major upgrades to the network.

Breaking Bad Habits

Learners need to be made aware of the health and safety issues associated with computer usage and they must be encouraged to take responsibility for their own welfare. Health issues which are normally taught in the second semester of the first year could be moved to the introductory lessons in the first semester. These issues could be reinforced in the practicals with proper demonstration from tutors. Shorter students need to be encouraged to sit at the front of the class or in seats from which they can best see the lecturer and the projection screen. Senior students who spend long hours at the computer should be encouraged to perform eye exercises and take regular breaks from their work

Good Housekeeping

Lab staff needs to conduct regular inspections to ensure that chairs are not broken. Broken chairs should be removed immediately into a safe area. Furthermore, broken desks, faulty air conditioners and broken window blinds need to be reported to the maintenance department for immediate repairs. Fire fighting equipment needs to be serviced regularly and fire doors inspected to determine their functionality. All papers and dirt must be removed immediately, and labs need to be cleaned regularly. During term breaks, a major spring cleaning operation must be conducted. Staff should perform visible, good ergonomics. If staff set the example, learners will follow.

The ideal computer classroom for universities should be built in tiers with curved desks surrounding the presentation area. The lecturer/tutor must have full control of ambience, comfort and must have a control desk from

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which to operate the data projector, sound system, lights and air conditioning. All that is required to make this ideal a reality is funding.

Conclusion

This study has clearly shown that at the University of Kwazulu Natal Westville Campus, computer facilities are not designed properly to promote learning. However, although the facilities are not ideal they have not hampered learning. The learning environment needs to be redesigned around the learner and learners should be integral to any future plans. In any study, it is important to outline the limitations of the study. The small sample size does not lend itself to generalise the results to all students and to all campuses of the University. Another study could be conducted using a larger sample and sampling all campuses. Furthermore, a similar exercise needs to be conducted in the School of Computer Science to determine unique needs of the School instead of using a one size fits all approach in designing labs. Some of the questions may have been ambiguous or may have needed explanation; hence, the questionnaire needs to be revisited. Other studies could focus specifically on each of the key issues of ergonomics namely productivity, health and user satisfaction. For Ergonomics to succeed, it will require support from the top and involvement from the bottom.

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