Ergonomics for Grade School Students Using Laptop Computers

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Abstract. This paper describes an ergonomics education program for grade 6 and 7 students at a private school in southern Alberta. The students use laptop computers within most of their classes and the education program provides information on repetitive strain and back disorders, set-up of their computer work area, and taking breaks. Types of carrying cases and methods to reduce the loads carried are also discussed. During the education session, students complete a discomfort survey using a scale from 0 to 10 to rank the discomfort they feel in various regions of the body while performing computer work. A higher frequency of discomfort of moderate to high intensity was found for both grades in the neck, upper back and lower back as well as eyes and headaches, as compared to the upper extremities (shoulders, elbows, forearms, wrists and hand/fingers).

INTRODUCTION

As computer use in the classroom is increasing, so too is concern about the potential for development of musculoskeletal disorders (MSDs) in students. While a linkage between MSDs in students and their computer work has not been definitively proven, research in the field has been increasing and there certainly appears to be cause for concern. This paper describes one school's efforts to educate their students about ergonomics and improve computer work areas.

PROGRAM DESCRIPTION

At a private school in southern Alberta, students begin a laptop program in grade 6 in which each student purchases a laptop and connection hubs are provided in the classroom so that it can be used for project writing, internet searches, etc. as determined by the teacher. Students take their laptops home to complete homework assignments, as well as for security, and will continue to use it in subsequent grades. Grade 6 classes are held in a dedicated classroom and height adjustable desks are available for each student. Desks are grouped in fours about the connection hubs. Grade 7 students change rooms for each class and work surfaces are of a fixed height. In science classrooms, higher benches with stools are used.

The ergonomics education program was started at the request of the Academic Technology Coordinator. For one period in the fall term, each class takes part in a 45 to 50 minute session on ergonomics. The discussion includes an understanding of what ergonomics is, body areas where the students feel discomfort, guidelines for computer work, as well as the importance of changing both

positions and activities on a regular basis. Students also complete a discomfort survey during the session.

During the discussion of baseline posture while working on the computer, students are able to check their work surface and chair heights and a determination of whether a surface needs to be raised or lowered can be made. Books or boxes are found to use as foot supports for those who's feet do not touch the floor. Students are encouraged to make suggestions as to how a problem at school or at home could be solved. For example, sitting on a phone book was suggested for those needing a higher chair when doing computer work at home and another suggested using a pillow on the lap as a support for the laptop if working on the couch. In the grade 7 classrooms, the work surface heights cannot be adjusted and therefore suggestions focus more on posture changes, and taking breaks.

Following the education sessions, the grade 6 class worked on a project showing the "do's" and "don'ts" of computer work by taking pictures of each other and then these were posted with captions in the hall outside of the classroom to serve as a reminder.

Students also wrote summaries in their school journals of the education session that showed that they grasped the concepts presented well. Even more complex subjects (one student asked about her father's disk herniation) could be understood if put in a context that the student could relate to (e.g. the disk is like a balloon filled with toothpaste).

Figure 1: Laptop use in the science classroom with both desks and lab benches

Carrying cases for the laptops, books and lunch kits are also discussed. In one session, backpacks and over the shoulder carrying cases used by the students were weighed. The majority of cases weighed in the 18 to 22 lb range with some as heavy as 32 lbs, while the students weighed about 90 lbs on average (range of 72 to 140 lbs). This results in many students carrying 20% or more of their body mass, well over the 15% value suggested by the American Medical Association. The pros and cons of different types of carrying cases ranging from briefcase style to backpack to roll-along cases are discussed and the features that should be looked for in each (e.g. hip belt on backpacks) are reviewed. Students are encouraged to come up with strategies to decrease the amount they carry back and forth to home and around school including bringing only what they need to class and leaving the rest in their lockers, carrying only the paper needed in binders, and in some cases 2 sets of a book might be considered; one for school and one for home.

Figure 2: Large backpack on small student. An example of the size of backpack being used by some students to carry laptop, books, binders and lunch kit

DISCOMFORT SURVEY RESULTS

As mentioned previously, during the education session students complete a discomfort survey to indicate how they feel when working on the computer. Each body part is ranked on a scale of 0 (no discomfort) to 10 (intolerable). Students were also asked to indicate how much time they spend using a computer at school and at home. Thirty-four (34) grade 6 and 62 grade 7 students completed the survey. The grade 6 students did not appear to be as good at providing time estimates as the grade 7 students. For grade 6 students, the average use at school was recorded as 3.7 hours +/- 1.5 hrs. While the average was close to teacher estimates of 3.5 hours of use on average per day, the variation was larger than for grade 7 students who recorded an average school use of 4.7 hours +/- 0.8 hours. Teacher estimates were not collected for the grade 7 students as they are in a different classroom each period. The average at home use was reported to be 1.4 +/- 0.7 hours for grade 6 students and 1.6 +/- 0.9 hours for grade 7 students.

The results of the survey are shown in figures 3 and 4 for the grade 6 students, and in figures 5 and 6 for the grade 7 students. Rankings of intensity of 1 to 3 were considered to be "Low", 4 to 6 were considered to be "Moderate" and scores of 7 and above were considered to be "High". For grade 6 students, the body parts showing the greatest frequency of moderate and high scores (combined) were the head (headaches) with 44% of students reporting moderate to high discomfort, the eyes with 50%, the neck with 64% and the upper and lower back each with 38%. For the same body parts, the frequency of moderate and high scores combined for the grade 7 students were: headaches 32%, eyes 34%, neck 37%, upper back 30% and lower back 35%.

Combined moderate and high scores for the upper extremities were lower with frequencies of 17 to 27% for the shoulders, wrists and hand and fingers for both grade 6 and 7 students as shown in figures 5 and 6. Lower frequencies of moderate and high scores were reported for the elbows and forearms.

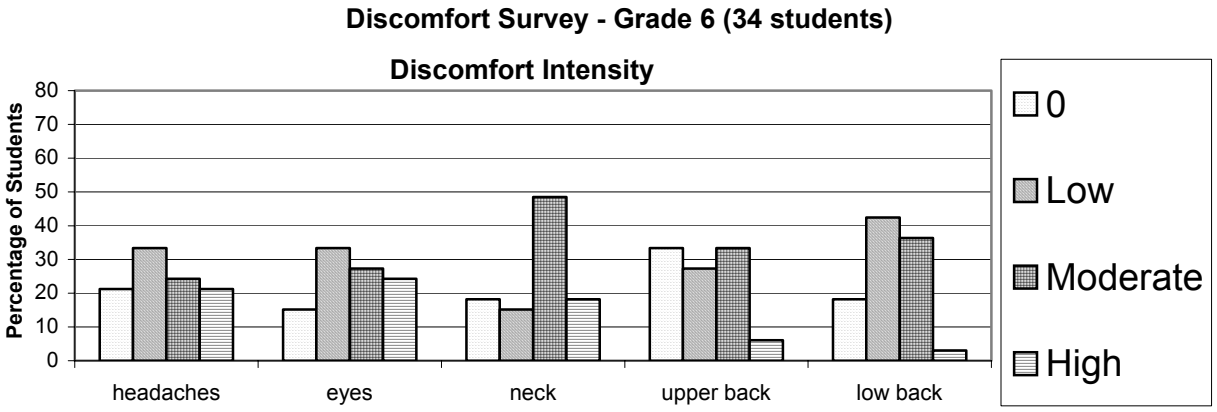

Figure 3: Discomfort Survey Results for Grade 6 students

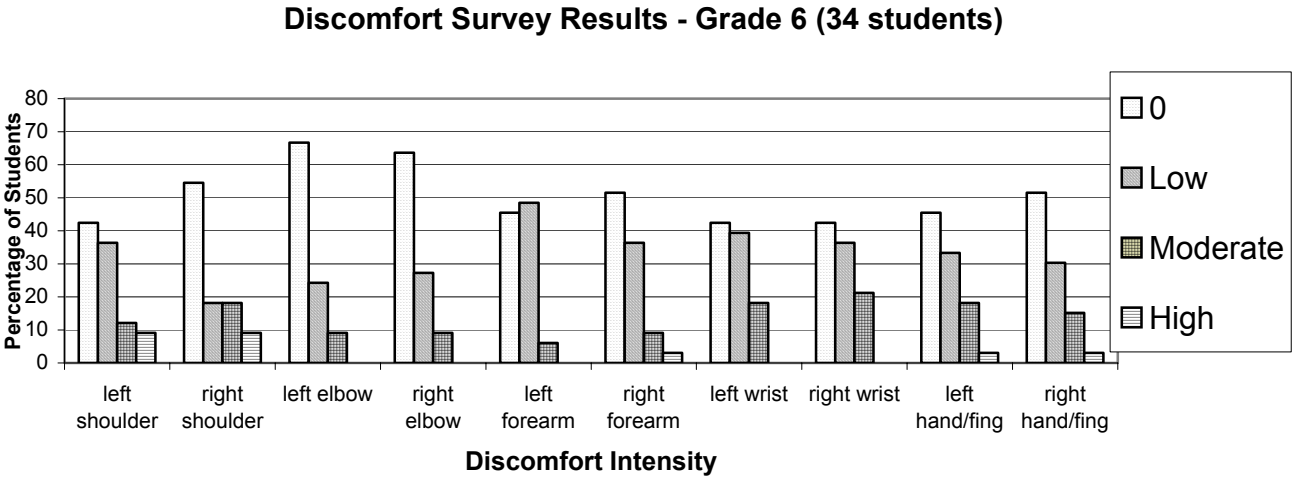

Figure 4: Discomfort Survey Results for grade 6 students

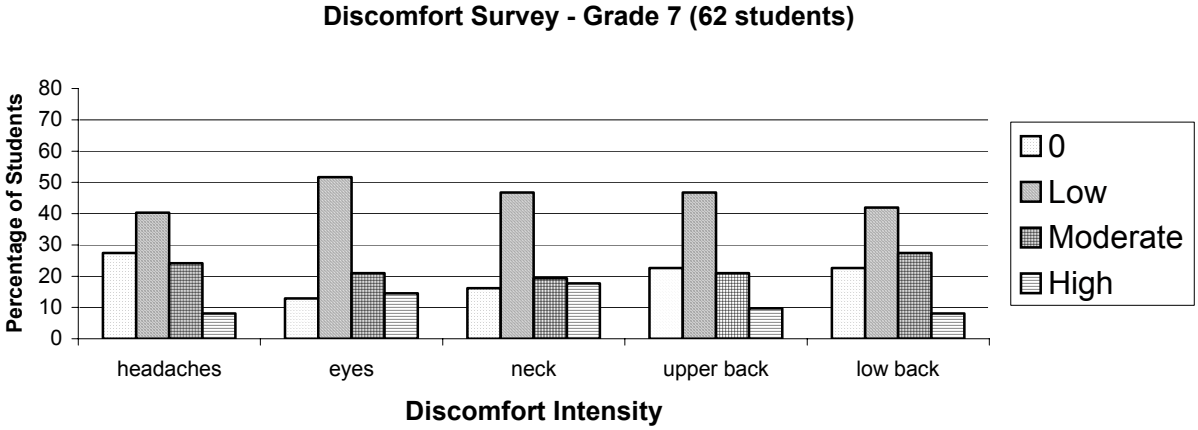

Figure 5: Discomfort Survey results for Grade 7 students

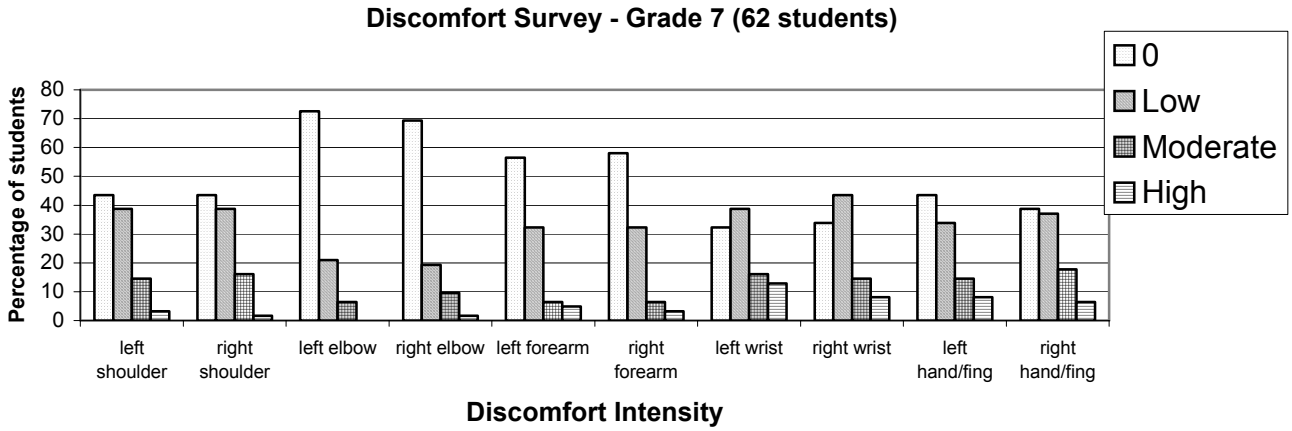

Figure 6: Discomfort Survey results for Grade 7 students

While it is possible that the discomfort experienced by the students could be attributed to other activities such as sports, music, etc., they do reflect the perceptions of the students' experiences with computer use, and are therefore cause for concern. More research, and particularly longitudinal studies tracking students over time, may help to provide a clearer picture of the ergonomic risk of computer work for children

OTHER MEASURES TO IMPROVE THE ERGONOMICS OF COMPUTER WORKSTATIONS IN THE SCHOOL

Other measures taken by the school to improve computer station set-ups were to place tables that have pin height adjustment in the common computer lab area used by Grade 1 to Grade 5 students. Because of the large height variation of the students, 3 different surface heights have been set. For shorter students, even with the surface at the lowest height of 23 inches, it is still too high. Therefore, chairs with pneumatic height adjustment were purchased for the stations and footrests were built to provide foot support when needed.

Grade 6 teachers spend 10 minutes each morning at the beginning of the school year working on typing skills with the students when they begin the laptop program and also talk to the students about posture and keying lightly during these sessions.

It is hoped that a combination of all of these measures will help reduce the risk of future MSD development in the participating students.