

# **Ergonomics for children: An educational program for physical education students**

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## **Abstract**

We present an overview of the “Ergonomics in the life-cycle” curriculum that has been delivered over the past nine years to Physical Education students at the Kibbutzim Teachers College of Education in Israel. A large part of the course is aimed at training the students to incorporate ergonomic subjects into the physical education programs in the elementary and the high schools, as well as in the movement lessons in kindergartens. The curriculum combines theoretical knowledge of ergonomics, human body sciences and human movement studies with applicable tools supplemented by studies of pedagogical issues. Students are required to construct and practice age-specific ergonomic intervention programs, which are followed by an evaluation stage with conclusions regarding improvements for follow-up programs. The intervention programs received positive feedback from the children and their parents and from the teachers and the directors of the schools where it was conducted. We are striving to introduce this program as an integral part of the Physical Education curriculum within the school system, which will accompany the children throughout their years of growth and development.

*Keywords: Children, curriculum, ergonomics and Physical Education*

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## **1. Introduction**

Traditional ergonomic programs for the prevention of work-related muscular-skeletal problems are directed mainly toward adults in their working environment [1]. However, since incorrect movement patterns and habits become firmly ingrained over the years, they are unlikely to be changed through such programs. It is widely accepted that effective education for proper posture, body-function and movement patterns is a long learning process that has to start at an early age. The subjects, as well as their ergonomic implications, should therefore be a part of the Physical Education (PE) programs in schools. The PE teacher, who watches the students during different movement

experiences and sports activities, should be trained to detect improper body use and to guide the students toward correct movement patterns in daily life. Accordingly, as part of the PE teachers’ training program, we have developed a course geared for PE students in colleges. The course, which is called “Ergonomics in the life cycle” combines theoretical knowledge of body sciences with applied topics, such as corrective exercises and body awareness. The course also deals with relevant pedagogical issues. During the second semester, the students already teach these subjects in schools and kindergartens.

Our aim is for PE teachers to be able to introduce ergonomic education for all ages, from early childhood to adulthood. We also expect that these concepts will

be incorporated into the schools' PE curricula.

The complexity of life and the rapid changes occurring in modern society have forced the educational system to focus on imparting life skills, including the ability to learn and adjust out of a sense of personal responsibility [2]. Accordingly, physical education subjects in schools must be expanded to include educating toward improved daily physical functioning in various areas of life throughout the life cycle [3, 4]. The attitude toward physical education can be likened to the approach toward an integrative field of knowledge combining theory and practice. This integrative field will combine the subjects of PE and Health Education [5, 3].

This article aims to present a PE teacher training program geared to enable teachers to impart correct patterns of movement and posture in daily life as a key component in developing life skills in kindergartens and schools.

## **2. Ergonomics at school**

We believe that ergonomic prevention programs must be an integral part of the educational process of imparting life skills from an early age. Children are capable of acquiring and even assimilating correct movement habits, without the need to change or "break" existing posture and movement patterns [6]. It is only through awareness of the changes occurring in the life cycle's daily functioning that the existing movement and posture patterns can be improved and that future problems avoided. Indeed, trial intervention programs designed to train children in correct biomechanical functioning through movement were conducted to prevent the onset of lower back pain problems. Schwartz and Jacobs [7] have shown that, in the wake of a short-term intervention program, the children's knowledge in these subjects grew. Balague [8] reports a decrease in the incidence of back pain in elementary schoolchildren in Switzerland as a result of an intervention program. However, a long-term program is needed to generate in-depth behavioural change.

Moreover, there is a growing awareness of another aspect relating to back pain prevention in children, namely suiting the school furniture to the students' needs. Research has shown that adjusting the furniture to the children's requirements has improved sitting posture as well as other classroom behavioural variables [9, 10]. Nonetheless, the need to accompany

the process of adapting the furniture to schoolchildren's needs with training in relevant ergonomic subjects and long-term prevention programs has been recognized. Some researchers recommend incorporating such programs into the school curricula [11, 12].

In Israel, as in many other countries nowadays, there is a growing interest in incorporating various health education subjects into the schools, following the realization that school-based health education for children and youth is the cheapest, most realistic and feasible approach. [13]

However, the ergonomic aspect has not been included in school curricula in Israel nor have they been part of the curricula at teacher training colleges.

Notwithstanding the above, these subjects have not yet been incorporated into the school curricula, nor have guidelines been drafted on the instruction and assimilation of good posture and movement habits. To cope with the problems presented above, subjects related to proper movement and posture patterns must be incorporated within the PE curriculum, according to the approach we call "movement ergonomics", which, for the first time, links between the field of ergonomics and the PE profession.

At the same time, PE teachers must also be trained accordingly. The PE teacher, who regularly watches students perform a variety of physical activities, can train them to acquire proper movement patterns, which they will carry with them throughout their life. PE classes in schools are an ideal setting for combining the teaching of the required theoretical knowledge and its practical application. As such, these classes provide a simple and accessible solution that does not require an investment of additional resources.

## **3. Movement ergonomics at the Teachers' College of Education**

A program for training PE students in "Ergonomics in the life cycle" has been in effect at the Kibbutzim College of Education for the past nine years. A major portion of the program consists of a specialized course on the subject, which is held as part of the overall theoretical and practical courses offered within the context of the "Fostering Posture and Movement" specialization third-year track. The course is also based on the knowledge acquired by the students during their years of study at the College in subjects such as Human Body Sciences, Psychology,

Behavioural and Educational Sciences and ties them with the “basic movement” course contents, which emphasize the notion of enhanced body awareness.

Below is a general description of the “Ergonomics in the life-cycle” curriculum contents (which, as mentioned previously, is part of a more comprehensive program). The main theoretical subjects and the accompanying hands-on experience are designed to illustrate and better define the link between the theoretical material learned in class and what happens in the field.

The first semester is dedicated to definitions and models of ergonomics in general and of ergonomics in working and living environments in particular. The following are the curriculum subjects:

### *3.1. The exposure model*

The first chapter presents an exposure model, which addresses the link between external exposure (to the sun, noise, chemical substances, furniture) and internal exposure (stress on the joints, muscles, ligaments.) and resultant physical and emotional injury. The model distinguishes between injuries subject to rehabilitation and those liable to become chronic.

According to the model under study, a variety of professions (nurses, salesmen, hairdressers, hi-tech employees) are analyzed in class. Already at this preliminary stage of the course, the students are required to think of efficiency-enhancing solutions and proposals.

### *3.2. Analysis of work-stations*

This section refers to a wide range of aspects that should be taken into account when analyzing a work-station, such as the work area height, the type of surface being worked on, lighting, noise, vibrations, the number of work hours, the work shift, psychological elements, and the employee’s anthropometric data. Special emphasis is placed on the analysis of computer workstations, when the knowledge is derived from the visits to different workplaces.

### *3.3. Cumulative Trauma Disorder (CTD)*

This chapter addresses various injuries caused as a result of ongoing stress on certain parts of the body and recurrent movements. These injuries lead to wear and tear and generate pathological processes and injuries of the muscular-skeletal system: joints, ligaments and muscles, as well as nerve damage, such as CTS,

tendonitis, and herniated disk.

To simplify and illustrate the study material the course includes hands-on experience both within the context of the class and as homework. In addition to cataloguing and analyzing various “trouble-prone” professions, other jobs are examined in reference to the type of injuries liable to accumulate and how they can be prevented.

### *3.4. Lifting, pushing and pulling*

This chapter analyses the differences between pushing and pulling, the circumstances under which it is appropriate and possible to use each of them, and the common physical injuries caused by incorrect lifting. An abundance of daily activities and various professions involving lifting, pushing and pulling is catalogued and analyzed. Common mistakes are pinpointed and suggestions are made to better organize the body and its movements. This serves to minimize, as much as possible, injuries stemming from incorrect movements. Special attention is paid to addressing these procedures among children of various ages.

### *3.5. Sitting*

As mentioned previously, in modern society, we have been doomed to spend most of the day in various states of sitting (at home, at school, and at work). Accordingly, a great deal of attention has been paid to this issue. The chapter refers to the place of the chair in modern society versus previous societies and different cultures as well as to the analysis of sitting positions by comparing sitting on a chair versus sitting on the floor.

Discussions are held on the nature of an “ergonomic chair”, on a variety of sitting options depending on the profession and the various work demands, and on how to shift from a standing to a sitting position and vice versa. Moreover, the link between prolonged sitting and various injuries of the lower back, shoulders and neck is also discussed.

The students go out to various locations at the College (offices, library) and analyze different types of occupations that are generally conducted in a sitting position, while taking into account the work environment. They also take anthropometric measurements and consolidate recommendations to better organize and optimize the workstations.

### *3.6. Final assignment, first semester*

During the first semester, the students select a

certain occupation and analyze it from an ergonomic point of view, by referring both to the organization of the work environment and the employee's movement and posture patterns. Each student presents his/her project in class.

#### **4. Ergonomic aspects related to children in kindergarten and school**

The second semester is dedicated to the ergonomic aspects related to children and to their living environment. The following are the curriculum subjects.

##### *4.1. Suiting the living environment to the child's needs*

Taking into account his anthropometric data, special attention is given to school's and home furniture and to the fact that the child is in a constant process of rapid growth and therefore his work/living environment must be modular so as to adjust it to these changes [14]. Since at home all of the family members, who are of varying ages, function in the same living environment, the latter must be planned so as to suit the unique needs of each of the family members.

##### *4.2. Living environment at school*

The learning environment at school is a given constant. As such, the focus is on ergonomic education aimed at finding local, individual solutions by using material available in the school (old telephone books that serve as footrests and as a means of elevating computer monitors or using a sweatshirt/coat to support the lower back).

##### *4.3. Carrying a school bag, general lifting and carrying*

Attention is paid to the weight of the school bag/load according to the child's weight and height and the way the schoolbag is carried. The different types of schoolbags are analyzed and ergonomic schoolbag models are developed. Special emphasis is placed on the types of injuries to which children are exposed from kindergarten through elementary school and up to high school. For example: Injuries can be caused as a result of how schoolbags are carried at different ages, the schoolbag's weight, shape, size and content, as well as the manner in which it is lifted and put down. The students photograph the children in all of these

positions and, in light of the knowledge they have acquired, explain what can and should be optimized and improved. This chapter is accompanied by a project. The students have to plan and design schoolbags according to ergonomic parameters and to produce explanatory booklets for parents, children, and teachers.

##### *4.4. Teaching proper posture and movement*

Proper posture and movement patterns are imparted through hands-on experience combined with relevant theoretical knowledge, both during static situations and during dynamic movement in school or daily life. Special emphasis is given to the connection between the principles of posture and movement and teaching effective ergonomic behavior.

##### *4.5. Implementation of Ergonomic education in Kindergartens and Elementary Schools*

Within the scope of the course, the students hold workshops in kindergartens, schools, and special education classes. These workshops encompass the teaching of theoretical knowledge as well as hands-on experience in topics pertaining to movement ergonomics, as described above.

##### *4.6. Final assignment, second semester*

The final project includes the preparation and presentation of: (1) a plan of an "Ergonomic Health-Day" for schools; (2) a design of computer workstations suited for the school; (3) an appropriate exposure to the teaching staff, parents, and students to the integration of ergonomics constellation in the life of the school; and (4) a program that incorporates the elements of ergonomics, movement, and posture in the study constellation in the kindergartens.

This project is presented in class, using various teaching aids such as videos, presentations, transparencies, and hands-on experience.

#### **5. Conclusions**

To date, the course has generated an enthusiastic response and a great deal of interest. We consider the graduates of the College's Fostering Posture and Movement study track who took this course as "good deed messengers". Within the context of their work in kindergartens and schools, they will be able to spread

the principles of “movement ergonomics” among the children, the parents, and the school teaching staff and to raise the awareness of this important issue among the public at large.

## 6. Recommendations

In light of our experience, which has accumulated during the past nine years in the teaching of the realm of ergonomics to PE students, and from our familiarity with the reality that exists in Israel in this field in the educational system, we recommend that these important topics be included as an inseparable part of the PE curriculum in schools.

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