

Enjoying school, Fun in learning.



More health and well-being in the "school as place of work".
A project report.

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1. Problem definition

At the time, **back complaints** represent the population's illness No. 1. These complaints are the cause of medical and therapeutic costs in billions. The causes have been scientifically documented and manifest themselves mainly in an increasingly **seated working population** (Reinhardt 1991). The sitting place of work has also become typical for schoolchildren as well !

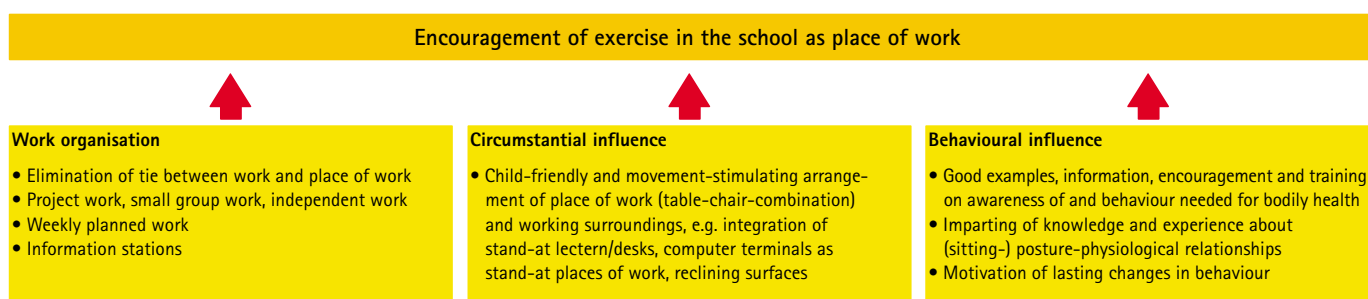
It is a fact that due to the progressive development of computer technology and the growing mental demands as well as the trend towards increasing social isolation, the behavioral profile of children and youths has increasingly changed. **Physical exercise and movement is being displaced more and more from daily life in favour of abstract and digitalized occupations – which are exclusively carried out in a sitting position.** However, for children and youths the health consequences are particularly fatal. Continuous sitting affects them just at a time when the decisive, highly sensitive growth changes which are consequently particularly prone to improper strain are determining their maturity and development.

Children are becoming increasingly physically inactive and are sitting more and more.

The "German Federal Working Group on the Development of Posture and Exercise" (Registered Association) has already been occupied for several years with the observation of the relationships between the lack of exercise, increasing sitting habits and the lack of health and fitness in childhood and teenage (see Breithecker 1996, Breithecker 1998, Illi; Breithecker 1998) whereby in a highly developed country such as Germany the following facts have become the dominant risk factor of government health-politics:

- Over 83% of primary school children sit at chair – desk combinations which are not suitable for their body height (dpa report from January 2002) !
- On the average, children of primary school age spend 9 hours per day sitting (Bös 1999) !
- One third of schoolchildren between the ages of 7 and 17 years complain of the "school headache" (Illi 1991, Faustmann 1994) !
- Postural complaints at primary school age are increasing significantly (Berquet 1998 and Balaque 1988 amongst others) !
- A lot of school furniture is out-of-date and does not conform to the minimum orthopaedic-physiological requirements in any way (Greithecker 1996, Jerosch, Jansen 1997) !

Illustration 1: Encouragement of exercise in the school as place of work



The sitting situation in German schools is miserable !

Experts are unanimous that at the latest when reaching school age, a happily-moving playing child becomes a sitting child. In the future, the sitting problem will become more acute. The sitting strain which will result from the current demands for "teaching on the Internet" can only be imagined. In order to avoid that "teaching on the Internet" becomes synonymous with "children into the sickbay", more attention must be paid to "seating quality", i.e. the relationship between sitting and working as well as the sitting and working postures of schoolchildren. The school as an institution is regarded as a particularly important place for the first step in the development of health-relevant modes of behaviour. The school as a flexible system capable of adapting to social changes should therefore place great value on a classroom concept with a variety of resources enabling ergonomic-physiological working (see Illus. 1).

2. The model school: a school in and with movement

Resulting from this responsibility, a pilot project "the school as place of work ? what will the future classroom look like?" was started at the Fridtjof-Nansen school in Hannover as a four-year long-term study at the beginning of the 1999/2000 school year. The **Fridtjof-Nansen school** with its pioneering school programme "motional school – school as learning system in the district" is particular suitable to handle this theme. For the last seven years in connection with the BLK pilot project "Network of health-promoting schools" , the school has been concerned with the formulation of health-relevant questions on the school as living area. Starting from the basic idea that a schoolchild's place of work should comply with the specific requirements of the individual and his/her work in the same way as an industrial workplace must do, concrete concepts on the ergonomic arrangement of the "school as place of work" and movement in the classroom were worked-out in cooperation with the "German Federal Working Group on the Development of Posture and Exercise". These are based on the ideas expressed in Illustration 1.

Surroundings animate modes of behaviour

The study will include concrete findings on the **sitting and motional behaviour** as well as the effect on the postural development of the children. **Circumstances and behaviour influence are regarded as indispensable, cross-stimulating, lasting factors in this investigation approach.**

3. Ergonomic demands and realization

What is taken for granted today for every office place of work – it must provide the ergonomic surroundings for maintaining the health and psycho-physical wellbeing of the employee – is neglected in schools for economic reasons and ignorance. **However, the school is a "place of work" not only for teachers but for the children as well.** Both parents and teachers currently demand high performance from school children. It is therefore particularly necessary that this is achieved in ergonomic pupils' places of work which satisfy the particular psycho-physical requirements of growing children.

In respect of the ergonomic arrangement of the place of work in the school, it is essential that both the school chair and the desk/table should be matched and regarded as an entity. They should assist the pupil in his/her work and not be a strain in any way. The basic prerequisite of an ideal schoolchild's place of work are sitting and writing furniture which not only suit or can be adjusted to suit the size of the child but also their need for varying working postures ("dynamic sitting") and thus contribute to physiologically correct **sitting with movement**. In addition, the table should be equipped with an inclinable top with a minimum inclination of 16°.

The first four school years are equipped with ergonomic school furniture based on the above-mentioned principles which satisfy the physical-mental desire for movement and not confront the child with rigid designs. In particular, the following arrangements have been provided. Two differing ergonomic designs of chairs are available which are however each based on a movable seat support.

One of these is the so-called "flexichair" which is not adjustable in height, the necessary selection of a suitable size being the responsibility of the teacher. In the case of the "flexichair", the seat inclination changes from front to back in response to changes in position of the centre of gravity of the body weight, i.e. if a child adopts the front sitting posture, then the seat surface is inclined forwards and partially the opposite. (see illus. 2)

The other chair version is a mobile swivel chair with "rocking mechanism" and stepless height adjustment. The "rocking mechanism" enables an approx. 7° inclination of the seat surface either forwards or backwards depending on whether the pupil sits on the front or rear third of the seating surface. (see illus. 3)

Both types of chair make the physiologically valuable but accident prone "tilting" of the chair unnecessary. The movable seating surface resorbs but doesn't block the natural and healthy need for movement.



Illus. 2: Sitting still with pleasant relief on the "PantoSwing-LuPo" flexible chair.



Illus. 3: Active sitting on the "PantoTurn"



Illus. 4: More physical and mental mobility through the stand-at lectern/desk.

A further important ergonomic addition to the test classrooms is a stand-at lectern which is steplessly adjustable in height and fitted with a large round working top. Because of space limitations, the teacher doesn't have his own lectern. If necessary he/she lowers the stand-at lectern and sits at it otherwise this item of furniture is available for the schoolchildren particularly during group work or phases of individual work. (see illus. 4)

A further reorganization of the classroom for space saving reasons is the provision of tall cupboards which make more floor space available for variations in the daily working routine (sitting in circles, group work, corner for reclining). In order to facilitate the regular rearrangement of the furniture, all heavy items found on the floor (sideboard, pupils' desks) are fitted with castors.

4. The test method(s)

The project "the school as place of work ? what will the future classroom look like?" continues the work started in the last few years in the field of the "active school" (more movement in the school as living area). The specific investigation aims of this project are concentrated on preventive measures in the classroom - the possible health promotion of ergonomic and pedagogic sitting concepts - an area neglected up to now. The study is a long term one and intended to last four years (1st ? 4th school years). The four form Fridtjof-Nansen primary school has been chosen for this project because of its claim to be the "classroom of the future" on account of it having the ergonomic furnishings described.

For comparison purposes, two forms of a neighbouring primary school have been selected. This school is fitted with conventional school furniture which is not regularly matched to the pupils' growth and where there is no special teacher training in respect of ergonomic and physiological matters.

The examination of the effectiveness of a classroom concept modified in line with ergonomic, pedagogic and active sitting considerations is restricted to the partial areas of posture and behaviour promotion or change. With the help of the following investigation methods, the positive effects of the modified classroom concept will be analyzed during and at the end of the study with respect to the future furnishing and arrangement of classrooms:

- medical-orthopaedic examination
- modified posture test (HAKI 6-10) for primary schoolchildren
- observations of behaviour
- issue of questionnaires

The medical-orthopaedic as well as the sport motoric and physiological examination results will not be statistically evaluated and publicized before the end of the long-term study. From time to time during the course of the study which is intended to last four years, specific behaviour observations will be carried out and questionnaires issued with the intention of checking the effectiveness of the ergonomic classroom furnishings. The behaviour observations described below are intended to analyze the sitting and postural behaviour to be used in the first school year on the available conditions.

5. Description and discussion of the behaviour observation.

5.1 Details of the behaviour observation

With the help of a selected group of schoolchildren in the first school year and using the behaviour observation described here, we attempt to verify the following hypothesis:

A lasting effect on the body and movement behaviour and thus an oriented rhythmic change from static to dynamic, from tension to relief, from strain to relaxation for the psychomotoric needs of primary schoolchildren at the "school as place of work" can be achieved through the specific surroundings and behaviour as well as the working organizational arrangements described in Section 1.

In each test and comparison classroom, three children were selected for the determination of body behaviour. Emphasis was placed on the fact that these three children had differing characteristic inclination to movement as chosen by their teacher.

- a passive type (hereafter called **type 0**)
- a normally active type (hereafter called **type 1**)
- a restless type (hereafter called **type 2**)

These totaled 12 schoolchildren in the four test classes and six in two selected comparison classes. Actual behaviour observations were started after an initial three school month start-up phase. The children in the test classes thus had adequate time to accustom themselves to the ergonomic conditions in the classroom; the teachers in the test classes had sufficient time to give the children basic information and instructions on physiological sitting and body behaviour. At the same time there was enough time to establish the three different behaviour characteristics.

The observation situations were so organized that the corresponding teacher of the subject gave the lessons and always three observers (one for each of the three motor movement profiles) made notes. Each child was watched over 12 school hours. The observation periods were spread out over the school year, during different subjects and organizational forms during the morning. The observations thus included school lessons with more restricted work places (frontal teaching) as well as more unrestricted work places (project teaching, handicrafts).

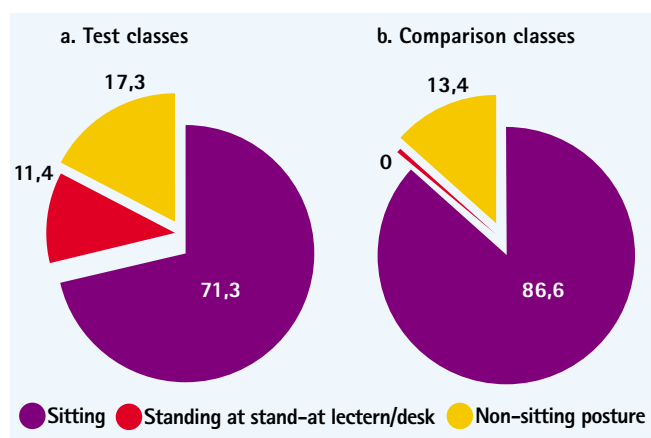
Prior to commencing their work, the observers were comprehensively instructed about the forms to be filled-in and the variables to be recorded. The instructions given to the observers were to follow the teaching carefully and the accurately record the corresponding actions of the pupils on the observation record form in the boxes which were designated in abbreviated form (e.g. R= reading, W= writing).

5.2 Observation of the bodily behaviour of all schoolchildren under the aspect of "utilization of ergonomic resources"

In this contribution, the analysis and interpretation of the observed bodily behaviour of all pupils will be compared. Here the prominent question is just how much the ergonomic classroom furnishings contributed to a bodily behaviour which included more movement and was thus more physiological. To enable the interested reader to better understand the physiological significance and thus the health-influencing value of a dynamic body/work relationship in interaction with the ergonomic surroundings, the individual discussion will be comprehensively explained in the course of the observation analysis.

In connection with the analyses and interpretations, it must be stressed once more, that the teachers in the test classes have received a very convincing training in respect to the necessity of conditional and behaviour-preventative measures in schools and the children were comprehensively instructed in the use of the ergonomic furnishings. Of course, these important and essential training measures significantly influenced the modes of behaviour and will not always be emphasized in the following discourse.

The observations of the body behaviour of all schoolchildren in the test and comparison classes showed that during the observation sessions, the body behaviour modes dominant in Illus. 5a and 5b were able to be recorded.

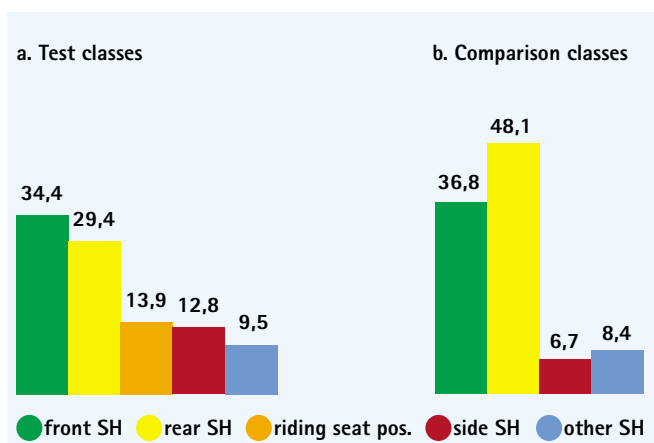


Illus. 5a and 5b: Body behaviour in the test and comparison classes

It is obvious, that the pure sitting times in the comparison classes are more significant time-wise than those in the test classes. The main reason for this is that in the test classrooms there was a stand-at lectern/table available. Added to the "not-sitting body positions" were such behaviour modes as standing for a short time at the place of work, moving around the room during changes to the working configuration (e.g. arranging a seating circle) but also lying for a short time on the mattress provided in the corner for this purpose. It is also recognizable here, that as a result of a greater (trained) tolerance for active body behaviour and the advantage to the children of the mobility of the facilities (easily moved on castors) which facilitates the frequent rearrangement of the working configuration, more dynamic in the teaching method is brought about.

5.3 Observation of the sitting behaviour of all schoolchildren and its effect on psycho-physical development processes.

The significant difference in the sitting times noticeable in the comparison of the different classes under examination has already been mentioned. Although the percentage of the time spent sitting in the test classes (71.3%) appears relatively high, it becomes relative however when one analyses the sitting behaviour. In accordance with the urge to be active which is necessary for their physical and mental development, the children have made their sitting behaviour not statically passive but dynamically active. This is shown by the continuous change between the front sitting position (34.4%), rear sitting position (29.4%), riding position (13.9%), side position (12.8%) and other positions (9.5%).



Illus. 6: Dynamic sitting

(SH = sitting position)



Illus. 7: Riding seat position.

In the test classes, the forward sitting position was used most. Is this also the active sitting position? no contact to the backrest, back muscles activated – this well-known working position is principally adopted for writing and reading. In contrast, the rear sitting position, also known as the resting position, was mainly used for listening or dialogue purposes.

The lighter and in some cases turnable ergonomic chairs with their intentionally narrower lower backrest section particularly encouraged the "riding position" sitting variation (see Illus. 7). Just like the side sitting position, these variations were most used in seating circles and group work. The healthy urge of the schoolchild for movement was also responsible for further short time sitting variations such as sitting on the knees, sitting with one leg alternatively underneath the bottom, sitting on the seat edge with one leg trailing backwards etc. All these alternative positions have been collected together under "other sitting positions".

The opposite was to be found in the comparison classes where the rear sitting position (rest position) with 48.1% is dominant. The main reason for this is the seating surface of traditional school furniture. The rigid surface inclined backwards positively encourages the user to position his body exclusively against the backrest. This static-passive body posture as well as the right-angled sitting position adopted on traditional chairs has dramatic long-term effects on the development of the maturing postural and locomotive system (see Breithecker 1998 on this subject). It was very difficult for the children in the comparison classes to adopt the "riding position" because the wide lower part of the backrest hardly permitted such an alternative sitting position.

The "healthy urge for movement" of the children in the comparison classes made itself significantly less noticeable through the adoption of short-term changes of position such as "sitting sideways" (6.7%) as well as "other sitting positions" (8.4%) where "tilting the chair" was used most.

The observations confirmed what we had suspected. When appropriate seat versions which encourage dynamic sitting are available and the teacher not only allows but actively encourages a reasonable active-dynamic sitting behaviour, then the schoolchildren will make consequent use of it.

It is only the regular dynamic change between static and dynamic, between strain and relief, that the whole body achieves its relaxation. "When this change of position even in the greatest relaxed position – i.e. lying or sleeping soundly – is automatical-

ly carried-out by the human body anatomically and physiologically, how much more necessary must such a change be by the physiologically extremely unsuitable sitting position " (Hanel, Kempes, Vogel 1190, 20)!

Dynamic sitting has important effects on postural physiological parameters.

This active-dynamic sitting is a sitting with movement which regularly encourages the movement of the pelvis forwards, to the side and backwards. This mobility of the pelvis is accompanied by a redeposition of the sacrum and with its end plate on which the lowest disc and thus the spinal column sits. This means that each change of position of the pelvis is accompanied by an appropriate dynamic of the spinal column.

Active-dynamic sitting means economy of effort ! So long as this active-dynamic equilibrium play can be kept up, then a natural physiological strain and relief of the muscles, sinews, ligaments, spinal discs and vertebrae involved in sitting is active.

In addition, the intentional change of stress supports the demand for a muscle-controlled sitting ("sitting upright") because in contrast to passive sitting on a comfortable chair, the long-term fitness of the muscles is increased. In the course of the change to different sitting positions, a group of muscle fibres is always needed for maintaining the position, the others have time to recover. The result is a symmetrical stress demand with agreed agonistical and antagonistical muscle balance. This continuously active muscle dynamic not only encourages continuous training of the spinal column muscles but stimulates the economical nourishment and waste disposal of this organ.

Furthermore, dynamic sitting with movement supports the diffusion processes in the spinal discs as these are no longer exposed to a partial continuous pressure but are surface stressed, i.e. the distribution of the pressure takes place alternately over the whole surface. A regular change of sitting position can thus almost be regarded as a "diffusion pump".

Many of the sitting variations chosen by the children in the course of dynamic sitting, such as the riding position, the rear sitting position or the so-called "lolling position" actually represent relaxing positions. These are specific measures intended to achieve short-term relief of the body - in our case the spinal column. They are based, amongst others, on the physical fact that the centre of the trunk sits on the greatest possible supporting surface and must not do any holding work. Each enlargement of the supporting surface contributes to the relief of the body.

Any exhortation to "sit still" or "stop wriggling" would just at this phase be contrary to the intrinsic needs of the child and cause long-term damage not only to the postural apparatus.

Dynamic sitting has important influences on neurophysiological parameters.

Static passive sitting can have a lasting effect on the school-child's ability to concentrate because not only the childish muscles are unsuitable for continuous static stress but also the childish mind. It is well known that in the human organism there are a considerable number of control systems which are concerned with posture and movement. Without doubt, the most important control system is the neural and neuro-muscular system. Conventional sitting does not place sufficient demand on the neuro-muscular system and thus has a negative effect on the development of the active and passive postural and motional apparatus. Many different movements particularly during long and monotonous sitting periods by appropriate change of sitting position and the change from sitting to standing deliver the necessary neuro-physiological impulses "because it is through the control circuits that the reflexes are controlled and the reflex motor kept awake" (Reinhardt 1991 b, 100)

The healthy brain of a child unconsciously signals the need for a dynamic change of stress which makes itself noticeable as motoric restlessness, for example, by tipping the chair. This behaviour which is often falsely interpreted by teachers as disturbance of the teaching and is not entirely without danger (chair tipping over backwards) was almost completely absent with the chairs used in our tests. It should be well known by now that children are hardly able to sit still and concentrate over a lengthy period of time.

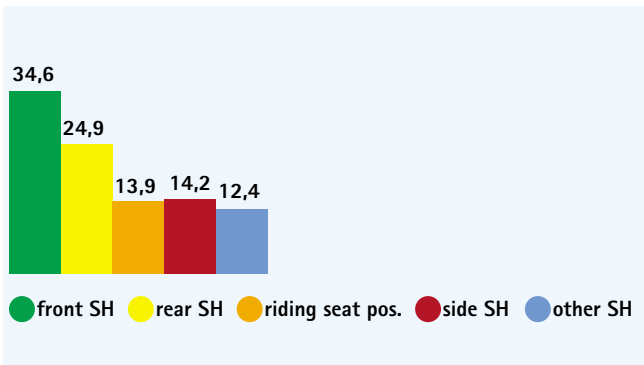
Movement doesn't only come from the head, it also uses the head

An adequate level of psycho-mental activity is the prerequisite for attention and concentrated learning. Uniform requirements which are quite common in the case of static-passive frontal teaching encourage a condition of reduced psycho-mental activity with the result that the child gives up his psycho-physical posture (withdraws into him/herself, lack of concentration, vacant gaze with vagrant thoughts) or the organism looks for additional stimulation (compensating bodily activity). Motoric activity such as stretching or craning or tipping on the chair as compensating self-regulation to maintain psycho-mental activity is not, as is regularly assumed by teachers, to be lack of discipline or interest but rather an involuntary measure intended to prevent a disorganization of behaviour.

Motoric activities, such as are realized here through dynamic sitting serve to maintain the conditions for attentive and concentrated behaviour. In this way the "monotony experienced when repeatedly carrying out a similar and unvarying activity" (Ulrich 1992, 282) can be mitigated when schoolchildren have the opportunity to arrange their sitting behaviour dynamically and if possible freely choose their own body and working posture.

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Illus. 8: "Requirement-ergonomics" ? School furniture must suit the needs of the schoolchildren and not vice-versa. (SH = sitting position)

6. Conclusions

Today, significantly different requirements must be placed on the quality of seating and the flexible body and working postures associated dependent on it. Children are becoming increasingly inactive and spending considerable more time sitting. "Children are always children of their generation". The children of the nineteen fifties and sixties used to play on the streets and thus had adequate opportunity and space for exercise. However the changes in society in the last few years and to be expected in the future have a more restrictive influence on the need for exercise of the adolescents. The increasing publication of a wide spectrum of psycho-physical disturbances at children's age clearly states the necessity for preventative measures. A study from Prof. Bös from the University of Karlsruhe (1999) confirms what many suspected: Today, primary schoolchildren spend on the average nine hours (!) daily sitting in the school, at home doing homework, before the television and the computer.

The demand for ergonomic school furniture and the dynamic body and working posture associated with it is, when considered from a health promoting viewpoint, not a question of comfort but a medical-health necessity.

