Physically active schoolchildren – alert heads. Teaching with exercise. Opportunities to improve performance and the ability to study?

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Introduction.

The following article deals with the ability of primary school children to concentrate as well as the manifold methods of applying their motor activities during teaching. On the basis of a current study with the emphasis on "sitting and moving during lessons", conclusions will be drawn as to the connection between physical and cognitive activities. Equivalent classes are available for comparison purposes.

Right from the beginning at primary school, there are a number of activities which demand a high degree of concentration. However, particularly at this age, children find it very difficult to concentrate for several minutes in the appropriate (body) posture expected from adults. Many adults still cherish the idea of the "ideal schoolchild" who is receptive, attentive and particularly motor passive to the cognitively presented material. The body language which is mainly unconsciously produced by the children frequently causes irritation to the person standing in front of the class. It is a fact that:

- concentration difficulties as well as motor activities during lessons are the subject of complaints from many different teachers.
- children who sit still and are thought by the teacher to be concentrating are usually not.
- many teachers feel uneasy about spontaneous motor activities (e.g. "tipping") during lessons.
- concentration weaknesses are an outstanding characteristic of present day schoolchildren.

In addition there are signs of considerable psycho-physical strain to which schoolchildren are exposed, when in addition to ergonomically unsuitable "workplaces", a hardly childlike attitude to work is expected from them.

The connection between physical and cognitive activity stands in the forefront of the study on "sitting and moving during lessons". There is proof of the considerable psycho-physical strain caused by inadequate ergonomic furniture and a passive-receptive attitude to work. This is the way school stress is encouraged.

Even at primary school age, "school stress" makes itself noticeable as a variety of physical complaints (see Brinkhoff 1996). In a nation-wide representative study, Bös, Opper & Woll (2002) found that 40 to 70 % of all primary school children interviewed (n = 1.442) suffered from psychosomatically-caused complaints (head, back and stomach ache, difficulty in concentration, insomnia). With the exception of insomnia, the frequency of these complaints increases with age – from the first to the fourth grades.

It is impossible to ascertain to what degree the school is (partially) responsible for the occurrence of psychosomatic disturbances in individual children. If however you want to take the childrens' individual living situations into account and offer them a "living, learning and experience sphere" in which they feel happy and are able "to study in a free and unrestricted atmosphere" (MSWWF NRW 1999, X), then their psycho-physical well-being should also be considered.

Children need movement, they just don't sit still – movement in schools

As justification for more movement ("the dynamic school") in the school, the promotion of health with preventive and compensation aspects as well as preventative behaviour and posture measures have priority. In addition, the "dynamic school" should be considered from a general development-encouraging as well as a social-ecological perspective. However the interest and expectations of the parents and teachers are mainly centred on the development of the learning ability, performance and school success of the children (see Dordel 2003).

More movement in schools assists the furtherance of health and the development of the children. In addition a variety of other effects such as stimulating the desire to work and study are achieved. Movement also contributes to a rhythmic pattern - the regular change from static to dynamic.

A comprehensive, systematic evaluation of the effects of the "dynamic school" has still to be carried out. However the existing empirical work shows a variety of positive effects (Breithecker 1998; Dordel 2000; Gröbert, Kleine & Podlich 2002; Kahl 1993; Müller 2000):

- in the sphere of ***motor capability***, it is not only a question of increasing the co-ordination of movement and postural strength but also an increase in muscular power.
- in the ***cognitive area*** an improvement in the ability to concentrate can be observed.
- in addition there is significant gain in ***social competence*** (ability to make contacts, mutual acceptance and integration, reduction in aggression).
- the ***independence*** of the children is increased.
- the ***daily well-being*** is influenced positively.
- finally, positive tendencies also generally result when assessing the childrens' ***childrens' happiness at school*** and ***eagerness to study.***

What is fundamentally missing is objective studies which directly involve the classroom and the pupil's "place of work" and take relieving ***ergonomic conditions*** and the resulting ***active modes of behaviour*** into account thus contributing suitable rhythmic patterns for the school morning of each individual child.
Under **rhythmic patterns** we understand regular changes of static and dynamic, of tension and relaxation, of strain and rest which suit the psycho-motor needs of the individual and contribute to balanced physical-mental-spiritual well-being whereby ***whereby motor activities contribute the dynamic part of the rhythmic patterns.***

There are of course a variety of ways of getting movement in daily school life which contribute to the dynamic part of the rhythmic patterns such as running around the school playground, climbing stairs, classroom duties (wiping the blackboard clean), periods of exercises, queuing up or standing before the door. All these are a sort of "external rhythmic pattern", i.e. concern certain periods of time, uniform options for motor activities which do not consider the difference from the individuals need for rhythmic patterns. For example, these occur at varying intervals with every schoolchild during the lesson such as:
- rocking with the chair ("tipping"),
- playing with the pen or chewing the pencil or finger nails,
- playing with their hair,
- continuously changing sitting position,
- sprawling and stretching.

Diagram 1: "Tipping serves to survive physically and mentally".

This body language has a systematic and regulating effect. It appears when performance drops off due to physical-mental stagnation/monotony and the organism seeks additional stimulation. Particularly the highly sensitive neuro-physiological maturing and developing process which in pre-school and primary school age is in its decisive biological differentiation phase resulting in primary school children ***having*** to adopt such modes of behaviour in order to maintain their physical-mental-spiritual resources and cause them to develop. School children thus regulate their need of a rhythmic pattern.

Movement and concentration, a contradiction?

Motor activities are regularly interpreted as disturbances or discussed in connection with the concentration difficulties of school children. An observation of the lessons revealed that the motor activities of the schoolchildren occur regularly and appear in a large variety of forms whereby it is fundamental to differentiate between two groups .
One the one hand, there are the activities which are carried on during the lesson and demand full concentration, such as fighting with the neighbour, communicating with fellow pupils at other tables by means of sign language or writing little "notes". On the other hand, however, there are the activities which take place unconsciously and automatically while working on a specific task and are already registered higher up as an important motor activity in the sense of physical and mental relief activity in the course of a self-regulating rhythmic pattern.

Motor activities which take place unconsciously and automatically are an important attempt of the schoolchild to sustain its physical and mental resources. The relationships between motor and cognition are development-psychologically, biologically and neuro-physiologically relevant.

While the former case represents an "illegal" activity in the sense that the pupil directs his attention to something other than the subject of the lesson which in our understanding amounts to averting attention, in the latter case which is carried on unconsciously and automatically alongside the main activity without interfering with the contents, we see an important action by the primary schoolchild to maintain his/her physical and mental resources.

The connection between motor and cognition as well as success in the school / academic studying respectively has been discussed for a long time and attracted renewed interest in recent years (see Daley & Ryan 2000; Etnier et al. 1997; Sallis et al. 1999; Shephard 1997).

Both development-psychological as well as biological and/or neuro-physiological aspects are to be found at the centre of discussion.

Even though influences on cognitive functions cannot be reliably proved, a carefully directed motor development is often accompanied by an increase in school success. This can be justified by:
- an increase in happiness in the school,
- an increased readiness of the child to work coupled with
  - a stronger self assurance and
  - a greater tolerance of frustration as well as
  - a better integration in their own age group as a result of increased confidence in social behaviour (see Eggert, Schuck & Wieland 1975).

It is possible that the parents and teachers can also support the motivation of the children to work by adopting a positive attitude to the motor development in the sense of hoping for success (Karch, Schellenschmidt & Feike 1989).

Movement is the aim! That is why teaching with movement is so important.

From what has already been said, it can be confirmed that physical and cognitive activities definitely interact with each other whereby it is a fundamental assumption that a stimulating influence on physical activities results in the maintenance of the conditions for attentive and concentrated behaviour. The human motor is valued not only for its function in respect to locomotion, fine-motor tasks or orientation in the environment, it is also the "source and mirror image of self-appreciation, the activation condition and motivational level. By using motor activities, drive can be created, eliminated, strengthened or weakened – in other words regulated" (Pöhlmann 1993, 93).

Physical activities have a stimulating effect on the ability to pay attention and concentrate. Certain motor activities successfully combat physical and mental static.

Therefore the hypothesis can be formulated that certain motor activities – which without interference with the contents – can be used to change situations in which a physical and mental static arises in such a way that a disorganisation of behaviour can be avoided and attentive and concentrated behaviour maintained.

What will the classroom of the future look like? – a long-term study.

The partial examination described in this contribution and available for evaluation relates to a four year long-term study at the Friedjof-Nansen primary school (four streams) in Hannover. The study with the examination aim: ***"Work place school – what will the classroom of the future look like?"*** started in the school year 1999/2000. A total of 128 pupils incl. two comparison classes took part in the project. This project continues the efforts made in recent years (more movement in the school as living area) in the area of "movement in the school" (see amongst others Illi 1995, Breithecker 1998 & 2001, Laging; Klupsch-Sahlmann 2001).

Because of its trend-setting school programme "the active school – school as learning system in part of the city", the ***Fridtjof-Nansen school*** is particularly predestined for the treatment of this theme (see. Städtler 1998). In the context of the BLK model experiments "Network of health promoting schools", they have been involved for several years with questions involving health in the school as living area. Oriented to the extensive health definitions of the WHO and the salutogenetic health model of A. Antonovsky, education in healthier living conditions for schools means:

The long-term study "The school as a place of work" has been running for four years at the Friedjof-Nansen primary school in Hannover. The aim of the study is to find out whether new classroom concepts are beneficial.

- development of a comprehensive health understanding
- encouragement of a positive studying climate
- practical suggestions on a healthy way of living coupled with the transmission of appropriate knowledge and capabilities.

With the help of selected examination methods, it is the intention to analyse during and at the end of the study the positive effects of the modified classroom concept with respect to the development of posture, behaviour as well as motor and be able to give some answers to the question of the future furnishing and arrangement of the classroom.

Does movement in lessons increase the performance and the capability to study?

The "dynamic" conditions used in this long-term study with which it is hoped to answer the special questions posed by this examination are based on ***ergonomic*** and ***pedagogic seating*** as well as ***teaching methods***. It is hoped that these will motivate the primary school child to be as active as he/she is accustomed to be at home.

"Teaching with movement" is based on alternative sitting and pedagogical approaches to teaching. The aim is to encourage the child's natural need for movement during lessons as far as possible.

The table and chair must match each other and be considered as an entity.

The need for freedom of behaviour on the one hand and the conditions – particularly pupils' work places – as well as teaching methods and work organisation which suit the psycho-motor needs of the primary school child on the other hand are considered to be indispensable mutually-motivating dynamic factors (see Diagram 2).

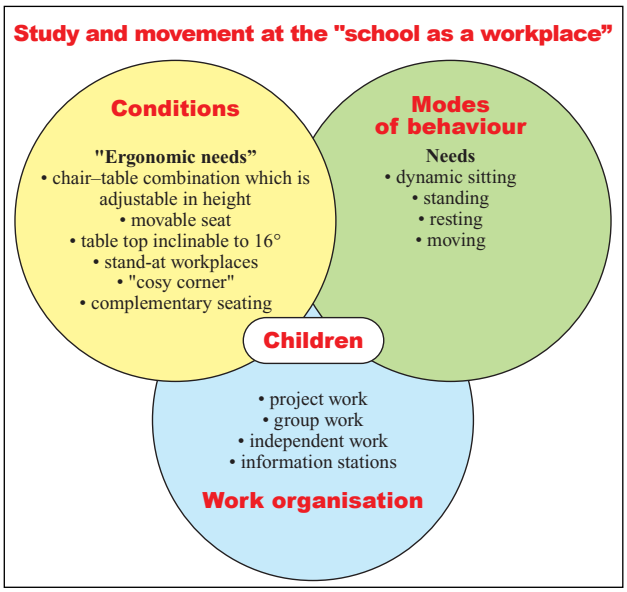


Diagram 2: The child is the centre of interest.

To enable a better understanding, the specific arrangements will be briefly explained.
With respect to the **conditions**, i.e. the ergonomic arrangement of the seating at the school work place, it is essential that school chair matches the school table and both are regarded as an entity. They should assist the pupils in their work and not cause them any sort of strain. Basic requirement of a work place suitable for a schoolchild are seating and writing furniture which suit or can be adjusted to suit both the height of the child as well as its need to vary its posture and working position ("dynamic sitting") and thus contribute to physiologically correct **sitting with movement.** In addition, the table should be fitted with a top which is inclinable to at least 16 degrees.
In accordance with this premise, the test classes are fitted with ergonomic school furniture which support the physical-mental need for motor activities – "movement ergonomics" - and doesn't confront the children with rigid designs.

Pupils' chairs should allow dynamic sitting, i.e. sitting with movement. These should take the schoolchild's natural urge for movement into account and encourage a regular change of sitting and working posture. The stand-at desk is an important ergonomic addition.

The ergonomic solutions (Breithecker 2002) make the physiologically-valuable but accident- prone "tipping" on the chair unnecessary. The natural and healthy need for movement are absorbed by the movable seats and not blocked. The alternating postures of the school child – relaxing / working – are supported and not restricted.

A further important ergonomic addition to the test classes is a **stand-at desk** which is steplessly adjustable in height and fitted with a large top. As a result and in order to save space, the teacher cannot have his/her own desk and if necessary can lower the stand-at desk and sit at it, otherwise the latter item of furniture is available to the pupils, particularly during group work or periods of independent work.

Diagram 3: "Movement ergonomics" – the conditions adapt to the behavioural needs of the user.

Diagram 4: More mobility thanks to the stand-at desk.

Many teachers are familiar with alternating **teaching methods** and the use of playing and exercising tasks. These measures support the stimulation of the child's development but also allow the simultaneous fulfilment of the present time. In particular, it contributes to an increase in the child's enjoyment in studying in the necessary practice sessions, to make practising more diversified (changes of method, experience of contrasting methods) and thus more interesting to devise (see Müller 2002). A rhythmic pattern to the lessons by means of alternate methods leads to a reduction in motor restlessness and an improvement of the child's attitude to studying. These changes also contribute to motivation and relief for the teaching staff.

Alternating teaching methods leads to less motor unrest and a better attitude to study. Varying forms of organisation also help to establish a rhythmic pattern.

Various **forms of organisation** such as working individually, regular weekly work, studying at stations are suitable. In the latter case, the teaching material has already been distributed at various stations in the classroom where the children can collect it themselves.

The influence of motor activity on the course of attention and concentration during a school morning.

Method.

In order to make a contribution to the clarification of the question whether the "dynamic school" concept influences the learning and performance capabilities of children, the attentiveness-strain-test (test d2) from Brickenkamp (2002) – a simple cross-off test – was carried our. Test d2 is used regularly, is a well proved and reliable psycho-diagnostic procedure which is known to be independent.

The attentiveness-strain test is used to examine the influence of movement on the ability of schoolchildren to work and study.

Test d2 belongs to the general performance tests; "it demands … a concentrated performance with reference to an external visual stimulation. Its origin can be traced back to the individual coordination of driving and checking functions" (Brickenkamp 2002, 6). The driving function is derived from the quantity of material processed in the prescribed Etime, i.e. the speed of working; the checking function results from the quality of the work, the accuracy of the work and the number of mistakes. In addition, the attitude to work during the course of time (e.g. constant, irregular, etc) gives added information about the checking function.

In the test, motivation and checking functions are recorder and evaluated. The three classes taking part differ in respect of the amount of movement during lessons, the teaching methods and ergonomic furnishings.

In the course of the evaluation of the present study, the following measurements are taken:

- the total number of characters processed (GZ) as criteria of the speed of working;
- the raw number of faults (F), the sum of all faults (including omissions as well as mistakes) as criteria of the accuracy of the work;
- the total number of characters processed minus the number of faults (GZ-F) as total performance whereby the quantitative part carries more weight than the qualitative aspect of the performance;
- the concentration performance value (KL) is derived from the number of correct crossed-off relevant characters minus the number of mistakes, in this case the qualitative performance aspect is of more importance than by the total performance.

Based on the Standard tables (German Calibration Sample), the raw values are converted into percentage orders (PR) and standard values (SW; M=100, SD=10). Standards are available for children from 9 years upwards (in each case standards are valid for 2 years, no differentiation between sexes).
Test d2 was carried out in June 2002 in three grade 3 classes of various primary schools, in each case in the first, third and fifth school lessons respectively.

The three school classes differ with respect to the normal amount of movement in the school / class:
- Class A (n = 21) is given "normal" lessons in which movement is allocated in the amount to which importance is attached in a primary school.

Class B and C visit the Friedjof-Nansen school which promotes the dynamic school concept:
- In addition to the dynamic teaching methods, class B (n = 18) has the opportunity of using the large choice of fixed and mobile gymnastic equipment during long breaks (25 min.) on two mornings.
- Class C (n = 17) has the same school playground options as class B but in addition takes part in a lesson organised on the basis of the ergonomic and teaching methods specified.

Results.

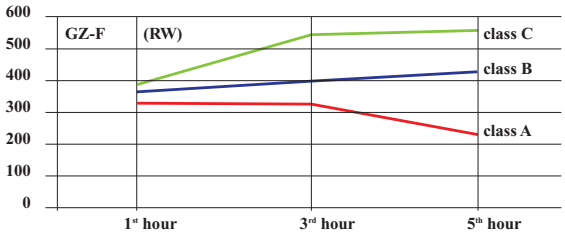
The results of the attentiveness-strain-test (Test d2) are summarised in table 1. In table 2 there is a grading of the total performance (GZ-F) and the concentration performance value (KL) in percentage order (PR) and standard value (SW) based on the standard tables (Calibration sample 2000, see Brickenkamp 2002).

In the first school lesson class A (not a dynamic school) differs from classes B and C in the slightly worse working tempo initial valueE (GZ). In class C, on average there are the largest number of characters processed but also the highest number of faults. If the total performance (GZ-F) and the concentration-performance value (KL) are taken into account, then the test values of both groups (B, C) are very similar. In the first school lesson, all three classes achieve above-average attentiveness (table 2).
In the third school lesson, the working tempo of class A is unchanged but the error quota rises so that the attentiveness performance is slightly lower but can still be classed as very good (GZ-F: PR 84, SW 110; KL: PR82, SW 109).

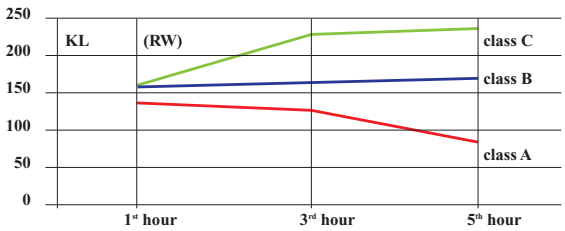
The result: From the first to the fifth period, the three classes being tested show significant differences in performance, working tempo and attentiveness. One class in particular shows a noticeable quantitative as well as qualitative increase in performance.

On the other hand, in class B a slight increase in working tempo as well as a slight reduction in the number of mistakes is noticed while class C shows a noticeable increase in working tempo coupled with a slight reduction in the number of mistakes. In both classes the attentiveness can be classed as well above average (table 2).

In the fifth school lesson there is a considerable fall in the performance of class A with a significant reduction of the working tempo and a slight increase in the error quota. The attentiveness can now be assessed as below average (GZ-F and KL: PR 13, SW 89).
In contrast to class A, class B and C can raise their working tempo once again. In class B the error quota increases slightly and has now reached the same value as in the first period. In class C there is further slight reduction in the error quota so that in the course of the school morning, an increase in both the quality and the quantity is noticeable here.
Both classes are well above the average in attentiveness.



Total performance (GZ-F) in the attentiveness-strain-test (Test d2) in the course of a school morning (Breithecker 2002)



Concentration-performance value (KL) in the attentiveness-strain-test (Test d2) - changes in the course of a school morning (Breithecker 2002)

Diagrams 5 and 6 illustrate the changes in the total performance of the three classes in the course of the school morning – with respect to total performance (Diagram 5, GZ-F) and the concentration value (Diagram 6 KL) and show that both follow the same course. The illustrations emphasise the differences in performance between classes B and C more clearly that the percentage rating and standard values can do (table 2).

The statistical analysis shows highly significant differences ($p < 0.001$) between the three groups and the times of the three observations.
Tables 3a and 3b show the difference between the three groups and the three times of observation for the total performance (GZ-F) and the concentration values (KL) in another way. A checking of the total number of characters processed (GZ) shows the same result as with the total performance (GZ-F; see tables 3a, b); when repeated for the sum of all errors, only group A shows significant differences ($p < 0,01$) between the 2 and 3 as well as the 1 and 3 times of measurement, in other words between the third and the fifth as well as the first and the fifth school lessons.

Discussion.

Just like perception, memory, speech, planning capability, decision making and problem solution, attentiveness and concentration are important cognitive aspects. The terms attentiveness and concentration are very often used synonymously. When used individually, attentiveness is understood to mean devotion, direction, selective perception: information must be "sought-out, discovered, compared, evaluated and differentiated between" (Gabler 2000, 179). On the other hand, concentration is considered to be an enhanced, intensive form of attentiveness which accompanies thought processes.

Attentiveness should be considered as care and attention, as direct selective perception. Concentration is an increased form of attentiveness which goes along with cognitive processes. Both are important prerequisites for success in learning and should be sustained during the school day if possible.

The readiness and capability to direct attentiveness to the material to be studied is assumed to be the secret of successful learning; if possible this should be maintained throughout the school day or regularly regenerated by varying the pattern of daily school life. The study described here with its monitoring of the attentiveness in three different classes during the course of the school morning is an attempt to make a contribution to the question of the significance of movement in maintaining attention and thus the studying capability of the children.

The results should not be over-rated because the sampling is relatively small, the investigation took place on only one day and other variables were not considered. However agreement with the findings of Kahl (1993) and Müller (2000) confirm that movement in school life has an effect on the attentiveness of children and is a convincing argument for a consequential implementation of the dynamic school concept (see Diagrams 5, 6):

- **Class (A)**, the arrangement of the place of work of which encourages a static-passive attitude to work and whose teaching methods do not allow any unusual movement already shows a slight reduction in attentiveness in the third lesson compared with the first lesson and in the fifth lesson a significant reduction compared with the other two test times. This applies equally to the rather quantitatively biased total performance (GZ-F) as to the concentration value (KL) which is an indication of the care with which the work is carried out.
- **Class (B)**, which partially fulfils the requirements of the dynamic school and concentrates mainly on playground activities – two intensive sessions of 25 minutes per morning school - is not only able to sustain its high degree of attentiveness in the course of the morning but significantly increase it during the fifth period.
- **Class (C)**, which fulfils the concept of the "dynamic school" in all aspects but particularly in respect of furnishing with ergonomic work places and the demand for dynamic working conditions, is capable of significantly increasing attentiveness at practically all testing times. Only when comparing the third and the fifth lessons is an insignificant improvement in concentration value (KL) noticeable.

There are significant differences between all comparison classes. The best performance was consistently achieved by class C in which the concept of the "dynamic school" was implemented in the sense of ergonomically-furnished workplaces and the encouragement of a dynamic attitude to work.

A comparison of the total performance (GZ-F) in which the eagerness to work and the quantitative component of the attentiveness shows itself compared with the concentration performance value (KL) in which the checking function and the accuracy of the work play a part produces no significant tendency. It can be assumed that both the amount of work and the care taken profit equally from increased attentiveness in the dynamic school. On the other hand, Müller (2000, 201) reported that children in a dynamic school worked faster than a comparison group "without deterioration in care", the accuracy of the work however was not significantly increased.

With the exception of the first observation time, there is a significant difference between all three groups. Class C continuously shows the highest performance values. Right from the measurement time in the first lesson, class A shows a slightly lower performance ($p < 0.05$) in comparison to classes B and C. However, since all classes show an above-average performance at this point in time (see table 2), this difference should be neglected here.

Traditional breaks between lessons are not sufficient to maintain the readiness to work and study during the course of a school morning. It is important to utilise these breaks with physical activity. A further increase in attentiveness can be achieved by additional movement, i.e. lessons incorporating movement.

The usual breaks between lessons which generally take place between the second and third as well as the fourth and fifth lessons and take the form of recreation on the playground divide up the school day are apparently inadequate alone for the maintenance of the readiness for active study (class A). Not until the children are permitted and/or motivated to make active use of the breaks, can the attentiveness during the course of the morning school not only be maintained but even increased (class B).

The surprisingly high increase in the attentiveness in class C is however a result of additional movement during lessons (no intentional breaks for exercise), the concept of dynamic studying together with the ergonomic arrangement of the workplace (see Breithecker 2000, 2002). These results are comparable with mainly highly significant improvement of the attentiveness when associated with the concept of a ‚sitting school, in the school. With exception of the encouragement of the activity during the playground breaks, this concept is very similar to the dynamic school, is however to be introduced here in a course version for a period of 10 to 12 weeks (Klavis 1997; May 1999; Rausch 1995; Schulz 1995; Stapf 1996).

It would seem that even specific support of movement in schools – the active use of existing breaks – not only suffices to sustain the attentiveness of children during the course of a school morning but also to increase and create a basis for the necessary willingness to study and work. However, the consequent application of the idea of the dynamic school enables a further surprising increase to be achieved. Just how much of the increased attentiveness results in better performance in the school has still to be investigated.

Summary and outlook.

The connections between motor and cognition, the influences of perception and movement on studying, on the capability of children to study and work is undisputed. Psychological and biological development and neuro-physiological processes are both quoted when trying to explain these connections. In an attempt to explain the "intelligence stimulating effect of movement programmes at school age", Jetter (1975, 58) suggested many years ago that neuro-physiological aspects ("rhythmic variations and coordination of neural control"), personality-psychological aspects (strengthening self-confidence, reduction of anxiety) and social-psychological aspects ("effectiveness of group therapy; encouragement of living up to roll expectations").
A school in which the child’s natural need of movement for the physical-motor and personality development is not suppressed but actively encouraged, a positive development of the ability to study and the willingness to work can be expected.
The present study confirms these expectations. The observation of the attentiveness of the children during the course of morning school (1st, 3rd, 5th. lessons) showed highly significant differences between the classes whose daily school life incorporated varying degrees of physical activity. If movement is not part of the curriculum, then the above-average attentiveness during the first lesson deteriorates so much that by the fifth lesson concentrated study does not appear to be possible any more. Should only physical activity be encouraged during the breaks, then attentiveness is not only sustained but can actually be increased during the morning. However, an incomparably large improvement in attentiveness is shown by the children who are able to study in a dynamic school whereby the significance of the ergonomic places of work ("child-friendly”) and the teaching of appropriate working postures should be emphasised.
It is to be expected that children will make use of the behaviour they have learnt at school in the daily life in the family as well; the success of this depends on how well the family are familiar with the idea of dynamic studying.

The study confirms that a school in which movement is supported and encouraged has a positive effect on the learning ability and attentiveness of the children. The observation of the attentiveness shows significant differences between the comparison classes. Great importance is attached to the ergonomic furnishing of the school workplaces.

The result of the present study once again confirms the significance of the consequent application of the dynamic school concept. The positive effects on the attentiveness which as one aspect of cognition represent an important prerequisite for academic success in the school no doubt convinces parents, teachers and school direction more than the equally important increase in daily well-being and happiness in the school for the children.
The great significance apparently attached to the ergonomic arrangement of school workplaces as well as the familiarity with corresponding modes of behaviour should, even in times of shortage of money, lead to a critical appraisal and optimisation of classroom furnishing in the interests of health promotion and school success.

Literature available from the authors

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1st lesson	GZ	F	GZ-F	KL
class A	353,61 ± 30,07	12,81 ± 16,48	340,76 ± 33,20	135,47 ± 20,13
class B	397,05 ± 65,21	11,83 ± 8,73	385,22 ± 67,18	155,72 ± 30,80
class C	415,17 ± 47,50	17,47 ± 17,44	397,70 ± 48,32	156,76 ± 24,61
3rd lesson				
class A	353,33 ± 49,86	23,90 ± 30,91	328,90 ± 30,95	125,90 ± 17,30
class B	419,55 ± 64,94	10,27 ± 14,17	409,27 ± 70,37	166,55 ± 36,59
class C	558,76 ± 35,28	16,64 ± 11,02	543,29 ± 34,05	225,78 ± 17,78
5th lesson				
class A	259,47 ± 84,78	25,95 ± 40,33	233,52 ± 61,67	82,95 ± 31,44
class B	435,27 ± 78,99	11,83 ± 14,42	423,50 ± 82,07	173,83 ± 42,87
class C	575,05 ± 36,89	15,41 ± 12,09	559,52 ± 35,98	237,82 ± 18,69

Table 1: Results of the attentiveness-strain-tests (Test d2) of the three school classes in the course of a school morning: Raw values (Average values ± SD) of the total number of characters worked (GZ), the number of mistakes (F), the total performance (GZ-F) and the concentration performance values (KL).

	GZ-F			KL		
1st lesson	**RW**	**PR**	**SW**	**RW**	**PR**	**SW**
class A (n=19)	343,15	92	114	138,42	90	113
class B (n=18)	385,22	99	122	155,72	98	121
class C (n=17)	397,70	99	125	156,76	99	122
3rd lesson						
class A (n=19)	327,7	84	110	128,05	82	109
class B (n=18)	409,27	>99	127	166,55	>99	126
class C (n=17)	543,29	>99	>130	225,78	>99	>130
5th lesson						
class A (n=19)	227,73	13	89	84,21	13	89
class B (n=18)	423,50	>99	130	173,83	>99	130
class C (n=17)	559,52	>99	>130	237,82	>99	>130

Table 2: Classification of the total performance (GZ-F) and the concentration performance value (KL) in percentage order (PR) and standard values (SW; M=100, SD=10) based on the Calibration samples 2000 (see Brickenkamp 2002).
In class A only the results of 19 test candidates are evaluated here; two who were more than 11 years old were not taken into account.

	1st lesson		3rd lesson		5th lesson	
	GZ-F	**KL**	**GZ-F**	**KL**	**GZ-F**	**KL**
class A - B	p< 0,05	p< 0,05	p< 0,01	p< 0,01	p< 0,01	p< 0,01
class A - C	p< 0,01	---	p< 0,01	p< 0,01	p< 0,01	p< 0,01
class B - C	---	---	p< 0,01	p< 0,01	p< 0,01	p< 0,01

Table 3a: Comparison of the attentiveness performance (total performance GZ-F and concentration performance value KL) in the individual classes during the various observation periods.

	class A		class B		class C	
	GZ-F	**KL**	**GZ-F**	**KL**	**GZ-F**	**KL**
1st - 3rd lesson	---	---	---	p< 0,01	p< 0,01	p< 0,01
3rd - 5th lesson	p< 0,01	p< 0,01	---	---	---	p< 0,05
1st - 5th lesson	p< 0,01	p< 0,01	p< 0,01	p< 0,01	p< 0,01	p< 0,01

Table 3b: Comparison of the attentiveness performance (total performance GZ-F and concentration performance value KL) in the individual classes during the various observation periods.

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