

Effect of physical education upon the psychological development of schoolboys*

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1. Introduction

The importance of physical exercise in relation to the development of children in its widest sense has generally been accepted. On one hand physical activity among young people decreases continually; on the other hand the abundant use of food with a high fat percentage exceeds the daily caloric output. This is a reason to raise the level of physical activity of pupils by increasing the number of weekly lessons in physical education (9). Although experiments are done with differences in frequency of lessons of physical education no unanimous effect can be found (1, 3, 16). At most schools in the Netherlands the number of lessons varies from two to three lessons a week.

The importance attached to physical education at school, appears from the Proposal Curriculum Government-schools (13) in which the objectives of physical education are described as follows:

the education in physical exercise aims to contribute to the development of the personality and is, by continuously observing these objectives, also directed to . . .

- a favourable stimulation of the development of the body
- increase the willingness and ability to produce achievements

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— increase the readiness to cooperate . . .

This implies that a differentiation between subjects with more or fewer lessons of physical education might be expected on the mentioned aspects. Therefore it was expected that the objectives of physical education will be reached in a greater extent with more lessons of physical education a week.

2. Methods

The independent variable

The independent variable was the frequency of lessons of physical education a week. Three lessons a week were given to the control group and five lessons were given to the experimental group. The two extra lessons meant for the timetable that the experimental group got a total of 34 instead of 32 lessons a week (Table 1).

Each class had its own teacher of physical education. All lessons of physical education were predesigned and given by the teachers in the same working order and as uniformly as possible. The two extra lessons should be seen as a pure quantitative extension of the curriculum.

Subjects

Subjects were 70 boys of the four first forms of a secondary-school in Amsterdam; mean chronological age 12.5 year ($\pm .4$). By lot two classes were assigned as experimental group ($n = 33$) and the other two classes as control group ($n = 37$).

Dependent variables

The dependent variables were measured at the beginning (pretest) and at the end (posttest) of the schoolyear. The objectives of physical education were operationalized as follows:

— willingness and ability to achieve measured by the Achievement Motivation Test for Children (P.M.T.-K.) with the scales P (achievement motivation), F+ (facilitating anxiety) and F- (debilitating anxiety) (7).

— readiness to cooperate by the Syracuse Amsterdam Groningen Sociometric Scale (S.A.G.S.) with the R-score (the score of the received appraisals by one subject from his classmates) and the G-score of appraisals given by one subject to his classmates) (4).

— the development of the personality, defined

sterdam Biographic Questionnaire (A.B.V.) (17).

— attitudes to concepts referring to cooperation, willingness and ability to achieve, learning performances and recreation and leisure time by the evaluation factor of a Standard Semantic Differential (S.S.D.) (12).

— attitude to school as an institution by the School Attitude Questionnaire (6).

— preference and ranking order of physical education and the other subjects of school by Coombs triads (2) and simple rankordering.

Interfering variables

As interfering variables were measured:

— biological age scored as skeletal age on pretest by X-ray photography of lefthand and wrist according to the bonespecific method of Tanner, Whitehouse and Healy (15).

— habitual physical activity scored by pedometers (14) attached to the waist. The total score was used as a measure of the amount of physical activity. Assuming physical activity during school hours as quite comparable, only the leisure time physical activity was measured (10).

— the teaching behaviour of the four teachers analyzed from videotaped lessons. Eight lessons, identical for all teachers, were selected, and judged by 5 trained independent judges on 17 categories of a modified interaction analysis system of Flanders (5). Teaching behavior was also rated on a number of professional aspects.

3. Statistical methods and hypotheses

Pretestdata were factoranalyzed to check the similarity in factor-structure of experimental and control group (8). Variables with a similar factorstructure in control and experimental group ($r \geq .60$) were analyzed by an analysis

of covariance and variables with an apparent difference in factorstructure with an unreduced multivariate two sample test (11). A similarity in factor-structure was found for the variables of the A.B.V. and Schoolattitude. These variables were treated with an analysis of covariance. The hypotheses were: T- and N-scores decrease (hypotheses 1 and 2) and E-scores increase in the experimental group in comparison with the control group (hypothesis 3); Schoolattitude-scores increase more in the experimental group than in the control group (hypothesis 4).

In the multivariate two sample test two groups of variables were analyzed separately: as group A the 10 concepts scored with the S.S.D. (hypothesis 5) and as group B the scores on the variables S.A.G.S.-R, S.A.G.S.-G and the variables P, F- and F+ of the P.M.T.-K and the Preference and Rankorder of physical education (hypothesis 6). The hypotheses for both groups of variables were that the pre-posttest differences were not the same for the experimental and control group. All hypotheses were tested on a 5% significance level.

4. Results

Hypotheses 1, 2, 3, 4 were tested by analysis of covariance with $H_0 : \alpha = \beta(\text{exp}) = \beta(\text{contr}) = \gamma = 0$.

A significant result means a difference between experimental and control group caused either by the extra lessons (α) and/or habitual physical activity (β) and/or skeletal age (γ). The interfering variable teaching behavior was not taken up in the analysis (see discussion).

Results revealed no significant effect (Table 2).

The hypotheses 5 and 6 were tested by means of the multivariate two sample test:

$$H_0 : E(X_i) = E(Y_i).$$

CHRONOLOGICAL AGE OF THE MALE SUBJECTS n = 70 (YEAR DECIMALS)					
	mean	s. d.	min.	max.	range
Chronological age:	12.5	0.4	11.9	13.7	1.8
Classes (first forms)	1 n=16	2 n=17	3 n=18	4 n=21	

Table 1: Chronological age of the subjects and assignment of classes to experimental and control group.

<i>Anocova*</i>	Ex. gp. vs. co. gp. hypotheses	Result
1. Testtaking attitude	↓	n. s.
2. Neuroticism	↓	n. s.
3. Extraversion	↑	n. s.
4. Schoolattitude	↑	n. s.
<i>Multivariate two-sample test</i>		
5. Group I (concepts sem. diff.)	≠	n. s.
6. Group II (psych. variables)	≠	.02

Table 2: Statistical analyses, hypotheses and results $\alpha = .05$.

* Covariates: biological age and habitual physical activity.

A significant result means a difference for at least one dependent variable (i) in the expectancy (E) of a difference between the experimental (X) and the control group (Y). In group A no significant difference was found. However, a significant difference appeared for all variables of group B together. The statistical model could not indicate in which dependent variable(s) the effect of the independent variable could be detected (see discussion). (For the raw data of the variables of group B see table 3, 4 and 5).

5. Discussion

Since each of the four classes was given physical education by its own teacher of physical educa-

tion it seemed important to measure the possible influence of a teacher effect as interfering variable. However, this variable was not measured directly on the subjects. The possible influence of this third interfering variable was therefore studied in an explorative way. The mean difference score of each of the dependent variables taken into the analysis of covariance had been calculated for the experimental classes (\bar{d}_2 and \bar{d}_3) and for the two control classes (\bar{d}_1 and \bar{d}_4). With these data the ratio was calculated: $(\bar{d}_2 + \bar{d}_3) - (\bar{d}_1 + \bar{d}_4) / (\bar{d}_2 - \bar{d}_3) + (\bar{d}_1 - \bar{d}_4)$.

The nominator contains the effect of the independent variable plus the class and/or teacher effects; the denominator the class and/or teacher effects. When this ratio is ≥ 3 one may suppose that the difference between experimental and control group might be explained by the independent variable and not by class and/or teacher effects; when this ratio is ≤ 1 it may also indicate a possible class and/or teacher effect. A ratio ≥ 3 could not be found, which means that an effect of the independent variable alone is not probable. A ratio ≤ 1 was found for the variables schoolattitude, the E (extraversion) and T (testtaking attitude) scale of the A.B.V. (Table 3). This indicates an effect of the two extra lessons of physical education on these dependent variables as well of the interfering variable class and/or teacher behavior. A teacher effect was also supported by results from the judgements of teaching behavior of the four teachers in professional skill and social emotional aspects. A

Dependent variables	Group	Class	Pretest		Posttest	
			Mean	S. D.	Mean	S. D.
Neuroticism (scoring range 11-105)	E	2	61.33	22.08	60.78	25.43
		3	57.06	19.04	59.19	18.37
	C	1	59.38	13.76	62.19	21.94
		4	66.62	19.69	71.29	20.30
Testtaking attitude (scoring range 67-20)	E	2	39.33	10.80	36.67	9.38
		3	41.38	11.70	36.75	11.20
	C	1	41.00	10.42	34.67	5.29
		4	36.95	7.95	37.38	9.05
Extraversion (scoring range 20-84)	E	2	58.50	11.80	59.67	12.13
		3	56.00	12.11	56.50	14.51
	C	1	51.81	13.43	53.31	19.52
		4	54.33	12.71	52.62	13.67
Schoolattitude (scoring range 0-9)	E	2	4.00	2.89	4.89	2.91
		3	5.75	2.27	5.42	1.90
	C	1	4.31	2.39	3.81	2.20
		4	5.00	2.10	4.19	2.46

dependent variables	group	class	pretest		posttest		diff.
			mean	S. D.	mean	S. D.	
SAGS R received appraisal	exp.	2	2.55	.41	2.55	.47	.0
		3	2.15	.44	2.42	.67	+ .27
	contr.	1	2.37	.35	1.84	.27	-.53
		4	1.59	.24	1.58	.26	-.01
SAGS G given appraisal	exp.	2	2.55	.79	2.57	.83	+ .02
		3	2.18	.56	2.42	.55	+ .24
	contr.	1	2.37	.65	1.84	.65	-.53
		4	1.59	.42	1.59	.46	.0
Preference of physical education	exp.	2	7.06	1.43	7.33	1.33	+ .27
		3	6.75	1.44	6.75	1.44	.0
	contr.	1	6.63	1.59	7.00	1.41	+ .37
		4	7.16	1.15	7.24	1.04	+ .08
rank of physical education	exp.	2	2.67	2.57	1.89	1.78	-.78
		3	3.25	2.46	3.38	3.24	+ .13
	contr.	1	2.81	3.31	2.75	2.62	-.06
		4	2.62	2.62	2.24	2.90	-.38

Table 4: Mean, S. D. and difference of the SAGS R, SAGS G, preference and rank of physical education with highest maximal test score of resp. 5, 5, 12 and 1.

dependent variables	group	class	pretest		posttest		diff.
			mean	S. D.	mean	S. D.	
P achievement motivation	exp.	2	19.29	4.12	16.94	6.35	-2.35
		3	17.81	5.01	17.16	5.64	-.65
	contr.	1	19.73	5.48	16.33	4.97	-3.40
		4	14.44	6.27	12.26	6.30	-2.18
F + facilitating anxiety	exp.	2	10.35	3.62	8.35	4.72	-2.00
		3	9.19	3.99	10.31	4.25	+ 1.12
	contr.	1	9.87	3.20	10.33	3.92	+ .46
		4	7.63	3.45	8.47	5.30	+ .84
F - debilitating anxiety	exp.	2	7.88	3.31	8.29	4.12	+ .41
		3	8.56	2.68	7.88	3.07	-.68
	contr.	1	7.87	3.64	6.93	4.46	-.94
		4	10.00	2.71	8.84	4.05	-1.16

Table 5: Mean, S. D. and difference of the achievement motivation test for children with the scales P (maximal score 33), F+ (max. score 17 and F- (max. score 15).

class effect was supported by the preposttest differences of the scores S.A.G.S.-R and -G of the four separate classes (classes 2 and 4 no difference, class 3 a difference of + .27 and class 1 of -.53) (Table 4 and 5).

It will be stressed that these results do not give any implication for the evaluation of the regular curriculum of physical education.

The importance of the regular curriculum of physical education may appear from the obtained data of the relative preference for physical education along the twelve other school subjects. As shown in Table 4, the preference for physical education was relatively high during the schoolyear, although at the same time the mean school attitude decreased from 5.20 to 4.80.

6. Conclusions

In general the expectations about the effects of two extra lessons of physical education upon the psychological development of 12 and 13 year old boys could not be confirmed. In a five versus a three lessons a week program only a significant difference between experimental and control group in a totalized score of a number of psy

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the assumed effects to aspects outside a physical education context is justified or not. It seems more relevant to investigate effects on those variables, which are related more directly to aspects of physical education. Maybe the objectives in physical education are unrealistic and limited.

An other problem is of a more practical nature. First, in this study the independent variable had to be limited to two extra lessons a week for organizational reasons (timetable). Second, the demands made by parents, schooldirections and schoolinspection-authorities did not allow a

reduction of the number of weekly lessons in physical education to zero in the control group. Perhaps more evident results about the effects of physical education will be found if the researcher is allowed to manipulate freely the frequency of the lessons. Concerning the tests which measure stable personality characteristics (A.B.V. and P.M.T.-K.), one may wonder if they are sensitive enough for this type of research, in which only short-term changes can be measured. This is a plea for a longitudinal approach of the assumed effects of physical education.

Footnotes — Anmerkungen

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Die Wirkung der Leibeserziehung auf die psychologische Entwicklung von Schuljungen*

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1. Einleitung

Die Bedeutung von Leibesübungen für die allgemeine Entwicklung von Kindern wird grundsätzlich anerkannt. Auf der einen Seite nimmt körperliche Betätigung unter Jugendlichen ständig ab; auf der anderen Seite übersteigt zu gute Ernährung mit hohem Fettgehalt den täglichen Kalorienbedarf. Dies ist der Grund für eine Vermehrung körperlicher Betätigung von Schülern durch Erhöhung der wöchentlichen Stundenzahl in Leibeserziehung (3). Obwohl Untersuchungen mit unterschiedlicher Stundenzahl im Sportunterricht durchgeführt wurden, läßt sich keine einheitliche Wirkung feststellen (1, 3, 16). An den meisten Schulen der Niederlande schwankt die Stundenzahl von 2—3 wöchentlich.

Die Bedeutung, die der schulischen Leibeserziehung beigemessen wird, ist aus den Zielsetzungen für Leibeserziehung ersichtlich, die in „Proposal Curriculum Government — Schools“ (13) folgendermaßen beschrieben werden:

Leibeserziehung soll zur Entwicklung der Persönlichkeit beitragen und richtet sich also durch ständige Beachtung dieser Zielsetzungen auf folgende Aspekte:

- positive Anregung für die Entwicklung des Körpers;
- Steigerung der Willenskraft und der Leistungsfähigkeit;

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— Verbesserung der Kooperationsbereitschaft. Daraus folgt, daß eine Unterscheidung zwischen Schülern mit mehr oder weniger Stunden in Leibeserziehung auf Grund dieser Gesichtspunkte erwartet werden kann. Deshalb wurde angenommen, daß die Ziele der Leibeserziehung mit zunehmender wöchentlicher Stundenzahl in Leibeserziehung eher erreicht werden können.

2. Methoden

Die unabhängige Variable

Die unabhängige Variable war die wöchentliche Stundenzahl für Leibeserziehung. Die Kontrollgruppe hatte drei Wochenstunden, die Experimentalgruppe fünf. Die beiden zusätzlichen Stunden bedeuten, daß die Experimentalgruppe 34 Stunden Schulunterricht gegenüber 32 bekam (Tabelle 1) (vgl. S. 11). Jede Klasse hatte ihren eigenen Sportlehrer. Alle Sportstunden wurden genau geplant und von den Lehrern so einheitlich wie möglich durchgeführt. Die zwei zusätzlichen Stunden sollten lediglich die quantitative Erweiterung des Lehrplans darstellen.

Untersuchungsgegenstand

Untersuchungsgegenstand war 70 Jungen von vier ersten Klassen einer Sekundarschule in Amsterdam. Das durchschnittliche chronologische Alter betrug 12,5 Jahre (± 4). Nach dem Zufallsprinzip wurden zwei Klassen als Experimentalgruppe ($N = 32$) und die anderen beiden Klassen als Kontrollgruppe ($N = 37$) gebildet.

Abhängige Variablen

Die abhängigen Variablen wurden zu Beginn (Pretest) und am Ende (Posttest) des Schuljahres gemessen. Die Ziele der Leibeserziehung wurden folgendermaßen operationalisiert:

— Willenskraft und Leistungsfähigkeit gemessen durch den „achievement motivation test for children“ (P.M.T. — K.) mit den Skalen P (Leistungsmotivation), F+ (Förderung von Angst) und F— (Verringerung von Angst) (7).

— Kooperationsfähigkeit „Syracuse Amsterdam Groningen Sociometric Scale“ (S.A.G.S.) mit dem R-Wert (die Zahl der erhaltenen Einschätzungen durch ein Mitglied der Klasse) und dem G-Wert (der Wert von Einschätzungen von einem Mitglied der Klasse für seine Klassenkameraden) (4).