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Kinesiology and Learning: Implications for Turkish School Curriculum

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Learning is a complex phenomenon and multi-faceted in nature. There are a number of parameters which influence learning cycle and the process in general. Physical exercise is thought to be one of the variants that affect the learning phenomenon. Accumulated scientific evidence can be found in the literature showing high correlations between physical activity and academic performance and cognitive functioning. The main purpose of the present paper is to present research findings on the correlations between physical activity, learning and academic performance. It is also intended to give international perspective on the importance of physical education at schools with a view to providing basis for the recommendations made for curriculum developers and policy makers in Turkey responsible for pre-teacher training curriculum.

Key words: Kinesiology, learning, physical education, curriculum.

INTRODUCTION

Some scientists used to claim that the development of human brain was shaped and determined genetically and other factors like nutrition, learning environment with which the child interacts, physical activity and love play minor roles. However, there seems to be a consensus among educators, scientists, especially among neuroscientists, over the past two decades, on the issue of multifaceted nature of learning and learning process and now it is claimed that there are a number of factors which affect learning process other than genetic ones. Some of those factors reported are nutrition, the way the parents interact with the child during the critical developmental stages, daily experiences, physical activity, love and caring the child receives (Brotherson, 2005). As a result of painstaking research conducted in the field of neuroscience, scientists learn more about how the human brain works, evolves and develops. In light of the new findings, many of our theories, definitions, methods and ideas about the brain are being challenged. The human brain weighs on average 1.36 kg and comprises only 2% of the human body. However, it consumes more than 20% of the oxygen and nutrients of body intakes. Over the last several decades a considerable amount of effort has been devoted to connecting advances in neuroscience research to educational interventions with a view to enhancing learning. There seems to be a growing need to improve teacher instruction and student learning based on a scientific understanding of how the brain functions (Ansari, 2008 and Goswami, 2006). Brain gets its energy through blood circulation like glucose, protein, trace elements, and most importantly oxygen. It is well known that water provides the electrolytic balance for proper functioning not only for the brain, but also for entire body. Experts recommended that the brain needs 8 to 12 glasses of water per day for optimal functioning (Jensen, 1998). Hannaford (2005) talked about the danger of dehydration which is believed to be a common problem in schools. He pointed out that dehydration leads to lethargy and impaired learning.

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Among the important factors and claimed by neuroscientists, physical activity or body movement has a significant impact on learning phenomenon. One of the first developed parts of the human brain is called cerebellum. It is determined that commands related to motor activities are given and controlled from this section. For this reason, the creation of action-oriented learning environments is especially important during childhood. It is worth asking ourselves as educators about how much opportunity we give to our students to move in a large and specious area. Jensen (1997) reported that in 1960s children spent approximately 100 hours sitting in a car and the duration has increased to 500 hours on average in 1995. Those passive hours should be spent in wide areas where children move freely and planning should be done accordingly. For one thing, moving in large areas from infancy onwards is now known to have a positive effect on learning. A recent survey revealed that subjects who spend more time for physical education, regardless of their socio-economic status, exhibit a superior performance on academic subjects such as math and reading (Hillman et al., 2008).

Surveys conducted in many developed countries reveal that majority of young generation, even children at the primary level, live sedentary lifestyles yet this can cause both health and learning problems in schools. For instance Ogden et al. (2012) stated that almost 1 in 3 young people whose ages range from 6 to 9 are considered to be overweight or obese in the U.S. Schools seem to be in a unique position to overcome the obesity problem (measured objectively via using body mass index) because this is where students spend most of their time. Obesity seems to be a prevalent problem among adolescents as well as young people and most people do not realize how schools can contribute towards overcoming this issue. In addition to the contribution of physical activity towards solving sedentary lifestyle, educators and curriculum developer should also keep in mind the significant correlation between physical activity and cognitive function. Evidence suggests a positive relationship between physical activity and academic performance of students, enhanced learning, alertness level as well as cognitive, social behavior and motor skill development (Trudeau and Shephard, 2008). Therefore, school settings, school curricula at all levels and our approach to students could be designed and shaped in a way that students have ample of opportunities to move and being physically active and help them develop a habit of working out regularly.

In light of the search findings and claims cited in this paper, it seems that we, as educators, need to think about how much opportunity we provide to the students at schools to be physically active and move freely. The main purpose of the present paper is to present research findings on the correlations between physical activity, learning and academic performance. It is also intended to give international perspective on the place of physical education at schools by providing American and European Union standards with regard to time allocation for Physical Education (PE) at schools. Moreover, the time allocation for physical education required by the Turkish Ministry of National Education for primary and secondary school curriculum, between 2007 and 2012, has been examined and recommendations are made accordingly.

Theoretical framework

In order to create effective learning environment, we need to have in-depth knowledge of human brain since learning occurs there. The human brain has approximately 100 billion neurons at birth. Each neuron has the potential to connect to the other 10,000 neurons and this means about 1 billion potential connections. New connections between brain cells and new neuron networks established are called learning (Duman, 2009). Neurons have bodies, dendrites and axons. They are responsible for information processing, sending and receiving electro- chemical signals back and forth. A normal functioning neuron fires, gets connected with other neurons and generate information continuously. Jensen (1998) stressed that the brain needs to get more oxygen and less carbon dioxide for higher levels of attention, mental functioning, and healing. Therefore, we need to make sure that students get enough amount of oxygen to maintain their alertness and cognitive functioning. This is where the importance of daily physical activity comes into play in addition to efficient ventilation of the classrooms and adequate daily water intake.

Education, as a field, is not isolated from other disciplines. At the end of the day, we deal with human beings whose nature is complex and multifaceted. For example there is a growing body of evidence in the literature on the correlation between learning and body movement. This branch of science is called kinesiology. It is sometimes referred as human kinetics. Kinesiology deals with physiological, mechanical, and psychological mechanisms of movement. Basically, movement, performance, biomechanics, anatomy, physiology and neuroscience are the main areas of interest of kinesiology.

We need to understand the mechanism on how physical exercise affects the learning process. New research has shown that the effect of exercise first occurs in the muscles (muscle contraction and relaxation) then in the brain with the protein called as IGF (Insulinlike Growth Factor) which is generated as a result of this. The IGF produced in muscles reaches the brain through blood and triggers the formation of neurotransmitters. BDNF (Brain Derived Neurotrophic Factor) is one of these essential neurotransmitters in providing the communication between the two brain cells (BDNF level increases in people who do regular exercise and as a

result of these dendrites occur in brain neurons.) This situation sets up a substructure for the probability of neuron-network occurrence that is to new learning. In summary, the IGF produced in muscles triggers the formation of BDNF and BDNF forms the learning substructure and eases communication between the two brain cells (Ozdinler and Macklis, 2006). Based on that mechanism, it should not come as a surprise to see the correlation between movement and cognitive performance. The hippocampus plays an important role in the consolidation of memory. One major mechanism essential to its functions is Long-Term Potentiation (LTP). LTP is believed to enhance the nervous influx following a first series of stimuli received. Chronic exercise creates a favorable environment in the brain for LTP. The main characteristic of LTP is that it can cause the long-term strengthening of the synapses between two neurons which are activated simultaneously. Hippocampal LTP is thought to be the most important physiological explanation for learning and memory in mammals, including humans (Cooke and Bliss, 2006). Continuous physical exercise increases the hippocampal concentrations of neuroprotective factors like brain-derived neurotrophic factor (BDNF) and also other growth factors such as insulin-like growth factor (IGF-1), nerve growth factor, and fibroblast growth factor 2 (FGF-2) (Cotman and Berchtold, 2002).

Until couple of decays ago neurologists used to claim that the brain cells die rapidly from the age of 30 onwards and they are never renewed. However, in recent years, especially experiments conducted on animals have shown that new nerve tissue can be produced in brain with exercise. Unfortunately, having done regular physical exercise at certain times is not enough. A research study was conducted which involved a population of 287 British Columbian primary school children at the 4th and 5th years. Physical activity was coordinated by classroom teachers, amounting to 47 minutes more per week in interventional than in control schools. Despite a decrease in academic time and increase for physical activity, the academic performance of the experimental group, as measured by the Canadian Achievement Test, remained unchanged. In fact, data analysis revealed a trend towards an enhanced academic performance in the intervention schools with the average score rising from 1,595 to 1,672 units (Ahamed et al., 2007). Another study was conducted involving 6th grade, 11 year-old, students covered a single school term. 55 minutes per day of physical education activities were included in the curriculum, vs. the same allocation of time for arts or computer sciences. The two groups performed equally well in mathematics, sciences and English (Raviv et al., 1994). Another intervention study involved 92 preschool and 266 first grade children. The experimental manipulation here was a school-based movement education program, and children in the experimental group showed greater reading skills and arithmetic scores than controls (Coe et al., 2006).

Research findings from the longitudinal Maryland Adolescent Development in Context Study included 67% African-Americans and 33% European-Americans showed that participation in extracurricular physical activities was a significant predictor of better academic results and of higher academic expectations (Hawkins and Mulkey, 2005). Moreover, sports participation by 8th grade African-American males resulted in aspirations to continue their studies toward college, with less likelihood of acting inappropriately in school.

The above research findings suggest that the enriched physical activity program demanded a substantial reduction in the time allocated for academic subjects. However, the children achieved at least equally despite the reduced teaching time, the evidence seems strong that the efficiency of learning was enhanced through physical activity (Shephard, 1997). Relying on the correlation between physical activity and learning, there have been a number of intervention techniques to be incorporated into the curriculum, especially during the implementation of classes, in order to enhance learning and improve students' academic performance. One of those intervention technique or approach is called Brain Gym. This approach is based on the assumption that children need to develop specific motor skills, at critical developmental stages, for efficient neurological and intellectual development. It further claims that a lack of such motor skills to be developed at those specific stages could cause complex difficulties later on and could also result in learning difficulties. According to Dennison (1981), Brain Gym® is the product of clinical work he conducted in 1969. It is further claimed that systematic use of specific body movements, in addition to deep breathing and plenty of water intake, can prepare the human brain for optimal learning regardless of age. The underlying principle of Brain Gym® is that learning can be enhanced through simple and specific movements which would in return stimulate both hemispheres of the brain to work in a balanced way. Dennison and Dennision (1985) claimed that, when the left and right hemispheres of the brain work in harmony, human beings could function in a more integrated and coordinated manner. Khalsa et al. (1988) and Sifft and Khalsa, (1991) reported improvements in their research with students on perceptual-motor skills such as balance and visual response times after the use of Brain Gym® techniques.

There have been many research findings reported in the literature vis-à-vis the relationship between body movement and cognitive processes and academic performances. Dwyer et al. (2001) made a cross-sectional survey with 9000 Australian schoolchildren between the ages of 7 and 15 years old about the correlation between physical activity and school performance. Significant association between academic achievement and physical activity was found. They

concluded that physical activity was contributing to academic achievement in both boys and girls. In another research, Sibley and Etnier (2003) conducted a meta-analysis covering 44 studies on the correlation between physical activity and cognitive function. They concluded that physical activity was positively associated with better cognitive functioning in children, especially grades 6–8, aged 11–13 years and younger.

International perspective on physical education European Physical Education Association (EUPEA, 2002) recommended daily physical exercise for children at early years of schooling and also the total of 180 minutes per week for secondary and high school students. In the United States, the National Association for Sport and Physical Education (NASPE) recommends a minimum of 150 minutes per week for PE in elementary schools and 225 minutes per week for middle and high school students. The Council of Europe Committee of Ministers on 30 April 2003 made a reference to the issue of time allocation to PE in schools. It was advised that schools must go beyond compulsory legal minimum of 180 minutes weekly and call for one hour of daily physical activity in or out of school settings (Hardman, 2008).

Comprehensive survey was undertaken by Cohen et al. (2007) in Los Angeles County public high schools. The survey was about school-based extracurricular sports programs to address issues about obesity and epidemic. It was observed that the average school offering 13 or fewer programs had 14% of its students participating, while the average school offering 16 or more programs had 31% of its students participating in sports. It was concluded that participation in high school extracurricular sports was limited.

Luepker (1999) reported that compared to American children, European children spend more time engaged in physical activity while in school as well as outside of school since generally speaking European children often walk to school. Declining physical activity among youth in U.S. both in the schools and at home was also reported. Leupker (1999) also gave physical education programs in Australian as a good example in which physical education programs were vigorous, challenging and led to improvement of student health.

Hardman (2008) reported that there are major discrepancies between legal requirement policy and actual implementation of physical education at schools in different parts of the world. It has been reported that the highest gaps between official policy and regulations and actual practice can be seen in Africa, Asia, Central and Latin America, and Southern Europe. It was stressed that those countries, where the above-mentioned discrepancies observed, are usually economically under-developed countries. Surprisingly, although not very severe, the same gap was also detected in economically developed countries within the North American, European and also Oceanic regions. Hardman (2008) found out that 109 minutes for primary schools and 101 minutes for secondary schools were allocated for physical activity in European Union countries. In his study it was stated this figure was 73 minutes in primary schools and 87 minutes in secondary schools in Central and South America. A fall in the amount of time allocated for physical activity was reported especially in the final years at school. Hardman (2008) expressed a concern about little or no effect of educational reforms, introduced since the late 1990s, on the place of physical education in school curricula. He also stated that time allocation for physical activity has decreased by about 17% in many countries during this period in spite of international advocacy based on medical, scientific, economic, social and cultural findings and support. Table 1 and 2 show time allocations for PE in EU countries (Harman, 2008: 10-11).

As can be seen from Table 1 and 2, for both primary and secondary schools in EU countries, the allocated time for physical education is below the NASPE and EUPEA standards.

Brief information on Turkish education system

Formal education in Turkey is governed by the Ministry of National Education at the pre-school, primary, secondary and high school level. In line with the recent legislation, each of the following educational periods namely; primary, middle and secondary schools takes 4 years. Therefore, Turkish school system is based on K-12. Primary education is compulsory in Turkey from the age of 6 to 14 and is free of charge in state schools. Up until last year, the primary education was composed of two divisions; the first 5 years being first division of the primary education and the second division took 3 years being the second division of the primary education. Primary Education Diploma (Ilkogretim Diplomasi), was to be awarded to those students who successfully complete the 8 year basic education program. The basic education program includes Turkish language and literature, mathematics, social studies, science, civics and human rights, the history of the Turkish Republic and Ataturk's reforms, a foreign language (English, French or German), individual and group activities, religious culture and ethics, art/handicraft, music, physical education, traffic safety and first aid, career guidance, and elective courses.

In both TIMSS (Third International Mathematics and Science Study) conducted in 1999 and PISA (Program for International Student Assessment) in 2003, 2006 and 2009 Turkish students were ranked very low. In fact, in the assessment of reading literacy, mathematics and science, Turkish students got 464, 445 and 454 points respectively out of the maximum point of 800 (TIMSS, 1999; PISA, 2003).

In response to repetitive unsuccessful results of the Turkish students in those international assessments,

Table 1. Time Allocation (minutes per week) for PE in EU primary schools: 2000-2007.

Primary Schools				
Country	**2000**		**2007**	
	Minimum	**Maximum**	**Minimum**	**Maximum**
Austria	100	200	100	200
Belgium	100	120	100	100
Bulgaria	120	120	100	150
Cyprus	90	90	80	80
Czech Republic	90	135	90	135
Denmark	90	100	90	90
Estonia	90	135	135	135
Finland	90	90	90	90
France	240	240	120	240
Germany	90	180	60	150
Greece	90	90	90	135
Hungary	90	90	112	225
Ireland	30	60	30	60
Italy	100	120	60	120
Latvia	120	120	80	80
Lithuania	90	90	35	45
Luxembourg	100	135	100	100
Malta	90	90	150	150
Netherlands	50	100	45	90
Poland	135	135	135	180
Portugal	150	180	90	135
Romania	100	100	100	100
Slovakia	90	135	90	135
Slovenia	135	135	45	135
Spain	60	60	100	180
Sweden	110	110	100	100
United Kingdom	30	120	30	130

(Hardman, 2008, p. 10).

Turkish authorities decided to review and revise the Turkish education system taking into account the best practices, especially in science education, in the world. To that end, Turkish Ministry of National Education decided to revise the curricula of primary education. The revised new curricula was claimed to be based on constructivism with the emphasis on encouraging high level thinking skills and creativity. The Turkish Ministry of National Education (MONE) has begun a massive reform initiative in the curriculum of elementary school since the beginning of 2004. The reform has been funded by a grant from the European Union. The new curricula had been piloted in about a hundred elementary schools in 6 different provinces before it was decided to put into practice all over Turkey as of 2005-06. As stated before, it was a major paradigm change which was intended to move away from a behaviorist approach to constructivist one. This major paradigm shift requires a substantial attitude change on behalf of the teachers. However, many researchers claim that there wasn't enough in-service training for teachers to prepare them for this huge endeavor (Babadogan and Olkun, 2006).

Physical education at Turkish schools: Time allocation for PE

Table 3 is prepared in accordance with the rules and regulations passed by the Turkish Ministry of Education and appeared in their Official Gazettes. As can be seen from Table 3, the allocated time for both primary and secondary school students for physical activity is well beyond NASPE and EUPEA standards, especially between 2007 to 2012.

For 2012-2013 academic year, for the first three years of primary school (1st, 2nd and the 3rd grades) physical

Table 2. Time allocation (minutes per week) for PE in EU secondary schools: 2000-2007.

	Secondary School			
Country	**2000**		**2007**	
	Minimum	**Maximum**	**Minimum**	**Maximum**
Austria	100	200	50	200
Belgium	150	150	100	150
Bulgaria	120	120	135	135
Cyprus	90	90	45	135
Czech Republic	90	90	90	135
Denmark	90	100	60	60
Estonia	90	90	90	90
Finland	90	90	45	90
France	120	240	90	240
Germany	90	180	60	135
Greece	90	90	90	135
Hungary	90	135	90	225
Ireland	45	120	57	120
Italy	100	120	120	120
Latvia	120	120	80	80
Lithuania	90	90	45	45
Luxembourg	45	150	125	125
Malta	45	90	45	90
Netherlands	50	100	90	120
Poland	90	135	135	180
Portugal	150	180	180	180
Romania	100	100	100	100
Slovakia	135	135	45	135
Slovenia	90	90	90	180
Spain	60	60	110	120
Sweden	110	110	60	60
United Kingdom	60	120	60	120

(Hardman, 2008, p. 11) .

Table 3. Number of Lessons per week for Physical Education at Turkish Schools- 2007 to 2012 .

Number of Lessons per week for Physical Education at Turkish Schools- 2007-2012								
Year	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8
2007-2008	2	2	2	2	2	1	1	2
2008-2009	2	2	2	2	2	2	2	2
2009-2010	2	2	2	2	2	2	2	2
2010-2011	2	2	2	2	2	2	2	2
2011-2012	2	2	2	2	2	2	2	2

education is allocated 5 lessons. Each lesson lasts 40 minutes and therefore the allocated time is 200 minutes per week under the name of “Play and Physical Activities”. Time allocation for 4th, 5th, 6th, 7th and 8th

grades for the same subject is 2 lessons/ 80 minutes per week.

In spite of accumulated scientific evidence about the benefits of physical activity, PE has not been seen as a priority by policy makers in Turkey. We could even see some attempts made in the past to reduce time allocation for PE in the curriculum of K-12 schools in Turkey during the 2010 to 2011 instructional years. This attempt was withdrawn as a result of protests against it by PE teachers in big cities like Istanbul, Ankara, Izmir and Antalya. Time allocated for physical education is certainly not enough for children at all levels in Turkey and it is strongly believed that this has to be redressed immediately.

DISCUSSION AND RECOMMENDATION

In light of the research findings given above, extra physical activities added to the regular course schedule could increase students' academic achievement and improve their health even if curricular time for so-called academic subjects is curtailed. As mentioned earlier on, sedentary life style could potentially cause obesity and a number of health problems like metabolic pathologies. Such pathologies would inevitably affect school performance adversely. Many questions and hypothesis remain unanswered and untested with regard to the correlation between academic performance and physical exercise. However, there is enough scientific evidence to claim that extra physical exercise to be incorporated into school curriculum would have positive effects on children and on their school performance. For example, in one of the studies conducted in Canada, it was found that the time allocated to physical activity was positively correlated with the time that children spent in reading (Feldman et al., 2003). Moreover, fifth, seventh and ninth grade students were involved in a study carried out in California. Although not very high, a positive correlation was observed between the students' academic scores and their scores in physical fitness tests. The same research findings revealed that high academic scores were associated with high-level sporting activity at almost all levels (Prosser and Jiang, 2002).

As concluded by Trudeau and Shephard (2008) physical activity could be added to the school curriculum by taking time from other academic subjects without risk of hindering students' academic performance. On the other hand, adding time to academic subjects by reducing time from physical education does not enhance grades in these subjects and may be detrimental to health.

In traditional school settings and classrooms students spend hours at their desks sitting and watching the teacher as they are being lectured. To break this immobility and habit of being sedentary some innovative techniques emerged and have been used in many schools. "Brain Gym" is one of those techniques. This technique is composed of around 26 physical activities which are claimed to enhance learning and performances of students specifically in; concentration and focus, memory, reading, writing, organizing, listening, physical coordination, sports performance. This technique is based on the understanding that there is a high correlation between the brain's neural pathways and movement/physical activity. Brain Gym was initiated during 1970's by Dr. Paul Dennison and Gail E. Dennison. Originally, this technique was created to help children and adults with learning disabilities. Brain Gym is used in more than 80 countries and is taught in thousands of public and private schools worldwide (Dennison and Dennison, 1994).

A number of research results indicate significant links between body movement and learning. Curriculum developers and school principals need to take into account these research findings and integrate more physical activities into everyday school life. This could be in the form of daily stretching, walking, dancing, using energizers, and increased physical education lessons. Donald Kirkendall stated that "Physical activity is essential in promoting normal growth of mental function" (Pollatschek and Hagen, 1996: 2). Teachers need to encourage students to move more in the classroom especially when they lose concentration. Some brain gym exercises could also be integrated in the implementation of regular lessons.

It is strongly believed that teachers in the 21st century should be trained professionally via contemporary curricula, with contemporary content, where learning opportunities are in place for them to fully equip themselves with high academic standards, pedagogical and practical skills and ethical and moral values. The need to revise and update the content of Turkish teacher curriculum in line with the modern and scientific improvements and the novelties was also suggested by the research conducted by Aydin and Baskan (2005).

Physical activity is believed to have positive impact on cardiovascular system, blood pressure, glucose control and delaying osteoporosis. Schools are ideal settings to encourage children to develop habits on various branches of sports. Based on the research findings above, it could be advisable for educators and decision makers, in the field of education that plenty of opportunities must be provided to the students to move and being physically active. Short and long term benefits of physical activity for both children and adults are unarguable and obvious. This could have positive effect on students in a number of different ways. If a decision is to be taken to do so, there seems to be a number of changes to be made in school curriculum, the climate of both classrooms and the school in general. Below are some recommendations for curriculum developers, educators and decision makers in Turkey:

a). The number of hours allocated for physical education classes, at all school levels in Turkey, should be

increased in accordance with the international standards. Ministry of National Education in Turkey could revise the school curricula accordingly.

b). Both students and teachers could be trained on basic warp-up, stretching, physical activities and brain gym exercises. Professional help could be obtained from experts in the field and be disseminated via in- service education activities. Such training could also be part of pre-service teacher training curricula.

c). Sessions on brain gym and physical exercises could be incorporated into regular school curriculum.

d). In addition to regular physical education classes, schools could provide the students with the opportunity to be physically active through extra-curricular sport events and leisure activities.

e). Some state, private and foundation schools have agreements with sport clubs in Turkey. Under those agreements, students of those schools play, for example basketball, table-tennis, swimming, volleyball and handball with special license obtained for them. This model could be shown as “best practice” and encouraged for other schools in peripherals (in small towns) to have engagement with professional clubs. Such collaboration has a number of benefits like; students are allowed to use the facilities which belong to the clubs, students are encouraged to be physically active, some students get full scholarships from certain schools as licensed players.

REFERENCES

Ahamed Y, Macdonald H, Reed K, Naylor PJ, Liu-Ambrose T, McKay H (2007). School-based physicalactivity does not compromise children's academic performance. Med. Sci. Sports Exercise. 39:371-376.

Ansari D (2008). Effects of development and enculturation on number representation in the brain. Nat. Rev. Neurosci. 9(4):278-291.

Aydin A, Baskan GA (2005). The problem of teacher training in Turkey. J. Biotechnol. Biotechnol. Equip. 19:2.

Babadogan C, Olkun S (2006). Program development models and reform in Turkish primary school mathematics curriculum. Int. J. Math. Teach. and Learn. Online/15 March. http://www.cimt.plymouth.ac.uk/journal/default.htm.

Brotherson S (2005). Understanding Brain Development in Young Children. NDSU FS-609.

Coe DP, Pivarnik JM, Womack CJ, Reeves MJ, Malina RM (2006). Effect of physical education and activity levels on academic achievement in children. Med. Sci. Sports Exercise. 38:1515-1519.

Cohen DA, Taylor SL, Zonta M, Schuster MA (2007). Availability of high school extracurricular sports programs and high-risk behaviors. J. Sch. Health. 77(2):80-86.

Cotman CW, Berchtold NC (2002). Exercise: a behavioral intervention to enhance brain health and plasticity. Trends Neurosci. 25: 295-301.

Cooke SF, Bliss TV (2006). Plasticity in the human central nervous system. Brain 129:1659-73.

Dennison PE, Dennison GE (1985). Personalized whole brain integration.Ventura: Edu-Kinesthetic, Inc.

Duman B (2009). Neden Beyin Temelli Ögrenme(Why Brain Based Learning)? Pegem Akademi, 2nd ed.

Dwyer T, Sallis JF, Blizzard L, Lazarus R, Dean K (2001). Relation of academic performance to physical activity and fitness in children. Pedi. Exe. Sci. 13:225-238.

EUPEA, European Physical Education Association (2002). Code of ethics and good practice guide for physical education. Ghent: EUPEA.

Feldman DE, Barnett T, Shrier I, Rossignol M, Abenhaim L (2003). Is physical activity differentially associated with different types of sedentary pursuits? Arch. Pediatr. Adoles. Med. 157:797-802.

Goswami U (2006). Neuroscience and education: from research to practice? Nat. Rev. Neurosci. 7(5):406-11.

Hannaford C (2005). Smart Moves: Why Learning is not All in Your Head. Great Ocean, 2nd ed.

Dennison P, Dennison G (1994). Brain Gym®, Teacher’s Edition,Ventura, CA, Edu-Kinesthetics, Inc.

Dennison PE (1981). Switching on: A guide to Edu-Kinesthetics. Ventura:Edu-Kinesthetics, Inc.

Hardman K (2008). Physical Education in Schools: A Global Perspective. Kinesiology 40(1):5-28.

Hawkins R, Mulkey LM (2005). Athletic investment and academic resilience in a national sample of African American females and males in the Middle Grades. Educ. Urban Soc. 38:62-88.

Hillman CH, Erickson KI, Kramer AF (2008). Be smart, exercise your heart: Exercise effects on brain and cognition. Nat. Rev. Neurosci. 9:58-65.

Jensen E (1997). Brain based learning (handout). Six Day Brain Based Certification Level One Conference, San Antonio. August 4-9.

Jensen E (1998). Teaching with the Brain in Mind. ASCD.

Luepker RV (1999). How physically active are American children and what can we do it? Int. J. Obes. 23:Suppl. 2.

NASPE, National Association for Sport and Physical Education. http://www.aahperd.org/naspe/standards/nationalGuidelines/PEguidelines.cfm.

Ogden CL, Carroll MD, Kit BK, Flegal KM (2012). Prevalence of obesity and trends in body mass index among US children and adolescents. J. Am. Med. Assoc. 307(5):483-90. Available online: http://jama.ama-assn.org/content/307/5/483

Ozdinler PH, Macklis JD (2006). IGF-I specifically enhances axon outgrowth of corticospinal motor neurons. Nat. Neurosci. 9(11):1371-81.

PISA (Programme for International Student Assessment). (2003). Learning for Tomorrow’s World First Results from PISA 2003. Online http://www.pisa.oecd.org.

Pollatschek J, Hagen F (1996). Smarter, Healthier, Happier. International Health, Racquet, and Sports club, Association Booklet, Boston, Mass.

Prosser L, Jiang X (2002). Relationship between school physical activity and academic performance of children. Int. J. Educ. Res. 15(3):11-16.

Raviv S, Reches I, Hecht O (1994). Effects of activities in the motor-cognitive-learning center on academic achievements, psychomotor and emotional development of children (aged 5–7). J. Sports Sci. Med. 2:50-84.

Shephard RJ (1997). Curricular physical activity and academic performance. Pedi. Exe. Sci. 9:113-126.

Sibley BA, Etnier J (2003). The relationship between physical activity and cognition in children: a meta- analysis. Pediat. Exercise Sci. 15:243-256.

Sifft JM, Khalsa GCK (1991). Effect of educational kinesiology upon simple response times and choice response times. Perceptual and Motor Skills. 73:1011-1015.

TIMSS (1999). International Mathematics Report Findings from IEA's Repeat of the Third Int. Math. and Sci. Study at the 8th Grade. Online:
http://timss.bc.edu/timss1999i/math_achievement_report.html.

Trudeau F, Shephard RJ (2008). Physical education, school physical activity, school sports and academic performance. Int. J. Behav. Nutr. Phys. Act. 5:10.