sustainability

MDPI

Review

Physical Illiteracy and Obesity Barrier: How Physical Education Can Overpass Potential Adverse Effects? A Narrative Review

Athos Trecroci [1,*], Pietro Luigi Invernizzi [1], Domenico Monacis [2] and Dario Colella [2]

[1] Department of Biomedical Sciences for Health, University of Milan, 20129 Milan, Italy; pietro.invernizzi1@unimi.it
[2] Department of Humanities, Cultural Heritage, Education Sciences, University of Foggia, 71100 Foggia, Italy; domenico.monacis@unifg.it (D.M.); dario.colella@unifg.it (D.C.)
* Correspondence: athos.trecroci@unimi.it

Abstract: Environments lacking in stimuli together with ineffective physical education programs can lead to motor illiteracy, causing several adverse effects that could be worsened by unhealthy weight conditions (e.g., obesity). Obesity can be seen as an actual barrier for children and adolescents, especially for affective, behavioral, physical, and cognitive domains. In this context, condensing what the literature proposes could be useful in order to improve the understanding of the best intervention strategies (i.e., proper physical education programs) to manage the adverse effects of motor illiteracy in relation to the obesity barrier. The purpose of this narrative review is to improve the understanding on how physical education programs can counteract the adverse effects of physical illiteracy and obesity barrier across childhood and adolescence. Proper physical education programs should develop motor competence by fostering an individual's awareness, self-perception, autonomous motivation, and muscular fitness on a realistic scenario (functional task difficulty related to his/her possibilities) in the attempt to counteract the adverse effects of the obesity barrier. Such programs should be designed without overlooking a proper multi teaching style approach.

Keywords: motor development; motor literacy; teaching styles; muscular fitness; self-determination theory

Citation: Trecroci, A.; Invernizzi, P.L.; Monacis, D.; Colella, D. Physical Illiteracy and Obesity Barrier: How Physical Education Can Overpass Potential Adverse Effects? A Narrative Review. *Sustainability* **2022**, *14*, 419. https://doi.org/10.3390/su14010419

Academic Editor: Jose Carmelo Adsuar Sala

Received: 21 November 2021
Accepted: 27 December 2021
Published: 31 December 2021

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

1. Introduction

Motor development includes different domains (i.e., physical, mental, and cognitive) that intersect to each other and influence a child's motor behavior. Motor behavior is the phenomenon of interest to be observed in motor development [1] providing direct information on the functional degree of a motor task, allowing a qualitative analysis of the movement. Specifically, the functional degree of a motor task encompasses the interplay between how challenging the task is, the skill level of the performer, and the condition under which the same task is performed [2]. This is different from the nominal degree of a motor task, which merely defines the task characteristics.

Motor behavior as well as its development can improve through continuous practice (e.g., continuous physical activity), which is responsible for constant improvement (motor learning) in the ability to perform a certain motor task. In accordance with the provisions of the World Health Organization, physical activity in children and adolescents is associated with improved physical, mental, and cognitive health outcomes as long as an average of 60 min per day of moderate-to-vigorous physical activity is met [3]. However, when dealing with children and adolescence, it would be too simplistic focusing on quantitative rather than qualitative aspects of physical activity (Brian et al., 2020). To use a similitude, it is as if we were telling a child to read at least 60 min per day to broaden his or her

vocabulary, which would probably be desirable. However, what would happen to his or her vocabulary if he or she continued to read the exact same book for a time ranging from pre-adolescence to adulthood? Presumably, it would lead to a low literacy, influencing a low extent of language and reading-comprehension skills as well as social skills [4] throughout the adulthood. Arguably, this unfavorable trend applies to a child's motor development.

In the context of movement assessment, going beyond the mere quantitative aspect (how much) without focusing on the qualitative aspect (how is it done) may be limiting other than anachronistic, regardless of the type of motor task involved. For example, given a jump-based activity (i.e., plyometrics), how informative would it be to know that a pre-adolescent meets the tailored guidelines (e.g., 1–3 sets x 6–10 reps twice per week on non-consecutive days)? [5]. This refers to the question "how much do you jump?" itself without informing on how the child is skilled and how the jumping activity is performed. Perhaps, obtaining information useful to infer his or her actual motor competence ("How do you jump?") and understanding what instructions he or she learned ("Do you know how to jump?") may be desirable [6]. Both the timing and the number of motor experiences along with the quality of the instruction (teaching style) (Malina, 2012) allow an individual, being surrounded by a positive environment, to enhance his or her motor behavior via an improved motor development [7–9].

In an appropriate environment, the earlier children learn, develop, and improve their motor behavior by a wide variety of motor skills, the more chances they have to overcome the proficiency barrier, thus creating positive effects on their physical activity and health status across the life span [6,9–12]. Conversely, children continuing to demonstrate poor development in multiple skills for a long time are likely to exhibit negative implications (e.g., unhealthy weight status) on health-related conditions by incurring cardiometabolic, musculoskeletal, cognitive, and psychosocial problems [13]. In this sense, obesity and overweight represent unhealthy conditions that could represent a barrier for children's present and future lifestyle, especially within an environment lacking in stimuli and intervention strategies that are not very effective in reducing their impact on motor development, raising their motor illiteracy. Motor illiteracy pertains to low levels of confidence, competence, and motivation in joining physical activity [13–15], and together with exercise deficit disorder and pediatric dynapenia (muscular weakness) constitute the pediatric inactivity triad [13]. The lack of motivation to continue with physical activity generates a cascade of negative effects not only related to weight gain (unhealthy weight conditions) and muscular weakness, but also to mental health with the onset of depressive symptoms [16]. In this context, the role of educational practitioners is crucial to promote a motivational learning climate to foster children and adolescents with unhealthy weights to engage more in physical activity [17] by appropriate physical education programs.

Although obesity and overweight represent a real epidemic in the youth population, the information on how motor development and motor behavior evolve over the course of pre-adolescence and adolescence is still fragmented and unclear, especially in the context of motor literacy domains (affective, behavioral, physical, and cognitive), teaching style, and training intervention. In this context, bringing some order by condensing what the literature proposes could be useful in order to improve the understanding of the whole phenomenon by trying to give qualitative-based indications (over quantitative) to clinicians and practitioners in the attempt to promote specific interventions and overcome potential adverse effects of the obesity barrier.

Therefore, the purpose of this narrative review is to empirically improve the understanding of how physical educations programs (based on motor development) can overpass potential adverse effects of motor illiteracy in relation to the obesity barrier across childhood and adolescence.

Search Methodology

In order to accomplish this narrative review: (i) We conducted a search of the literature drawing from the databases MEDLINE (pubmed) (n = 427), Web of Science (29), Scopus (n = 180), CINAHL (n = 291), and EMBASE (n = 116) as primary sources, and from Google Scholar (n = 5910) as secondary source. (ii) We identified appropriate keywords to find individual studies that were pertinent to the current aim of the review. The search used the terms "physical literacy" OR "teaching style" OR "physical education" AND "pediatric obesity." (iii) We reviewed abstracts and main texts immediately after all duplicates were removed. Specifically, the term "physical literacy" included those studies focusing on the affective and behavioral (n = 18 articles), physical (n = 14 articles), and cognitive (n = 19 articles) domains in an attempt to reach a comprehensive understanding of the state of literature science. Moreover, 18 articles linked to the terms "teaching style" were also included to this narrative review. The retrieved articles were further screened for specific inclusion criteria linked to the writing language (only articles published in English) and scientific soundness (only articles in refereed journals). (iv) We summarized and synthesized the overall 51 and 18 articles focusing on the physical literacy domains and teaching style, respectively, and integrated them into the main text, which was organized in sections following a narrative style [18].

2. Physical Illiteracy versus Physical Literacy

The term physical literacy includes a conceptual link between different domains afferent to the affective and behavioral, physical, and cognitive domains [14,19]. In short, a child is defined as physically literate if his/her development has followed a holistic path towards each single domain leading to motivation, confidence, sensitivity, and awareness of their own individual endowment or potential within multiple environments [14,19]. This condition, although not easy to achieve, is crucial to create a breeding ground for participation in physical activity by children and, consequently, further development of their physical literacy [20]. However, in the presence obesity and overweight, the achievement of adequate and appropriate levels of physical literacy are undermined, causing a cascade of negative effects equal and opposite (physical illiteracy) to those mentioned above within the affective, physical, cognitive, and behavioral domains. Children or adolescents that are physically illiterate manifest low levels of confidence, competence, and motivation that lead them to hardly engage in game-based activities with their peers, causing a drastic reduction in both qualitative and quantitative physical activity. In this circumstance, it can become a vicious cycle capable of bolstering the obesity barrier, thus hindering their ability to overcome this during their life span.

2.1. Affective and Behavioral Domain

The affective and behavioral domains are two sides of the same coin and contain multiple elements influencing a child's physical literacy [21]. In accordance with what has been previously summarized in the literature, those elements range from motivation and self-confidence to perception of motor competence and physical activity engagement [22]. In the case of an unhealthy weight status (with low level of perception), the affective domain could be in crisis by interfering with a young individual's lifestyle changes (e.g., initiation and retention of physical activity) [23]. This might be attributable to a high probability of dropout resulting from a sharp motivation [23,24]. At the same time, the perception of motor competence plays a key role in regulating the interplay between initiation and retention. The willingness to lose weight as well as the desire to improve physical condition are among the most important factors influencing the initiation of physical activity in children, whilst social interactions accompanied by an increase in self-esteem and self-confidence seem to be the main factors influencing the retention of physical activity [24].

Undoubtedly, obese children are less prone to undergo a new physical activity (ex novo) and hardly present high retention. According to some studies, perceived and actual motor competence play synergistic roles from which obese children can benefit [25,26]. In fact, a child with an optimal perceived motor competence can promote their physical activity with a gradual increase in their actual motor competence, greater motivation to continue exercising, and a consequent reduction in BMI [27–29]. The perception of motor competence develops during the school years and appears to be positively associated with actual motor competence [6,29–31]. Furthermore, it has been suggested that knowing perceived competence is an important psychological need underlying the achievement of optimal motivation in accordance with the self-determination theory.

Standage et al. [32] found that satisfaction of the need for competence (in physical education) is associated with a good quality of life for both physical and social dimensions in adolescents [32]. However, this is not enough to structurally change the motivation (autonomous motivation) of young individuals over time. In fact, being and perceiving oneself to be competent does not mean being autonomous or expressing self-determination [33]. Autonomy is linked to the qualitative measure of conduct (e.g., motor behavior) that is personally approved and undertaken with an intimately voluntary sense (autonomous motivation) rather than externally induced (when under pressure) [33,34]. Determining the "type" and "quality" of motivation can represent a further strategy in prompting obese and overweight children to be proactive towards a change in their lifestyle (or quality of life) and, consequently, in their physical literacy. Indeed, specific interventions should not ignore important elements associated with the process involved in adopting new behaviors (e.g., authentic interest in exercise and physical activity).

The effective and lasting internalization of new behaviors is necessary and can be conveyed by intervention strategies that explicitly support the development of autonomy on new behavioral models. For example, given the theoretical model of the Youth Physical Activity Promotion Model [35], predisposing factors (child's enjoyment and perception of physical competence) on physical activity retention could be determined in obese children and adolescents by offering them: (i) a choice between different options on content and activities to be carried out, ii) feedback on motor behavior (how to improve the activity), (iii) graded tasks (increasingly difficult, but achievable), and (iv) repeated practice or rehearsal of the activity (even in different contexts and times) [35]. All together, these elements harmonize to enhance children's enjoyment and their perception of physical competence to engage physical activity [36]. Likewise, the start of an activity in obese children can benefit from interventions that also consider the enabling factors (i.e., skill, fitness, proximity or access, and environment). Specifically, focusing on enhancing skills would help unhealthy weight children to obtain the quality-related prerequisites to be physically active (i.e., muscular strength), while also improving the physical domain of their physical literacy. Finally, interventions should be designed over the long term to build significant changes in motivational parameters as previously supported in literature [37].

2.2. Physical Domain

Developing skills and movement patterns in a wide range of physical activities and environmental settings is the foundation of the physical domain [19]. It has the aim not only to provide children with better motor behavior, but also to foster their readiness for increasing movement intensity and duration. In this wake, muscular strength can be considered one of the main prerequisites to get an individual physically active. However, given an increased sedentary conduct together with a reduced physical activity, a remarkable decline of temporal trends in muscular strength and power (i.e., dynapenia) has been observed in both modern-day children and adolescents [38].

The term dynapenia defines a physical condition in which a child presents reduced levels of muscle strength and power associated with functional limitations both in practicing sport-like (e.g., running and jumping) and daily gestures (e.g., moving weights and climbing stairs) [39]. For this reason, muscle strength may represent a marker of general

health in children, having a mitigating effect on cardiovascular risk [40,41]. This is because high levels of strength contribute for the improvement of energy expenditure by encouraging children to take a proactive approach to physical activity [40,41]. Otherwise, enormous difficulties could occur in fulfilling various types of motor tasks, due to worse muscle function associated with a potential decrease in self-efficacy and self-esteem in children, especially if they present unhealthy physical conditions (i.e., overweight and obesity).

Mostly, young obese or overweight individuals have lower physical activity levels, which affect their muscle fitness outcomes [42]. However, it should be noted that an extra mass could result in a positive training stimulus on skeletal muscle itself [43]. Of note, unhealthy weight individuals may be able to compensate for their degree of obesity (extra weight) by increasing levels of voluntary activation during a muscle action [44], which roughly reflects what occurs when an individual has to move additional load. Intuitively, the muscles are subjected to a greater load, inducing a neuromuscular system adaptation to the additional load (by the body weight) [43,44]. At first glance, it could represent a positive circumstance. However, the additional load produced by such a condition (i.e., obesity) is likely to cause high muscle fatiguability under exercise, resulting in a high energy cost during a movement. Interpreting the concept of "challenge point" [2], an obese child faces a motor task (climbing stairs or jumping a small obstacle) of low nominal value with increasing functional difficulty in relation to the duration of the task itself.

According to a previous systematic review, it was found that young obese children showed lower levels of lower limb performance on more dynamic gestures (e.g., long jump) than on those more static (e.g., leg extension) [42]. It appears that body weight is positively correlated with isometric muscle strength (e.g., hand grip strength) while it would be negatively correlated with the force expressed to move/lift the body (i.e., vertical jump) [41]. This could be explained by the fact that obese individuals also have reduced maximum muscle strength relative to body mass in their antigravity muscles compared to non-obese peers, which would support the greater strength of obese children in static motor tests and their lower explosiveness in dynamic motor tests than their non-obese peers [42]. Overall, it is suggested that without adequate levels of strength underlying dynamic activities (intimately connected with deliberate play), children and adolescents will be less vigorous and prone to participate with consequent difficulty in minding the gap with their healthy weight and stronger peers. Moreover, weight gain and reduced musculoskeletal fitness can have negative effects on mental health (e.g., reduced self-esteem and depressive symptoms). This vicious cycle, known by the term "pediatric depreobesity loop" [16], can be interrupted by acting precisely on musculoskeletal fitness. In fact, the increase in strength levels seems to have a contrasting effect on the deterioration of mental health [45].

In accordance with the ACSM guidelines, 1–3 sets of 6–15 repetitions performed 2–3 times a week on non-consecutive days seems to be an indication consistent with the needs of children and adolescents [46]. However, they remain quantitative guidelines (referring to "how much") without taking into account the qualitative methodological aspects (e.g., children versus adolescents). Furthermore, if taken individually, the quantitative guidelines tend to focus exclusively on increasing muscle strength. Given the complexity of the cascading effects leading to muscle weakness, it would be reductive to rely only on quantitative guidelines. In fact, both children and adolescents need to improve the quality of movement, proliferate their social networks, and promote healthy behaviors within a stimulating environment [47]. In this sense, Faigenbaum and MacFarland formulated seven fundamental principles of strength training in young people: (i) progression, (ii) regularity, (iii) overload, (iv) creativity, (v) enjoyment, (vi) socialization, and (vii) supervision [47]. These principles, if correctly balanced by practitioners or educational staff, can be selectively effective for both children and adolescents by providing them with all the psychomotor tools to overcome the "barrier of strength" [39] and its negative carryover effects. Indeed, principles such as creativity and enjoyment can help a child to develop

her/his motor behavior in a fun and engaging way at the same time, for example through the use of animal shapes [48]. Concurrently, principles such as socialization and regularity would enable adolescents to develop the prerequisite levels of muscle strength necessary to participate in games and various motor activities with confidence and long-term motivation over time [47].

2.3. Cognitive Domain

All the elements relating to the cognitive domain contribute to determining a child's knowledge and awareness of physical education as crucial elements for improving their health condition. In addition, it also reflects the ability to think, understand, and make decisions on how and when to adopt a certain motor behaviors (i.e., movement or skill). These are aspects to be considered in the context of a physical education program aimed at the development of physical literacy. However, it becomes even more important in children and adolescents who presents unhealthy weight conditions. In fact, obesity may potentially lead to a reduction in cognitive functions both at a structural and functional level [49]. Although there is no apparent clear-cut association between changes in BMI and cognitive function in young people [50], pediatric obesity appears to be associated with problems in visuo-spatial tasks [51], shifting and attention skills [52], and in executive functions [53]. Specifically, the latter are a set of functions related to mental control and self-regulation processes [53], which mainly include: (i) resisting distractions involving thinking before acting (i.e., inhibitor control), (ii) working mentally while holding information in mind (i.e., working memory), and (iii) managing demands and priorities within an unpredictable environment (i.e., cognitive flexibility) [54].

Evidence suggests that obese children may present deficits in inhibitory control, attention, and impulsivity due to altered/impaired regulation of several top-down neural connections [55]. Hsieh et al. [56] also found that reduced hours of physical and educational activity negatively affects working memory [56]. Similarly, it seems that the intensity of physical activity itself is a key factor associated with working memory [57]. This also seems to extend to cognitive flexibility. The results from the study by Khan et al. [58] indicate that obese children may show less cognitive flexibility in the face of greater demands for executive functions [58]. It is conceivable to state that in the context of physical activity where the environment is rich in stimuli, an obese child may find it more difficult due to an overall reduced level of executive functions compared to his healthy weight peers.

Given the extreme importance of these characteristics, obese children or adolescents should be considered as individuals with special needs also requiring equally special interventions in order to maximize their inclusion to movement [59], without affecting cognitive domain development. It is well-known how regular physical education intervention seems to have a positive effect on the cognitive domain both in children [60] and adolescents [60,61]. For example, an acute bout of 20–30 min of exercise was seen to positively affect inhibitory control and attention [62,63]. However, this may not be enough in obese individuals who are already strongly demotivated and less oriented to start physical activity for the sole purpose of moving. Moreover, in the context of a deliberate activity, an obese child would be in a position of inferiority compared to her/his healthy weight peer, who is likely to have a greater ability to think, understand, and make decisions knowing how and when to perform certain movements.

Therefore, it is possible that, compared to an ordinary physical education program, activities with stimuli based on the development of executive functions may be privileged in obese individuals, providing them with the adequate tools to positively influence their cognitive processes [55]. This type of interventions is known as "thinking movement" and are opposed to activities that involve movements per se [64]. According to Carnery et al. (2016), stimuli based on thinking movements should incorporate challenging activities that are enough to induce motor development within different environments [64]. Accordingly, integrative neuromuscular training may be a solution to develop

neurocognitive processing and visual-motor abilities based on movement (i.e., fundamental movement skills and motor control tasks) [65]. With this approach, an unhealthy weight child or adolescent would benefit from learning to focus on a task performance within a distractive environment, improving their attention. In this wake, a motor task of low nominal difficulty can be gradually internalized through a progressive increase of its functional difficulty [2].

Of note, all should be commensurate with the efficiency and motor behavior of the individual in relation to realistic solutions. In fact, asking an obese child or adolescent to switch from a forward roll on an inclined surface to one on a non-inclined surface is more realistic than switching directly to a front walkover. However, the potentiality of the integrative neuromuscular training or similar approaches (e.g., enriched sport program) [66] cannot be completely effective unless appropriate corrective and supportive feedback are delivered by qualified instructors [65], including the adopted teaching style.

3. Teaching Styles

At the basis of physical education in its pedagogical dimension, a teacher's teaching style is crucial in order to obtain positive effects on children's self-image [59]. The approach by which teachers develop their educational process has an impact on the way young individuals learn skills and acquire knowledge about themselves and the surrounding environment by improving their competence and confidence. Whatever educational intervention strategy is being adopted with obese children, it should be conveyed through a pedagogical child-centered process to create a motivational and favorable climate for the continuous exploration of motor development during physical activity. In fact, the acquisition of new skills is facilitated by social and often playful interactions. These social interactions do not refer only to the relationship with their peers, but also to the relationship with the teacher or educator who represents an important guide for developing new motor skills and competences [67]. According to Vygotsky's concept, a child may encounter difficulties in mastering more complex skills, and these difficulties can be overcome through the guidance and encouragement of the teacher, which is defined as the zone of proximal development [68] within the physical education context. This area becomes even more valuable with obese children or adolescents whose physical literacy is less developed.

In this context, teaching styles are effective for teaching multiple components of the activities incorporated in physical education. Within the spectrum of teaching styles, the reproductive one based on the "practice style" can encourage an obese child to work at their own pace accompanied by individual feedback from the teacher. This feedback help to consolidate a unique set of teacher-learner social behaviors associated with the practice itself [69]. However, if the teacher is not particularly motivated, this approach may not be effective. In fact, it has been seen how the teacher's intrinsic motivation can influence the style adopted to lead the child to learn [70]. A non-autonomously motivated teacher will tend to use a reproductive style more frequently [70]. Although the reproductive style can be useful in the physical education curriculum (e.g., in the practice style approach), its frequent use can be counterproductive because of the complexity of a child's physical literacy, which includes individual characteristics, ideas, and needs [71] along the affective, behavioral, and cognitive spheres.

Conversely, in the productive style, the teacher lets the child be at the foundation of the educational process. For instance, through specific approaches such as in the "guided discovery," the teacher asks a question (or plans a goal or poses a problem) and accompanies the child to discover the answer (or to reach the goal or solve the problem) by promoting a better motivational climate [72]. This discovery can occur in a convergent or divergent manner. In the convergent approach, a child is put in a position to find the answer by converging into a single solution. For example, the teacher may ask the child what the fastest way is to overcome an obstacle. In the case of a divergent approach, the child will have to find alternative solutions to overcome the obstacle by discovering which is

the actual fastest or slowest way. For example, the child tries to climb sideways or underneath it. In both cases, the teacher will give him support and feedback without showing the solution. Intuitively, this approach may be able to provide the child and adolescent with the tools to answer the questions "Do you know how to," reflecting a marked development of the affective, behavioral, cognitive, and physical domains, which is physical literacy. Summing up, how a young individual learns (becoming physically literate) may be improved through structured motor experiences that prompt them to choose a spectrum of motor actions on a regular basis while being supported by the teachers' ability to accommodate an optimal variation of teaching styles.

Of note, with an obese child, additional attention should necessarily be paid to specific elements so that the nominal difficulty of the motor task is not amplified or not too arduous in the attempt to avoid immediate discouragement and loss of self-confidence. Then, it is necessary to offer a safe, inclusive, and supportive approach to tackling obesity in childhood and adolescence [59] via a combination of general and practical recommendations. Specifically, a teacher should make adjustments to the physical education program to accommodate for an individual's body size or exercise tolerance (e.g., changing the height of the obstacle or its size in the aforementioned example) while helping him/her to feel good about their own body and to manage strengths and weakness [73].

4. Conclusions

Motor illiteracy embraces complications in the motor development (e.g., relating to competence and confidence decline) magnified by the presence of unhealthy conditions such as obesity, which represents an actual barrier. This condition can emphasize adverse effects within the affective/behavioral, physical, and cognitive domains that could bolster the obesity barrier itself. Physical education strategies that explicitly support the development of autonomy, motivation, and confidence concur to enhance an individual's enjoyment and perception of physical competence that can favor a continuous engagement in physical activity over the long term. In the wake of this, Figure 1 summarizes the main key points outlined in the current narrative review. This would contribute to tracing a proper course of action for educators and school personnel (i.e., teachers) in providing children and adolescents with the right tools to counteract potential adverse effects resulting from the obesity barrier. Given the importance of each domain of physical literacy, it would be appropriate to consider correct physical education programs/methodologies so that they can foster awareness (e.g., about the task to be performed), self-perception (with respect to one's body shape, in relation with others, and with the environment), and autonomous motivation, leading a child to approach physical activity (and continue it) with enthusiasm. These programs must also focus on more qualitative aspects that help an individual to achieve a certain motor competence according to his/her possibilities, which are mainly related to functional task difficulty. Among such programs, those focusing on improving muscular fitness appear appropriate for both children and adolescents. However, this operates on the condition that specific methodological principles are suitably applied. Lastly, teaching style appears to play a key role in managing the obese barrier in children and adolescents. The teacher must create a motivational and favorable climate for the continuous exploration of motor development during physical activity, being capable of adopting a multi-teaching approach based on an optimal mixture of productive and reproductive styles.

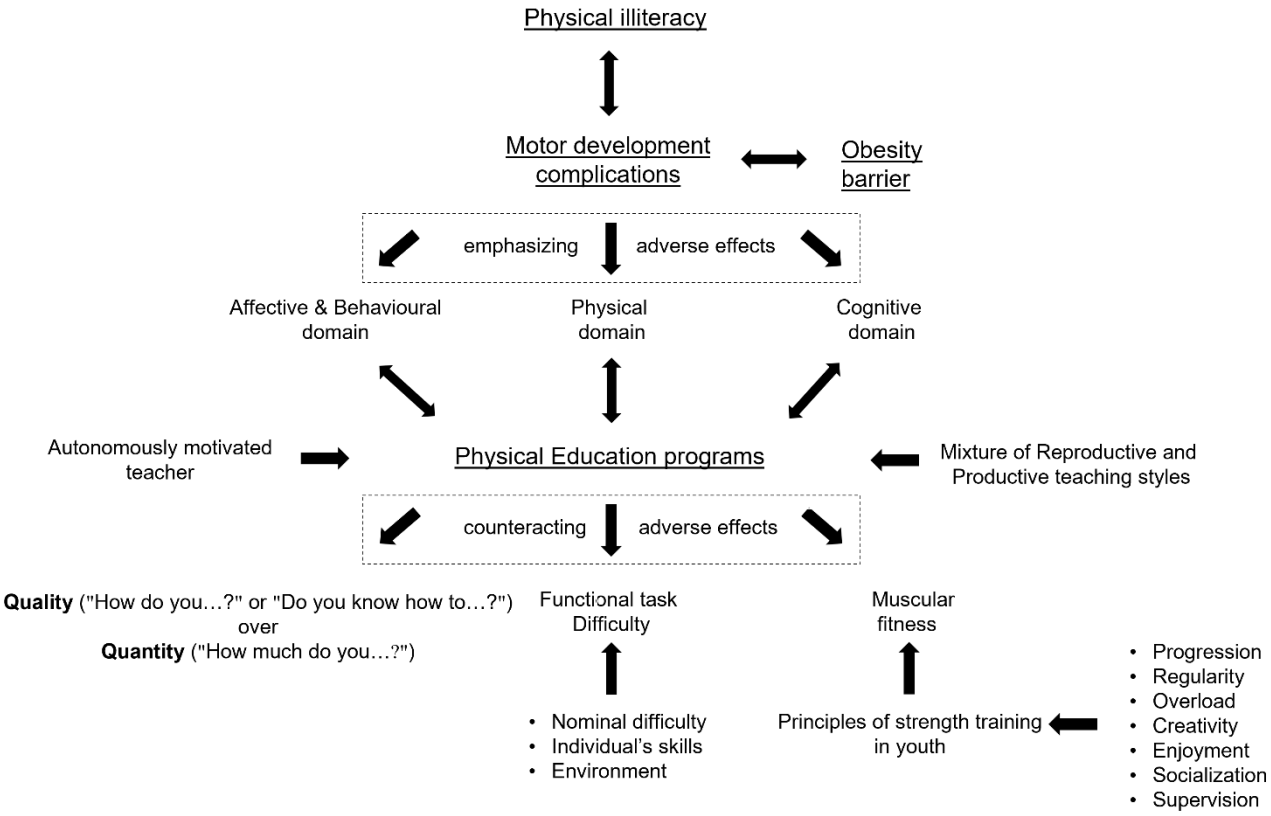

Figure 1. Schematic representation of the main key points outlined in the current narrative review.

Author Contributions: Conceptualization, A.T., P.L.I., and D.C.; methodology, A.T. and P.L.I.; formal analysis; writing—original draft preparation, A.T., P.L.I., D.M. and D.C.; visualization, A.T. and D.M.; supervision, P.L.I. and D.C. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Adolph, K.E.; Robinson, S.R. Motor Development. In *Handbook of Child Psychology and Developmental Science*; Lerner, R.M., Ed.; John Wiley & Sons, Inc.: Hoboken, NJ, USA, 2015; pp. 1–45, ISBN 9781118963418.
2. Guadagnoli, M.A.; Lee, T.D. Challenge Point: A Framework for Conceptualizing the Effects of Various Practice Conditions in Motor Learning. *J. Mot. Behav.* **2004**, *36*, 212–224, https://doi.org/10.3200/JMBR.36.2.212-224.
3. Bull, F.C.; Al-Ansari, S.S.; Biddle, S.; Borodulin, K.; Buman, M.P.; Cardon, G.; Carty, C.; Chaput, J.-P.; Chastin, S.; Chou, R.; et al. World Health Organization 2020 Guidelines on Physical Activity and Sedentary Behaviour. *Br. J. Sports Med.* **2020**, *54*, 1451–1462, https://doi.org/10.1136/bjsports-2020-102955.
4. Sparapani, N.; Connor, C.M.; McLean, L.; Wood, T.; Toste, J.; Day, S. Direct and Reciprocal Effects among Social Skills, Vocabulary, and Reading Comprehension in First Grade. *Contemp. Educ. Psychol.* **2018**, *53*, 159–167, https://doi.org/10.1016/j.cedpsych.2018.03.003.
5. Faigenbaum, A.D.; Chu, D.A. *Plyometric Training for Children and Adolescents*; American College of Sports Medicine; American College of Sports Medicine: Indianapolis, IN, USA, 2017.
6. Trecroci, A.; Invernizzi, P.L.; Monacis, D.; Colella, D. Actual and Perceived Motor Competence in Relation to Body Mass Index in Primary School-Aged Children: A Systematic Review. *Sustainability* **2021**, *13*, 9994, https://doi.org/10.3390/su13179994.

7. Invernizzi, P.; Crotti, M.; Bosio, A.; Cavaggioni, L.; Alberti, G.; Scurati, R. Multi-Teaching Styles Approach and Active Reflection: Effectiveness in Improving Fitness Level, Motor Competence, Enjoyment, Amount of Physical Activity, and Effects on the Perception of Physical Education Lessons in Primary School Children. *Sustainability* **2019**, *11*, 405, https://doi.org/10.3390/su11020405.
8. Lopes, L.; Santos, R.; Coelho-e-Silva, M.; Draper, C.; Mota, J.; Jidovtseff, B.; Clark, C.; Schmidt, M.; Morgan, P.; Duncan, M.; et al. A Narrative Review of Motor Competence in Children and Adolescents: What We Know and What We Need to Find Out. *Int. J. Environ. Res. Public Health* **2020**, *18*, 18, https://doi.org/10.3390/ijerph18010018.
9. Brian, A.; Getchell, N.; True, L.; De Meester, A.; Stodden, D.F. Reconceptualizing and Operationalizing Seefeldt's Proficiency Barrier: Applications and Future Directions. *Sports Med.* **2020**, *50*, 1889–1900, https://doi.org/10.1007/s40279-020-01332-6.
10. Colella, D.; D'arando, C. Teaching Styles and Outdoor Education to Promote Non-Linear Learning. *JPES* **2021**, *21*, 507–512.
11. Colella, D.; Monacis, D. Assessing the Evolution of Physical Fitness in Children and Adolescents for Evidence-Based Teaching. *Adv. Phys. Educ.* **2021**, *11*, 183–194, https://doi.org/10.4236/ape.2021.112014.
12. Seefeldt, V. *Developmental Motor Patterns: Implications for Elementary School Physical Education*; In *Psychology of Motor Behavior and Sport*; Nadeau, C., Holliwell, W., Roberts, G., Eds.; Human Kinetics: Champaign, IL, USA, 1980.
13. Faigenbaum, A.D.; Rial Rebullido, T.; MacDonald, J.P. The Unsolved Problem of Paediatric Physical Inactivity: It's Time for a New Perspective. *Acta Paediatr.* **2018**, *107*, 1857–1859, https://doi.org/10.1111/apa.14527.
14. Whitehead, M. Definition of Physical Literacy and Clarification of Related Issues. *Int. Counc. Sport Sci. Phys. Educ.* **2013**, *65*, 28–42.
15. Faigenbaum, A.D.; Rial Rebullido, T. Understanding Physical Literacy in Youth. *Strength Cond. J.* **2018**, *40*, 90–94, https://doi.org/10.1519/SSC.0000000000000417.
16. Chulvi-Medrano, I.; Villa-González, E.; Rial Rebullido, T.; Faigenbaum, A.D. The Impact of COVID-19 Quarantine on Youth: From Physical Inactivity to Pediatric Depreobesity. *J. Mov. Health* **2020**, *18*, https://doi.org/10.5027/jmh-Vol18-Issue1art100.
17. Lee, J.; Zhang, T.; Chu, T.; Gu, X. Effects of a Need-Supportive Motor Skill Intervention on Children's Motor Skill Competence and Physical Activity. *Children* **2020**, *7*, 21, https://doi.org/10.3390/children7030021.
18. Demiris, G.; Oliver, D.P.; Washington, K.T. *Behavioral Intervention Research in Hospice and Palliative Care: Building an Evidence Base*; Chapter 3—Defining and Analyzing the Problem; Academia Press: Cambridge, MA, USA, 2019; ISBN 9780128144497.
19. *Sport for Life Canadian's Physical Literacy Consensus Statement*; 2015.
20. Cornish, K.; Fox, G.; Fyfe, T.; Koopmans, E.; Pousette, A.; Pelletier, C.A. Understanding Physical Literacy in the Context of Health: A Rapid Scoping Review. *BMC Public Health* **2020**, *20*, 1569, https://doi.org/10.1186/s12889-020-09583-8.
21. Dudley, D.A. A Conceptual Model of Observed Physical Literacy. *Phys. Educ.* **2015**, *72*, 236–260, https://doi.org/10.18666/TPE-2015-V72-I5-6020.
22. Shearer, C.; Goss, H.R.; Boddy, L.M.; Knowles, Z.R.; Durden-Myers, E.J.; Foweather, L. Assessments Related to the Physical, Affective and Cognitive Domains of Physical Literacy Amongst Children Aged 7–11.9 Years: A Systematic Review. *Sports Med. Open* **2021**, *7*, 37, https://doi.org/10.1186/s40798-021-00324-8.
23. Woo, S.; Park, K.H. Motivating Children and Adolescents in Obesity Treatment. *J. Obes. Metab. Syndr.* **2020**, *29*, 260–269, https://doi.org/10.7570/jomes20026.
24. Pescud, M.; Pettigrew, S.; McGuigan, M.R.; Newton, R.U. Factors Influencing Overweight Children's Commencement of and Continuation in a Resistance Training Program. *BMC Public Health* **2010**, *10*, 709, https://doi.org/10.1186/1471-2458-10-709.
25. D'Hondt, E.; Deforche, B.; Vaeyens, R.; Vandorpe, B.; Vandendriessche, J.; Pion, J.; Philippaerts, R.; de Bourdeaudhuij, I.; Lenoir, M. Gross Motor Coordination in Relation to Weight Status and Age in 5- to 12-Year-Old Boys and Girls: A Cross-Sectional Study. *Int. J. Pediatr. Obes.* **2011**, *6*, e556–e564, https://doi.org/10.3109/17477166.2010.500388.
26. Khodaverdi, Z.; Bahram, A.; Stodden, D.; Kazemnejad, A. The Relationship between Actual Motor Competence and Physical Activity in Children: Mediating Roles of Perceived Motor Competence and Health-Related Physical Fitness. *J. Sports Sci.* **2016**, *34*, 1523–1529, https://doi.org/10.1080/02640414.2015.1122202.
27. Utesch, T.; Dreiskämper, D.; Naul, R.; Geukes, K. Understanding Physical (in-) Activity, Overweight, and Obesity in Childhood: Effects of Congruence between Physical Self-Concept and Motor Competence. *Sci. Rep.* **2018**, *8*, 5908, https://doi.org/10.1038/s41598-018-24139-y.
28. Valentini, N.C.; Nobre, G.C.; de Souza, M.S.; Duncan, M.J. Are BMI, Self-Perceptions, Motor Competence, Engagement, and Fitness Related to Physical Activity in Physical Education Lessons? *J. Phys. Act. Health* **2020**, *17*, 493–500, https://doi.org/10.1123/jpah.2019-0532.
29. De Meester, A.; Stodden, D.; Brian, A.; True, L.; Cardon, G.; Tallir, I.; Haerens, L. Associations among Elementary School Children's Actual Motor Competence, Perceived Motor Competence, Physical Activity and BMI: A Cross-Sectional Study. *PLoS ONE* **2016**, *11*, e0164600, https://doi.org/10.1371/journal.pone.0164600.
30. Spessato, B.C.; Gabbard, C.; Robinson, L.; Valentini, N.C. Body Mass Index, Perceived and Actual Physical Competence: The Relationship among Young Children: Perceived and Actual Physical Competence and Body Mass Index among Young Children. *Child Care Health Dev.* **2012**, *39*, 845–850, https://doi.org/10.1111/cch.12014.
31. Morrison, K.M.; Cairney, J.; Eisenmann, J.; Pfeiffer, K.; Gould, D. Associations of Body Mass Index, Motor Performance, and Perceived Athletic Competence with Physical Activity in Normal Weight and Overweight Children. *J. Obes.* **2018**, *2018*, 3598321, https://doi.org/10.1155/2018/3598321.

32. Standage, M.; Gillison, F. Students' Motivational Responses toward School Physical Education and Their Relationship to General Self-Esteem and Health-Related Quality of Life. *Psychol. Sport Exerc.* **2007**, *8*, 704–721, https://doi.org/10.1016/j.psychsport.2006.12.004.
33. Teixeira, P.J.; Silva, M.N.; Mata, J.; Palmeira, A.L.; Markland, D. Motivation, Self-Determination, and Long-Term Weight Control. *Int. J. Behav. Nutr. Phys. Act.* **2012**, *9*, 22, https://doi.org/10.1186/1479-5868-9-22.
34. Buttitta, M.; Rousseau, A.; Guerrien, A. A New Understanding of Quality of Life in Children and Adolescents with Obesity: Contribution of the Self-Determination Theory. *Curr. Obes. Rep.* **2017**, *6*, 432–437, https://doi.org/10.1007/s13679-017-0281-8.
35. Demetriou, Y.; Bachner, J. A School-Based Intervention Based on Self-Determination Theory to Promote Girls' Physical Activity: Study Protocol of the CReActivity Cluster Randomised Controlled Trial. *BMC Public Health* **2019**, *19*, 519, https://doi.org/10.1186/s12889-019-6817-y.
36. Seabra, A.C.; Maia, J.; Seabra, A.F.; Welk, G.; Brustad, R.; Fonseca, A.M. Evaluating the Youth Physical Activity Promotion Model Among Portuguese Elementary Schoolchildren. *J. Phys. Act. Health* **2013**, *10*, 1159–1165, https://doi.org/10.1123/jpah.10.8.1159.
37. Saavedra, J.M.; García-Hermoso, A.; Escalante, Y.; Domínguez, A.M. Self-Determined Motivation, Physical Exercise and Diet in Obese Children: A Three-Year Follow-up Study. *Int. J. Clin. Health Psychol.* **2014**, *14*, 195–201, https://doi.org/10.1016/j.ijchp.2013.12.001.
38. Chulvi-Medrano, I.; Pombo, M.; Saavedra-García, M.Á.; Rebullido, T.R.; Faigenbaum, A.D. A 47-Year Comparison of Lower Body Muscular Power in Spanish Boys: A Short Report. *J. Funct. Morphol. Kinesiol.* **2020**, *5*, 64, https://doi.org/10.3390/jfmk5030064.
39. Faigenbaum, A.D.; MacDonald, J.P. Dynapenia: It's Not Just for Grown-Ups Anymore. *Acta Paediatr.* **2017**, *106*, 696–697, https://doi.org/10.1111/apa.13797.
40. Albornoz-Guerrero, J.; Zapata-Lamana, R.; Reyes-Molina, D.; Cigarroa, I.; García Pérez de Sevilla, G.; García-Merino, S. Overweight/Obese Schoolchildren with Low Muscle Strength Have a Lower Cardiorespiratory Capacity and Greater Cardiovascular Risk: Results of the School Health Survey of the Extreme South of Chile 2019. *Children* **2021**, *8*, 734, https://doi.org/10.3390/children8090734.
41. He, H.; Pan, L.; Du, J.; Liu, F.; Jin, Y.; Ma, J.; Wang, L.; Jia, P.; Hu, Z.; Shan, G. Muscle Fitness and Its Association with Body Mass Index in Children and Adolescents Aged 7–18 Years in China: A Cross-Sectional Study. *BMC Pediatr.* **2019**, *19*, 101, https://doi.org/10.1186/s12887-019-1477-8.
42. Thivel, D.; Ring-Dimitriou, S.; Weghuber, D.; Frelut, M.-L.; O'Malley, G. Muscle Strength and Fitness in Pediatric Obesity: A Systematic Review from the European Childhood Obesity Group. *Obes. Facts* **2016**, *9*, 52–63, https://doi.org/10.1159/000443687.
43. Tomlinson, D.J.; Erskine, R.M.; Morse, C.I.; Winwood, K.; Onambélé-Pearson, G. The Impact of Obesity on Skeletal Muscle Strength and Structure through Adolescence to Old Age. *Biogerontology* **2016**, *17*, 467–483, https://doi.org/10.1007/s10522-015-9626-4.
44. Garcia-Vicencio, S.; Coudeyre, E.; Kluka, V.; Cardenoux, C.; Jegu, A.-G.; Fourot, A.-V.; Ratel, S.; Martin, V. The Bigger, the Stronger? Insights from Muscle Architecture and Nervous Characteristics in Obese Adolescent Girls. *Int. J. Obes.* **2016**, *40*, 245–251, https://doi.org/10.1038/ijo.2015.158.
45. Westcott, W.L. Resistance Training Is Medicine: Effects of Strength Training on Health. *Curr. Sports Med. Rep.* **2012**, *11*, 8. Available online: https://journals.lww.com/acsm-csmr/Fulltext/2012/07000/Resistance_Training_is_Medicine__Effects_of.13.aspx (accessed date: 20 November 2021)
46. Faigenbaum, A.D.; Micheli, L. *Youth Strength Training*; American College of Sports Medicine: Indianapolis, IN, USA, 2017. Available online: https://www.acsm.org/docs/default-source/files-for-resource-library/smb-youth-strength-training.pdf (accessed date: 20 November 2021)
47. Faigenbaum, A.D.; McFarland, J.E. Resistance Training for Kids: Right from the Start. *ACSMS Health Fit. J.* **2016**, *20*, 16–22, https://doi.org/10.1249/FIT.0000000000000236.
48. Radnor, J.M.; Moeskops, S.; Morris, S.J.; Mathews, T.A.; Kumar, N.T.A.; Pullen, B.J.; Meyers, R.W.; Pedley, J.S.; Gould, Z.I.; Oliver, J.L.; et al. Developing Athletic Motor Skill Competencies in Youth. *Strength Cond. J.* **2020**, *42*, 54–70, https://doi.org/10.1519/SSC.0000000000000602.
49. Wang, C.; Chan, J.S.Y.; Ren, L.; Yan, J.H. Obesity Reduces Cognitive and Motor Functions across the Lifespan. *Neural Plast.* **2016**, *2016*, 1–13, https://doi.org/10.1155/2016/2473081.
50. Anderson, Y.C.; Kirkpatrick, K.; Dolan, G.M.S.; Wouldes, T.A.; Grant, C.C.; Cave, T.L.; Wild, C.E.K.; Derraik, J.G.B.; Cutfield, W.S.; Hofman, P.L. Do Changes in Weight Status Affect Cognitive Function in Children and Adolescents with Obesity? A Secondary Analysis of a Clinical Trial. *BMJ Open* **2019**, *9*, e021586, https://doi.org/10.1136/bmjopen-2018-021586.
51. Jansen, P.; Schmelter, A.; Kasten, L.; Heil, M. Impaired Mental Rotation Performance in Overweight Children. *Appetite* **2011**, *56*, 766–769, https://doi.org/10.1016/j.appet.2011.02.021.
52. Cserjési, R.; Molnár, D.; Luminet, O.; Lénárd, L. Is There Any Relationship between Obesity and Mental Flexibility in Children? *Appetite* **2007**, *49*, 675–678, https://doi.org/10.1016/j.appet.2007.04.001.
53. Liang, J.; Matheson, B.E.; Kaye, W.H.; Boutelle, K.N. Neurocognitive Correlates of Obesity and Obesity-Related Behaviors in Children and Adolescents. *Int. J. Obes.* **2014**, *38*, 494–506, https://doi.org/10.1038/ijo.2013.142.
54. Diamond, A. Effects of Physical Exercise on Executive Functions: Going beyond Simply Moving to Moving with Thought. *Ann. Sports Med. Res.* **2015**, *2*, 1011. Available online: https://pubmed.ncbi.nlm.nih.gov/26000340/ (accessed date: 20 November 2021)

55. Reyes, S.; Peirano, P.; Peigneux, P.; Lozoff, B.; Algarin, C. Inhibitory Control in Otherwise Healthy Overweight 10-Year-Old Children. *Int. J. Obes.* **2015**, *39*, 1230–1235, https://doi.org/10.1038/ijo.2015.49.
56. Hsieh, S.-S.; Fung, D.; Tsai, H.; Chang, Y.-K.; Huang, C.-J.; Hung, T.-M. Differences in Working Memory as a Function of Physical Activity in Children. *Neuropsychology* **2018**, *32*, 797–808, https://doi.org/10.1037/neu0000473.
57. Mora - Gonzalez, J.; Esteban - Cornejo, I.; Cadenas - Sanchez, C.; Migueles, J.H.; Rodriguez - Ayllon, M.; Molina - García, P.; Hillman, C.H.; Catena, A.; Pontifex, M.B.; Ortega, F.B. Fitness, Physical Activity, Working Memory, and Neuroelectric Activity in Children with Overweight/Obesity. *Scand. J. Med. Sci. Sports* **2019**, *29*, 1352–1363, https://doi.org/10.1111/sms.13456.
58. Khan, N.; Raine, L.; Drollette, E.; Scudder, M.; Pontifex, M.; Hillman, C. Differences in Cognitive Flexibility between Healthy Weight and Obese Children: An ERP Study (629.6). *FASEB J.* **2014**, *28: 629.6*.
59. Pop, C. Physical Activities for Overweight and Obese Children–an Inclusive Approach. *Procedia Soc. Behav. Sci.* **2014**, *163*, 142–147, https://doi.org/10.1016/j.sbspro.2014.12.299.
60. Sun, X.; Li, Y.; Cai, L.; Wang, Y. Effects of Physical Activity Interventions on Cognitive Performance of Overweight or Obese Children and Adolescents: A Systematic Review and Meta-Analysis. *Pediatr. Res.* **2021**, *89*, 46–53, https://doi.org/10.1038/s41390-020-0941-3.
61. Gameiro, F.; Rosa, B. Risks of Obesity in Adolescence: The Role of Physical Activity in Executive Functions. *Obesities* **2021**, *1*, 101–106, https://doi.org/10.3390/Obesities1020009.
62. Hillman, C.H.; Pontifex, M.B.; Raine, L.B.; Castelli, D.M.; Hall, E.E.; Kramer, A.F. The Effect of Acute Treadmill Walking on Cognitive Control and Academic Achievement in Preadolescent Children. *Neuroscience* **2009**, *159*, 1044–1054, https://doi.org/10.1016/j.neuroscience.2009.01.057.
63. Palmer, K.K.; Miller, M.W.; Robinson, L.E. Acute Exercise Enhances Preschoolers' Ability to Sustain Attention. *J. Sport Exerc. Psychol.* **2013**, *35*, 433–437, https://doi.org/10.1123/jsep.35.4.433.
64. Cairney, J.; Bedard, C.; Dudley, D. Towards a Physical Literacy Framework to Guide the Design, Implementation and Evaluation of Early Childhood Movement-Based Interventions Targeting Cognitive Development. *Ann. Sports Med. Res.* **2016**, *3*, 1073. Available online: https://www.jscimedcentral.com/SportsMedicine/sportsmedicine-3-1073.pdf (accessed date: 20 November 2021)
65. Myer, G.D.; Kushner, A.M.; Faigenbaum, A.D.; Kiefer, A.; Kashikar-Zuck, S.; Clark, J.F. Training the Developing Brain, Part I: Cognitive Developmental Considerations for Training Youth. *Curr. Sports Med. Rep.* **2013**, *12*, 7. Available online: https://pubmed.ncbi.nlm.nih.gov/24030303/ (accessed date: 20 November 2021)
66. Gentile, A.; Boca, S.; Şahin, F.N.; Güler, Ö.; Pajaujiene, S.; Indriuniene, V.; Demetriou, Y.; Sturm, D.; Gómez-López, M.; Bianco, A.; et al. The Effect of an Enriched Sport Program on Children's Executive Functions: The ESA Program. *Front. Psychol.* **2020**, *11*, 657, https://doi.org/10.3389/fpsyg.2020.00657.
67. Yogman, M.; Garner, A.; Hutchinson, J.; Hirsh-Pasek, K.; Golinkoff, R.M.; Committee on Psychosocial Aspects of Child and Family Health.; Council on Communications and Media. The Power of Play: A Pediatric Role in Enhancing Development in Young Children. *Pediatrics* **2018**, *142*, e20182058, https://doi.org/10.1542/peds.2018-2058.
68. Vygotsky, L.S. Play and Its Role in the Mental Development of the Child. *Sov. Psychol.* **1967**, *5*, 6–18, https://doi.org/10.2753/RPO1061-040505036.
69. Mosston, M.; Ashworth, S. *Teaching Physical Education*; Benjamin-Cummings Pub Co: San Francisco, CA, USA, 2002.
70. Hein, V.; Ries, F.; Pires, F.; Caune, A.; Emeljanovas, A.; Ekler, H.; Valantiniene, I. The Relationship between Teaching Styles and Motivation to Teach among Physical Education Teachers. *J. Sports Sci. Med.* **2012**, *11*, 123–130. Available online: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3737859/ (accessed date: 20 November 2021)
71. Chow, J.Y.; Davids, K.; Hristovski, R.; Araújo, D.; Passos, P. Nonlinear Pedagogy: Learning Design for Self-Organizing Neurobiological Systems. *New Ideas Psychol.* **2011**, *29*, 189–200, https://doi.org/10.1016/j.newideapsych.2010.10.001.
72. Morgan, K.; Kingston, K.; Sproule, J. Effects of Different Teaching Styles on the Teacher Behaviours That Influence Motivational Climate and Pupils' Motivation in Physical Education. *Eur. Phys. Educ. Rev.* **2005**, *11*, 257–285, https://doi.org/10.1177/1356336X05056651.
73. Cale, L.; Harris, J. 'Every Child (of Every Size) Matters' in Physical Education! Physical Education's Role in Childhood Obesity. *Sport Educ. Soc.* **2013**, *18*, 433–452, https://doi.org/10.1080/13573322.2011.601734.