

Relationship between dynamic balance and writing skills in preschool

INTA BULA-BITENIECE¹, MAKSIMS KORNEJEVS², RENARS LICIS³, RIHARDS LEJA⁴, RODRIGO LAVINS⁵, ROBERTS RADICUKS⁶

^{1,6}, Department of Sport and Training Theory, Latvian Academy of Sport Education, Riga, LATVIA

², Riga 213. Preschool, Riga, LATVIA

^{3,4,5}, Department of Sport and Training Theory, Latvian Academy of Sport Education, Riga, LATVIA

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Abstract:

At the end of preschool, a child must be able to read short and important words, write elements of written letters, as well as be able to hold and use writing tools correctly. Sufficient movement development plays an important role in the child's later life and allows the child to participate in activities that promote his or her physical and cognitive development. This practical study was divided into three parts. The first part was a test of literacy and dynamic balance before performing balance exercises. In the second part, dynamic balance exercises were performed for three weeks. The third part involved a test of writing and dynamic balance - after performing dynamic balance exercises. The writing tests before and after the dynamic balance exercises were identical, in order to examine the effect of carrying out a set of exercises over a three-week period on the completion of the same written task. Given that children's attention at this age is still volatile, the challenges were short. Other age characteristics that would affect children's performance have also been considered. 26 children participated in the case study, and 20 of them participated in both exercises. The mean number of errors in the dynamic balance test decreased by 3.3, while in the writing skill test - by 3.5. The range of errors in the dynamic balance tests before the experiment was 3–16, but after the experiment - 1-14, while in the writing skill tests the number of errors before the experiment was 1-12, but afterwards - 1-8. It is concluded that in learning the exact execution of basic movements, the regularity, purposeful activity of the teacher, as well as the variety of classes are important in improving the results - additional purposeful activities affect the development of both physical and cognitive skills, as well as improve the ability to perform movements accurately.

Key Words: physical activities, coordination, writing, preschool child

Introduction

Starting primary school is a remarkable event for a child as it marks the beginning of a period of great change in a person's life. Opinions differ on what a child should know at this age. Although there are parents and professionals who believe that a child should not be able to read and write because school will teach it, practice shows that textbooks are already used extensively in first grade and that the learning process is slower and more complicated for children whose reading and writing skills are underdeveloped.

At the end of preschool, the child must be able to read short, important words, write elements of written letters, as well as be able to hold and use writing tools correctly (Education for Modern Skills: A Description of Curriculum and Approach (2017). This means that today's education professionals believe that basic reading and writing skills are important when starting primary school. Moreover, literacy is the basis for the further development of text comprehension skills, which is an essential transversal skill, not only for language, but for all subjects.

This highlights an important question for pre-school teachers: how does one achieve the successful acquisition of the basics of literacy in pre-school? There are studies on this topic that try to find an answer to this topical question (Gerde, Bingham & Wasik, 2012; Al Otaiba et al., 2012; Axelsson, Lundqvist & Sandberg, 2019, Pellegrini P., Donzilli L., 2016). It can be argued that there is no single main influencing factor, but there are many different stimulating conditions and factors that can contribute to the development of writing skills. This study focuses on the relationship between balance development and physical activity, and successful literacy development.

Goal of the research: Find relationships between dynamic balance and writing to promote preschool literacy.

Sufficient movement development plays an important role in the child's later life and allows the child to participate in activities that promote his or her physical and cognitive development (Barton et al., 1999; Goudas, Giannoudis, 2008). Balance is controlled from the Central Nervous System (CNS) that receives a signal from the somatosensory system and processes the information, consequently, the balance of the body is maintained (Alpay & Işık, 2017). Fine motor skills are critical to the health and development, particularly in preschool age,

where brain plasticity is conducive to learning in all sectors (Valentini & Lamanna, (2018). Children need to be allowed to move as much as they want; an active lifestyle must be encouraged to meet their need for movement, which further affects not only their future physical activity, but also their cognitive functioning, including the development of literacy.

Balance is divided into static and dynamic balance. The process of muscle coordination takes place to promote balance. Its good development requires the mobilisation of all sensory systems, the provision of frequent movement activities and all the necessary resources to secure them, setting an example for children, and demonstrating such with both movements and words, providing an assessment and paying close attention to the technically correct execution of movements.

Balance means maintaining a stable position, and it can be considered an essential skill, as it helps a person to perform various movements and activities and indicates good physical development of the body. The ability of 5–6-year old children to perform various jumps, balance on one leg, walk on a bench and perform other exercises is based on the ability to maintain balance. Balance can be at different levels of development, but all children should basically be able to maintain balance on one leg, further varying and combining movements according to their ability and the specifics of their present development.

Maintaining a stable position is important, but due to the structure of the body, it can be a challenging task. About two-thirds of our body weight, including very delicate organs, is unsafely balanced at a certain distance from the ground on two thin structures, or legs, which provide a very limited support base. This is critical for the postural or posture-balance control system. Balance is integral to the safe execution of most movements (Winter et al., 1990). Difficulties in maintaining balance can be considered a very serious problem that interferes with the successful functioning of a person.

Stability skills form a fundamental group of skills that can be divided into two types: stationary balance (the ability to maintain a stable support base with minimal disturbance to movement) and dynamic balance (the ability to maintain a stable body position in motion) (Winter et al., 1990). Both types of balance are essential to increase the range of human functional activity.

Several researchers have found that girls perform significantly better in activities that require balance (Al-Haroun, 1998; Malina et al., 2004; Lam, 2008). Although research is ambiguous and cannot be considered as a determining factor in assessing boys' and girls' balance skills, it should be borne in mind that poor balance can lead to learning problems, as adequate balance allows the child to sit still (Cheatum & Hammond, 2000). Also, in a preschool educational institution, when acquiring writing skills, the child must be able to sit still for a certain period to be able to concentrate on holding, coordinating and, as a result, writing letters. This means that, although it cannot be said that boys have worse balance than girls, this possible case must be considered for the child to receive the necessary support. Regular and continuous monitoring is required to detect and respond to disturbances.

The posture and balance control system consists of several subsystems:

- Sensory system consisting of the vestibular, visual and proprioceptive system;
- Central nervous system (CNS);
- Musculoskeletal system (Winter et al., 1990).

The process of writing is complicated in terms of organisation of the brain, as it requires the coordination of thinking and formulation of thought with the action of the fine arm muscles. This requires the active use of intellectual abilities. The coordinated fine and precise finger movements required for writing develop well when the child prepares the hand for writing with the help of special classes, when the child colours, draws, embroiders, cuts out and trains the tiny finger muscles in other ways. In addition, the good development of these muscles also affects language, as the language centres responsible for language perception, comprehension and use in speech are developed (Sénéchal, & Le Fevre, 2002).

The first stage of writing is to connect the dots, draw the lines and fill in the areas. Writing skills involve the ability to write letters that require thinking and fine muscle coordination. Their development not only requires the intensive use of intellectual abilities, but also the development of fine muscles and coordination. During preparation for writing skills, the system of hand muscle movements, ability to coordinate and regulate movements, as well as sense of rhythm is developed. The beginning of writing involves colouring, connecting dots and drawing, and it requires muscle and eye coordination, which initially develops best with balance training. The positive effects of drawing include the coordination of visual and mechanical analysers and the strengthening of fine muscles. In the pre-ABC phase, preparations are made for the development of writing skills, with an emphasis on the process rather than the result, developing the muscles of the little fingers, the coordination of movements, regulation, and a sense of rhythm.

Motor development is an active process that is closely linked to cognitive activity. In physical activity, it is recommended to focus on how the body should move in activities where fine motor skills are used (Gallahue & Cleland, 2003).

Summarising the information offered by Maria Montessori (1969), Kathy Austin (2016) and Ina Sternfelde (2016), a system of recommendations for the development of writing skills has been created:

- Use of appropriate games and movement games in pre-school - finger games are the most well-known.

- Performing creative and figurative works, where fine finger muscles are used - paper cutting, tearing, yarn winding, braiding, embroidery, making shapes with plasticine, clay, plastic, finger drawing, ornament drawing, dot to dots, etc.
- Work with various materials (water, sand, beans, buttons, yarn, thread) - casting, throwing, turning, grouping, counting, winding, braiding, etc.
- Targeted exercises - the correct use of stationery to circle objects on paper, colouring to fill in a figure, drawing lines, and drawing according to a pattern.

In the child's mind, these activities and exercises do not involve writing, but they prepare the hand well so that the beginning to write is not too difficult and does not spoil the joy of writing. The child unconsciously learns to control the hand and its movements, and this provides great support in the process of learning to write.

The practical research should consider the fact that children can and should be encouraged to perform complex activities, but should consider previous preparation and rest breaks as well as the individual abilities of each child, so group research should be carried out to determine the current development of movements, as well as the possible difficulties in performing the exercises. For this purpose, a follow-up test is organised to observe the children in action and to find out what their current abilities and skills are.

After the follow-up test, it is necessary to carefully plan the classes, control their course and correct the children's activities to achieve the accurate execution of movements and not to form incorrect movement habits, as they form the basis for performing movements throughout life.

To develop balance, basic movement exercises can be used - walking, running, jumping, crawling, and throwing.

For the more successful development of balance in classes it is recommended to use music, rhythm, activate sensory systems - touch, hearing, vision. This means that audio and visual materials should be included in the class plan, as well as the performance of exercises should be supplemented with aids that ensure a sensory experience.

Many and varied techniques are available both for the development of balance and writing, which can be implemented frequently and in different ways so as not to bother the child, while at the same time ensuring the acquisition of movements.

Material and Methods

The practical study is divided into three parts. The first part involves taking a test of literacy and dynamic balance before performing balance exercises. In the second part, dynamic balance exercises are performed for three weeks. The third part involves taking a test of writing and dynamic balance after performing dynamic balance exercises. The writing tests before and after the dynamic balance exercises are designed to be identical, examining the effect of completing a set of exercises over a three-week period on the completion of the same written task. Given that children's attention at this age is still sporadic, the challenges are short in duration. Other age characteristics that would affect children's performance have also been considered.

26 children participated in the case study, and 20 of them participated in both exercises. These children have also attended all the activities included in the set of exercises; therefore, their performance can be assessed as adequate for the successful completion of the study.

The dynamic balance tests before and after the execution of the set of exercises were developed according to the method of the Maria Montessori ellipse.

Writing skills are examined in a control exercise - by drawing and joining lines.

Results are analysed with attention placed on line accuracy and the number of errors.

Balance was examined by carrying out a balance exercise – assessing the number of errors before and after the execution of the set of exercises. By determining the number of errors at the beginning and the end of an experiment, it was possible to collect the results and to conclude whether the results were better, worse, or the same.

After analysing the individual results, the mean value was calculated.

To test the normality of data distribution, the Shapiro-Wilk test was performed. After this procedure the Student's T-test was next, which is the most common test to recognise the statistical significance in differences between two group mean values.

In the case if data are not normally distributed, and a comparison between the mean values of two samples is required, the unpaired two-samples Wilcoxon test should be performed. In data processing the method of correlation was also used to ascertain whether there is a positive correlation between dynamic balance and writing skills.

Results

During dynamic balance and literacy tests, the number of errors is recorded and a comparison is made of each child's performance before and after a set of exercises.

Considering the large differences in test performance, changes in the development of all the children's skills were compared.

Changes in the number of errors in the test of dynamic balance

For most children, the result improved; for two it remained the same as it was, but at a high level (1-2 errors), while the result for one child deteriorated. In general, the trends indicate that the performance of the set of exercises helped to improve the ability to maintain balance and perform dynamic balance exercises. The improvement in the result is not the same; it ranges from a reduction of 1 error to a reduction of 7 errors, which indicates the effect of other factors on children's performance. Extensive observation and research of individual development is needed to determine exactly which factors have been affected.

Changes in the number of errors in the writing test

The results of the writing test for most children also improved, proving the effectiveness of the set of exercises. One child's score remained the same (10 errors), while all others had improvements ranging from a reduction of 1 error to a reduction of 9 errors. Also in this test, large differences in the dynamics of change are observed, indicating the presence of other influencing factors. It is acceptable for the dynamics of children's development to differ due to circumstances that are not observed in the preschool educational institution, depending on the individual physical and cognitive characteristics of each child, as well as on the family environment and its impact. Influencing these factors is not within the competence of the preschool teacher, but it is undeniable that the implementation of the set of exercises promotes children's development and is therefore feasible daily, using such to improve both dynamic balance and writing skills.

It can be concluded that the performance of almost all children improved in both tests. The relationship between children's performances did not change much - those who showed the best results at the beginning made fewer mistakes at the end.

Comparing the results of the writing test and the dynamic balance test, a correlation is repeated, which confirms that different development areas are interrelated.

Dynamic balance and writing results after the experiment

The test results after the experiment still show a correlation, but it is not as pronounced as at the beginning of the experiment. It can be concluded that the results improved at different rates and depend not only on the performance of the set of exercises, but also on other factors not observed and summarised in this study. This confirms that children's development is influenced by a variety of factors, not just one, so the level of development and dynamics of children in the same family or, in this case, in one preschool education group, can vary greatly.

Using the data processing program RStudio, the arithmetic mean results of both tests before and after the approbation of the set of exercises were calculated, and the obtained results are shown in the table for comparison (see Table 1).

Table 1

Mean number of errors in tests

	Dynamic balance test		Test of writing skills	
	Pre	Post	Pre	Post
AM	7.32	4	8.91	5.44
SD	2.13	0.45	2.43	1.65

There is an improvement in the mean result, which confirms that the performance of the set of exercises helped the children to improve their performance in both the physical test and in the test of writing skills.

Shapiro-Wilk test was performed during data processing, which shows whether the data corresponding to the continuous variable is normally distributed or not. If the result of the Shapiro-Wilk test is greater than 0.5, then the variable may be normally distributed.

According to the Shapiro-Wilk test, one point does not correspond to the normal distribution, so a Wilcoxon test is performed, which shows how much the arithmetic mean decreased. (Wilcoxon p-value = 0.0001335) After that the T-test was performed, and the Shapiro-Wilk test corresponds to the normal distribution. T-value p-value = 8.612e-06.

After the Wilcoxon test, the first results were processed before the set of exercises was performed, as the Shapiro-Wilk test showed that some data did not correspond to the normal distribution. The results after the set of exercises were processed with the T-test, as the background data processing was in accordance with the normal distribution.

Discussion

At the age of 5-6-years old, children are expected to be able to perform more complex activities, such as maintaining balance on one leg (Dosman, Andrews & Goulden, 2012). In this study, the emphasis is on dynamic equilibrium, where the expected result is to keep the balance in motion rather than when static, so this criterion is not adaptable, and the different performance in complex exercises shows that children's ability to perform more complex activities is ambiguous. The factors influencing performance should be further explored and discussed. According to Igors Puskarevs (2001), not all children have well-developed self-control. The development of self-control could be one of the factors in the development of dynamic balance, which influences the performance of

more complex exercises. It can be assumed that not all children are subject to the same criteria, but that an observation must be made, considering the dynamics and achievements of each child's personal development, and also gender plays role (Sayanti Banerjee & Sandip Sankar Gosh (2021), Sandip Sankar Ghosh et al, 2022). The endurance of good balance forms with the development of all sensory organs (Karlovska, 2017, Klavina et al, 2017). Children not only performed a specific balance exercise, but also combined it with visual, hearing, and tactile triggers not only creating an exciting and stimulating environment for the exercise, but also, based on the opinion of R. Karlovska (2017), promoting a long-lasting sense of balance. It was observed that the quality of exercises performed by children improved, especially when doing the same exercise repeatedly every day. If in the first classes the teacher had to frequently correct the performance of the exercises and their accuracy, then in the last week they not only had to issue far fewer reprimands, but the explanation of the exercises itself was no longer necessary. The children, who had missed a class, also remembered what to do, especially if they could observe the rest of the activity. With this in mind, the teacher invited those children who arrived after an absence of at least one day to stand at the end of the row to follow the example of the others.

Conclusions

The spheres of development are interconnected; therefore, the peculiarities of other aspects are also significant for the purposeful promotion of one aspect. The pre-school stage is known as the most important in the child's development because it lays the foundations for the entire future development process. The age of 5-6 is characterised by the development of the body's coordination, balance, and the ability to perform more complex exercises, high movement activity, as well as by the rapid development of speech, the need to imagine and fantasise, the formation of movement memory and the great influence of the adult as an authority. The development of both dynamic balance and writing skills is very important for a child's learning at school and for the quality of their future lives. Balance is trained through basic movements. The first stage in the development of writing skills is connecting points, drawing lines, and filling in the fields, and this requires the coordination of muscles and eyes, which initially develops best with balance training. Many and varied techniques are available for both the development of balance and the acquisition of writing skills, which can be implemented frequently and in different ways so as not to bother the child, while at the same time ensuring the acquisition of the necessary movements.

The development of the dynamic balance and writing skills of the group members is at different levels - from making 1-2 mistakes to 16 mistakes in one test. The ability of children to coordinate the action of the eyes and hands and perform two tasks simultaneously differs, as well as the development of fine muscles of the hands and the dexterity of the hand.

Additional purposeful activities affect the development of both physical and cognitive skills, and improve the ability to perform movements accurately. The mean number of errors in the dynamic balance test decreased by 3.3, while in the writing skill test - by 3.5. The range of errors in the dynamic balance tests before the experiment was 3-16, but after the experiment - 1-14, while in the writing skill tests the number of errors before the experiment was 1-12, but afterwards - 1-8. It is concluded that in learning the exact execution of basic movements, the regularity, purposeful activity of the teacher, as well as the variety of classes are important in improving the results.

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