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Original Article Research

Analysis of Manipulative Movement Skills in Students with Down Syndrome at SLBN-A Citereup, Cimahi City

Christanto Nurfadilah [1]*, Yunyun Yudiana[1], Reshandi Nugraha[1]

[1]*Department Physical Education Health and Recreation, Faculty of Sports and Health Education, Universitas Pendidikan Indonesia, Bandung, Indonesia*

*email corresponding author: christantochris07@gmail.com

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Abstract

This study aims to analyze manipulative motor skills in students with Down Syndrome at SLBN-A Citereup, Cimahi City, and to examine the influence of room conditions on their motor performance. This study employs a descriptive approach involving 20 students selected based on the consent and willingness of their accompanying teachers. The instruments used include the manipulative movement subtests from the Test of Gross Motor Development-2 (TGMD-2) and a room condition observation sheet. Validity was tested using Pearson Product Moment correlation, while reliability was assessed using Cronbach's Alpha. Statistical assumptions were tested through normality and homogeneity tests, followed by Spearman's correlation and One-Way ANOVA to test the influence between variables. The results showed that the instrument had high validity and reliability ($\alpha = 0.910$), with the best performance on the throwing and catching items, and the highest difficulty on the dribbling and hitting items. Despite variations in room conditions, the correlation and ANOVA results indicated that room conditions did not significantly affect students' manipulative motor skills ($p > 0.05$). The discussion indicates that internal factors such as age and motor experience play a more significant role in achieving motor skills than environmental conditions. This study recommends the use of more diverse experimental designs and more detailed sample classifications in future research to expand understanding of the factors influencing motor skills in children with special needs.

Keywords: Manipulative Movement, Down Syndrome, Students

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1. INTRODUCTION

Manipulative motor skills are an important element in gross motor development, which includes an individual's ability to control objects through activities such as throwing, catching,

kicking, and hitting. In children with special needs, especially those living with Down Syndrome, the development of these skills reflects not only physical aspects but is also closely related to cognitive, social, and affective development. Students with Down Syndrome often exhibit delays in motor development, caused by muscle hypotonia, proprioceptive dysfunction, and poor coordination. This results in limitations in performing manipulative skills that typically developing children can achieve at the same age. The urgency of this research lies in the fact that manipulative motor skills play an important role in supporting the independence of children with Down Syndrome, both in daily activities and in social interactions (Jain et al., 2022; Malak et al., 2015).

In this context, there is a clear inconsistency in the findings of previous studies regarding the influence of the physical environment on the motor activities of children with disabilities. The research gap exists because most previous studies have focused on biological aspects and exercise interventions, while physical environmental factors—particularly the conditions of the rooms where children engage in activities—have rarely been systematically studied. Some studies have shown that the design of learning spaces can increase children's physical engagement. Studies conducted by (Hartikainen et al., 2021, 2023; Kilbourne et al., 2017) indicate that well-designed and inclusive classroom or learning areas for children with disabilities can significantly enhance their participation and physical activity. However, other studies have confirmed that intrinsic motivation and social support play a greater role than the physical conditions of the room. The inconsistency of these findings indicates an important research gap that warrants further investigation. Research by (Mahy et al., 2010a; Wentz et al., 2021) indicates that the most crucial factor in supporting children with special needs is not the condition of the room, but rather the children's intrinsic motivation and the social support they receive. This discrepancy in results raises an important question: to what extent do room conditions significantly influence the physical performance of students with special needs? There is a gap in the research that underscores the importance of conducting this study with a more contextual and measurable approach.

This study aims to examine the level of manipulative movement skills among students with Down Syndrome at SLBN-A Citereup in Cimahi City, as well as to evaluate the influence of room conditions on their performance. Through a descriptive approach and the use of standardized instruments, this study aims to provide an objective picture of the development of manipulative motor skills in students with special needs. Additionally, the results of this study are expected to serve as a foundation for physical education teachers and therapists in designing more effective and contextual learning strategies.

2. METHOD

Please provide concise but complete information about the material and the analytical, statistical, and experimental procedures used. This part should be as clear as possible to enable other scientists to repeat the research presented. The use of subheadings to divide the text is encouraged. In the case of animal/human experiments or clinical trials, authors must give the details of ethical approval. The method also adapts to the type of research both original article research, literature review, and editorial. In the original article research must write the participants research design, instruments, procedures, and analytical data.

2.1 Participants

The population in this study included all students with special needs enrolled at SLBN-A Citereup Kota Cimahi, with the main characteristic being intellectual disabilities, particularly those related to Down Syndrome. The sample size consisted of 20 students, selected based on their willingness and permission from the school, particularly from the teachers who taught and assisted the students in motor learning activities. The sampling technique applied was purposive, where participant selection was conducted considering practical and ethical aspects: only students who met the inclusion criteria and had obtained permission from the supervising teachers were involved in data collection. The distribution of characteristics shows that the sample consisted of 11 male students and 9 female students, with ages ranging from 8 to 17 years. This data indicates that the sample covers the age range from basic motor development to the end of early adolescence, resulting in variations in the performance of manipulative movement skills.

2.2 Research Design

This study uses a descriptive approach. This method facilitates a comprehensive explanation of the phenomenon being studied (Aggarwal & Ranganathan, 2019) and utilizes statistical evaluation to gain a deeper understanding of the relevant variables (Waruwu, 2023).The specific focus of this study is to describe the manipulative skill conditions of students with Down Syndrome, while also considering the relationship between room conditions (X) as the independent variable and manipulative motor skills (Y) as the dependent variable.

2.3 Instruments

The instrument used in this study was the Test of Gross Motor Development-2 (TGMD-2) (Table 1) developed by Ulrich, (2000), focusing on the manipulative movement subtest (object control subtest). This subtest consists of six items testing gross motor skills involving interaction with objects, namely: throwing a ball (overhand throw), catching a ball (catch), kicking a ball (kick), striking a stationary ball with a stick (strike a stationary ball), dribbling a ball (dribble), and rolling a ball underhand (underhand roll). According to the official TGMD-2 manual, the internal reliability for this subtest is reported to be very high with a Cronbach's Alpha value of 0.91, indicating the internal consistency of the items in measuring manipulative movement skills. However, Ulrich does not include specific quantitative validity values in his document and instead encourages researchers to report the validity results of the instrument in the context of their respective studies. Therefore, in this study, the researcher will also conduct a re-validation and reliability test on the items of the manipulative subtest using the Pearson Product Moment technique, with a significance level of 5% and a comparison value of 0.227, as determined based on the sample size used in this study.

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Table 1.

Instrument Test Manipulative

Manipulative Movement Test Items and Room Conditions			
Test Manipulatif	Kode	Kondisi Ruangan	Kode
Hitting a Stationary Ball	Y1	Noise Level	X1
Dribbling the Ball	Y2	Instructions	X2
Catching	Y3	Distractions	X3
Kicking	Y4	Light	X4
Overhand Throw	Y5	Temperature	X5
Underhand Throw	Y6		

Source: Primary Data

2.4 Procedures

The research was conducted through a systematic approach that initiated with problem identification, statement formulation, instrument selection, data collection, and data analysis. The research process commenced with preliminary observations and collaboration with the school to secure research approval and identify participants who met the established criteria. Subsequently, the researcher selected and adjusted a measurement tool for locomotor skills, adhering to the guidelines of the Gross Motor Development Test (TGMD-2), specifically focusing on the manipulative movement subtest (object control subtest). This subtest includes six components that evaluate gross motor skills that involve interaction with objects, which are: throwing a ball (overhand throw), catching a ball (catch), kicking a ball (kick), striking a stationary ball with a stick (strike a stationary ball), dribbling a ball (dribble), and rolling a ball with an underhand motion (underhand roll). Following this, data collection took place through direct observation, where the researcher documented the performance of each participant as they executed the movements in accordance with the instructions of the test instrument. The findings were recorded on a pre-defined observation sheet. The gathered data were then analyzed descriptively to characterize the locomotor ability levels of the students, including the calculation of minimum and maximum scores, mean scores, and standard deviations. Each phase of this process was conducted in a methodical manner to ensure the accuracy of the data and the relevance of the results to the research objectives.

2.5 Data Analysis

In the data analysis phase, this study will apply a descriptive approach involving various statistical analysis techniques. The validity of the instrument is tested using the Pearson Product Moment correlation technique, which aims to measure the relationship between each item and the total score. This process considers the comparative r value corresponding to the number of respondents and a significance level of 5%. The reliability test is carried out using Cronbach's Alpha coefficient to analyze the internal consistency among the items in the manipulative movement subscale. Before testing the hypothesis, it is important to test the data for normality and homogeneity. This aims to ensure that the data meets the criteria required for parametric analysis. In answering the research question, the researcher applied correlation analysis to identify

the relationship between room conditions and manipulative movement skills. Additionally, a one-way ANOVA test was used to evaluate differences in manipulative movement skills based on the room condition categories experienced by the respondents. The researcher also analyzed the age variable to identify whether there were differences in manipulative movement skills based on the age groups of the students. The approach used was one-way ANOVA, which aimed to provide a more comprehensive picture of the factors that influence manipulative movement skills in students with Down Syndrome.

3. RESULTS

Analysis of the level of manipulative motor skills in students with Down Syndrome at SLBN-A Citereup, Cimahi City, and evaluation of the influence of room conditions on their performance. A series of data was produced and processed using a series of SPSS software version 29.

Table 2.

Pearson Product Moment

Correlations							Reabilitty Cronbach's Alpha
		Y1	Y2	Y3	Y4	Y5	Y6	
Y1	Pearson Correlation	1	.626**	.475*	.525*	0.414	.600**	0,910
	Sig. (2-tailed)		0.003	0.034	0.017	0.069	0.005	
	N	20	20	20	20	20	20	
Y2	Pearson Correlation	.626**	1	.650**	.821**	.864**	.732**	
	Sig. (2-tailed)	0.003		0.002	<.001	<.001	<.001	
	N	20	20	20	20	20	20	
Y3	Pearson Correlation	.475*	.650**	1	.690**	.546*	.481*	
	Sig. (2-tailed)	0.034	0.002		<.001	0.013	0.032	
	N	20	20	20	20	20	20	
Y4	Pearson Correlation	.525*	.821**	.690**	1	.790**	.758**	
	Sig. (2-tailed)	0.017	<.001	<.001		<.001	<.001	
	N	20	20	20	20	20	20	
Y5	Pearson Correlation	0.414	.864**	.546*	.790**	1	.748**	

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	Sig. (2-tailed)	0.069	<.001	0.013	<.001		<.001
	N	20	20	20	20	20	20
Y6	Pearson Correlation	.600**	.732**	.481*	.758**	.748**	1
	Sig. (2-tailed)	0.005	<.001	0.032	<.001	<.001	
	N	20	20	20	20	20	20

Source: Primary Data

The validity test results using Pearson Product Moment correlation show that all items in the manipulative movement variable (Y1–Y6) have a positive relationship between items, with most correlations significant at the 0.01 and 0.05 levels (Table 2). The highest correlation was observed between items Y2 and Y5 (r = 0.864**), while the lowest significant correlation was between Y1 and Y3 (r = 0.475*), indicating that all items exhibit good construct consistency in measuring the dimension of manipulative skills in students with Down Syndrome. Additionally, the reliability test results showed a Cronbach's Alpha value of 0.910, which is very high, indicating that the six items of the instrument have very good internal consistency. Therefore, both in terms of validity and reliability, the instrument used in this study has been proven to meet the criteria and is reliable for measuring the manipulative motor skills of students with Down Syndrome at SLBN-A Citereup, Cimahi City.

Table 3.

Statistik Deskriptif

	N	Minimum	Maximum	Mean	Std. Deviation
Y1	20	1	7	4.05	1.96
Y2	20	0	6	2.95	1.93
Y3	20	2	6	4.75	1.37
Y4	20	1	6	3.65	1.35
Y5	20	0	6	2.6	2.04
Y6	20	0	8	3.35	2.13
X1	20	5	5	5	0
X2	20	2	5	3.7	1.03
X3	20	2	5	3.3	0.73
X4	20	5	5	5	0
X5	20	5	5	5	0

Source: Primary Data

The results of the descriptive analysis indicate that the manipulative motor skills of students with Down Syndrome at SLBN-A Citeureup Cimahi, as measured by six indicators (Y1–Y6), show significant variation. Item Y3 had the highest average with a mean of 4.75 and

a standard deviation of 1.37, indicating that students tend to perform better and more consistently in this aspect (e.g., throwing or catching). Conversely, the lowest average scores were found in Y5 (mean = 2.60; SD = 2.04) and Y2 (mean = 2.95; SD = 1.93), indicating that in these skills (such as dribbling a ball or hitting an object), students tend to experience greater difficulties and show significant performance variation.

In addition, analysis of variable X (Room Conditions), which consists of five items (X1–X5), shows that some conditions remain constant. Items X1, X4, and X5 have an average value of 5.00 with a standard deviation of 0.00, indicating that all respondents experienced uniform conditions in that aspect—such as consistent lighting or unchanging floor surfaces during the measurement period. On the other hand, X2 and X3 show moderate variation (mean = 3.70 and 3.30; standard deviation = 1.03 and 0.73), indicating differences in students' experiences with varying room conditions, such as temperature or environmental noise during testing.

Overall, this interpretation suggests that irregularities in certain environmental conditions (X2 and X3) may influence score variations on some manipulative motor skill items, particularly on items with high standard deviations like Y5 and Y6, reflecting the complexity and challenges faced by students with Down Syndrome in unstable motor situations.

Table 4.

Hypothesis Testing

Test Type	Variabel	Statistik Test	*p*	Description
Normality Test	Manipulative Movement	Shapiro–Wilk	0,318	Normal
	Room Condition	Shapiro–Wilk	0,018	Abnormal
Homogeneity Test	Manipulative Movement between Groups | Room Condition	Levene's Test (Mean)	0,276	Homogeneous
Spearman's correlation test	Manipulative Movement × Room Condition	Spearman's rho (r)	0,270	Insignificant
One-Way ANOVA	Manipulative Movement by Room Condition	F = 0,709	0,714	Insignificant
	Manipulative Movement by Age	F = 3,200	0.66	Insignificant

Source: Primary Data

The results of normality tests using Kolmogorov–Smirnov and Shapiro–Wilk indicate that the data for the manipulative movement variable are normally distributed with a significance value of p > 0.05, namely 0.200 (K–S) and 0.318 (S–W). This shows that the data meet the normality assumption. Conversely, the room condition variable does not meet the normality assumption, with significance values of 0.002 (K–S) and 0.018 (S–W), thus statistically indicating that the room condition is not normally distributed. This finding is understandable, considering that room conditions in the field are influenced by external factors such as weather, lighting, and ventilation, which cannot be consistently controlled during data

collection. Additionally, the Levene's test for homogeneity of variances yielded non-significant results ($p > 0.05$) for all approaches, whether based on the mean (sig. = 0.276), median (sig. = 0.421), or trimmed mean (sig. = 0.292). This indicates that the variance among the room condition groups is homogeneous, thus meeting the assumption of homogeneity.

The Spearman correlation test showed a weak negative relationship between room conditions and manipulative motor skills ($r = –0.259$), although this relationship was not statistically significant ($p = 0.270$). This means that, although there is a tendency for less optimal room conditions to be associated with a decline in manipulative motor skills, the existing statistical evidence is not strong enough to support this conclusion. The results of the one-way ANOVA hypothesis test showed that there were no significant differences in manipulative movement scores based on room condition categories ($F = 0.709$; $p = 0.714$). This reinforces the previous finding that variations in room conditions did not have a statistically significant impact on the manipulative movement skills of students with Down Syndrome in the context of this study.

4. DISCUSSIONS

The results of this study indicate that the manipulative movement skills of students with Down Syndrome at SLBN-A Citereup, Cimahi City, show significant variations in performance. Some students demonstrate adequate mastery in aspects such as throwing and catching a ball, while others experience considerable difficulty, particularly in dribbling or hitting a ball. The highest average score was obtained on item Y3 (average = 4.75), while the lowest score was recorded on Y5 (average = 2.60), indicating an imbalance in skills across items. This suggests that despite intellectual limitations, some students can still develop specific manipulative skills, depending on the training stimulus, prior motor experience, and environmental conditions during the test administration.

Spearman's correlation analysis between room conditions and manipulative movement skills showed a weak and non-significant negative correlation ($r = –0.259$; $p = 0.270$). These results indicate that varying room conditions, such as lighting, temperature, or floor type, do not have a statistically significant relationship with students' manipulative movement skills in this study. This means that although environmental conditions logically could influence physical performance, in this context, performance variations are more likely determined by internal student factors, such as sensorimotor conditions, motivation, and understanding of instructions. These findings are consistent with research by (Kim et al., 2017; Winders et al., 2019) showing that children with Down Syndrome tend to have motor performance more influenced by neurological capacity and individual motor experience than by the surrounding environment.

The results of the One-Way ANOVA test showed no significant differences in manipulative movement skills based on different room condition groups ($F = 0.709$; $p = 0.714$). This confirms that while room conditions may fluctuate due to external factors (such as weather), such variations are insufficient to cause significant differences in performance in the context of manipulative movements. These findings are supported by research (Ferasinta et al., 2024; Jariono et al., 2023; Jin et al., 2023; Roșu et al., 2024) emphasizing that motor skills in children with special needs are more stable when trained in familiar and repetitive learning contexts, even in less-than-ideal environmental conditions. Additionally, (Yi & Ellis, 2023) in their study of children with intellectual disabilities showed that environmental conditions have a smaller

influence compared to personal variables such as mental age, muscle strength, and prior motor experience.

On the other hand, the addition of age as a variable revealed an important pattern that, although not statistically significant (in the initial test), showed that older students tended to have better manipulative movement scores. This supports the motor development theory proposed by (K. M. Haywood & Getchell, 2014), which states that although children with developmental limitations show a slower rate of development, they continue to accumulate movement experiences as they age, especially when in an environment that offers repetitive practice and consistent pedagogical support. The literature also discusses improvements in behavioral performance and positive changes in repetitive movements (Su et al., 2022) , so in an educational context, collaboration between health professionals, educators, and families is crucial to support the development and movement experiences of children with disabilities to achieve inclusive physical activity in line with research recommendations (Arbour-Nicitopoulos et al., 2021; Utley, 2007). This research stands out because it treats room conditions as an independent variable, which is seldom investigated in studies concerning motor skills in children with Down syndrome. In contrast, most earlier research has concentrated primarily on exercise interventions or biological aspects (Jain et al., 2022; Winders et al., 2019), In the meantime, this research seeks to evaluate how much the physical environment affects motor performance. The study's findings suggest that internal factors like age, motor experience, and individual preparedness outweigh the impact of environmental differences. This research offers novel insights by demonstrating that enhancing physical learning for children with special needs doesn't necessarily rely on optimal spatial conditions, but instead on consistent teaching strategies and motor stimulation (K. G. N. Haywood, 2014)

Nonetheless, this research paves the way for additional investigation. First, a more nuanced categorization of Down Syndrome conditions is essential, particularly in differentiating individuals with specific comorbidities or varying degrees of developmental delay. Second, longitudinal studies and experimental methodologies with more rigorous controls could offer greater insight into the progression of motor skill development over time (Su et al., 2022). Additionally, psychosocial elements like motivation, support from peers, and family participation should be included in the evaluation, as they can play a crucial role in enhancing the acquisition of manipulative skills in children with Down syndrome (Arbour-Nicitopoulos et al., 2021b; Mahy et al., 2010b). Consequently, upcoming studies are anticipated to enhance our comprehension of not just the biological and environmental factors, but also the social and emotional aspects that affect motor performance.

5. CONCLUSIONS

Based on the findings and analysis, it can be concluded that the manipulative motor skills of students with Down Syndrome at SLBN-A Citereup, Cimahi City, vary, with the best performance in skills such as throwing and catching, and greater difficulty in skills such as dribbling and hitting objects. The instrument used in this study was found to be valid and reliable with a Cronbach's Alpha value of 0.910. Although logically the room conditions were expected to influence motor performance, the results of the correlation test and ANOVA showed that this influence was not statistically significant, meaning that internal variables such as age, experience, and motor readiness of the students played a more significant role in achieving manipulative skills. However, this study has several limitations, including the limited number of respondents

and the absence of specific classifications regarding the type of disability each student has, whether it is solely Down Syndrome or accompanied by other impairments such as vision or hearing. Additionally, the one-shot case study design used only allows for a momentary measurement of manipulative motor skills, thus not providing a longitudinal or causal perspective. Therefore, it is recommended that future research employ more diverse experimental methods, such as pretest-posttest or longitudinal tracking, and conduct a more detailed classification of sample characteristics to gain a more comprehensive understanding of the factors influencing motor skills in children with special needs.

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REFERENCES

Aggarwal, R., & Ranganathan, P. (2019). Study designs: Part 2 - Descriptive studies. *Perspectives in Clinical Research*, *10*(1), 34–36. https://doi.org/10.4103/picr.PICR_154_18

Arbour-Nicitopoulos, K. P., Bassett-Gunter, R. L., Leo, J., Sharma, R., Olds, T., Latimer-Cheung, A. E., & Martin Ginis, K. A. (2021a). A cross-sectional examination of the 24-hour movement behaviours in Canadian youth with physical and sensory disabilities. *Disability and Health Journal*, *14*(1), 100980. https://doi.org/10.1016/j.dhjo.2020.100980

Arbour-Nicitopoulos, K. P., Bassett-Gunter, R. L., Leo, J., Sharma, R., Olds, T., Latimer-Cheung, A. E., & Martin Ginis, K. A. (2021b). A cross-sectional examination of the 24-hour movement behaviours in Canadian youth with physical and sensory disabilities. *Disability and Health Journal*, *14*(1). https://doi.org/10.1016/j.dhjo.2020.100980

Ferasinta, F., Hidayatin, T., Dinata, E. Z., & Sartika, A. (2024). Improving Fine Motor Skills in Children with Special Needs Through Foam Squeezing Play Therapy. *Health and Technology Journal (HTechJ)*, *2*(1), 52–56. https://doi.org/10.53713/htechj.v2i1.148

Hartikainen, J., Haapala, E. A., Poikkeus, A.-M., Sääkslahti, A., Laukkanen, A., Gao, Y., & Finni, T. (2023). Classroom-based physical activity and teachers' instructions on students' movement in conventional classrooms and open learning spaces. *Learning Environments Research*, *26*(1), 177–198. https://doi.org/10.1007/s10984-022-09411-3

Hartikainen, J., Poikkeus, A.-M., Haapala, E. A., Sääkslahti, A., & Finni, T. (2021). Associations of Classroom Design and Classroom-Based Physical Activity with Behavioral and Emotional Engagement among Primary School Students. *Sustainability*, *13*(14), 8116. https://doi.org/10.3390/su13148116

Haywood, K. G. N. (2014). *KINE 3367.1 Lifespan Motor Development*. www.mhhe.com/payne8e

Haywood, K. M., & Getchell, N. (2014). *Life Span Motor Development* (6th ed.). Human Kinetics Publishers Inc.

Jain, P. D., Nayak, A., Karnad, S. D., & Doctor, K. N. (2022a). Gross motor dysfunction and balance impairments in children and adolescents with Down Syndrome: a systematic review. *Clinical and Experimental Pediatrics*, *65*(3), 142–149. https://doi.org/10.3345/cep.2021.00479

Jain, P. D., Nayak, A., Karnad, S. D., & Doctor, K. N. (2022b). Gross motor dysfunction and balance impairments in children and adolescents with Down syndrome: a systematic review. *Clinical and Experimental Pediatrics*, *65*(3), 142–149. https://doi.org/10.3345/cep.2021.00479

Jariono, G., Nurhidayat, Yunita, P., Gontara, S. Y., Nugroho, H., & Maslikah, U. (2023). Strategies to Improve Children's Motor Skills with Special Needs Through Circuit Method Based Inclusion Education. *Kinestetik: Jurnal Ilmiah Pendidikan Jasmani*, *7*(2), 434–440. https://doi.org/10.33369/jk.v7i2.27485

Jin, Y.-R., Sung, Y.-S., Koh, C.-L., Chu, S. Y., Yang, H.-C., & Lin, L.-Y. (2023). Efficacy of Motor Interventions on Functional Performance Among Preschool Children With Autism Spectrum Disorder: A Pilot Randomized Controlled Trial. *The American Journal of Occupational Therapy*, *77*(6). https://doi.org/10.5014/ajot.2023.050283

Kilbourne, J. R., Scott-Webber, L., & Kapitula, L. R. (2017). An Activity-Permissible Classroom: Impacts of an Evidence-Based Design Solution on Student Engagement and Movement in an Elementary School Classroom. *Children, Youth and Environments*, *27*(1), 112. https://doi.org/10.7721/chilyoutenvi.27.1.0112

Kim, H. I., Kim, S. W., Kim, J., Jeon, H. R., & Jung, D. W. (2017). Motor and Cognitive Developmental Profiles in Children With Down Syndrome. *Annals of Rehabilitation Medicine*, *41*(1), 97. https://doi.org/10.5535/arm.2017.41.1.97

Mahy, J., Shields, N., Taylor, N. F., & Dodd, K. J. (2010a). Identifying facilitators and barriers to physical activity for adults with Down Syndrome. *Journal of Intellectual Disability Research*, *54*(9), 795–805. https://doi.org/10.1111/j.1365-2788.2010.01308.x

Mahy, J., Shields, N., Taylor, N. F., & Dodd, K. J. (2010b). Identifying facilitators and barriers to physical activity for adults with Down syndrome. *Journal of Intellectual Disability Research*, *54*(9), 795–805. https://doi.org/10.1111/j.1365-2788.2010.01308.x

Malak, R., Kostiukow, A., Krawczyk-Wasielewska, A., Mojs, E., & Samborski, W. (2015). Delays in Motor Development in Children with Down Syndrome. *Medical Science Monitor*, *21*, 1904–1910. https://doi.org/10.12659/MSM.893377

Roșu, D., Cojanu, F., Vișan, P.-F., Samarescu, N., Ene, M. A., Muntean, R.-I., & Ursu, V. E. (2024). Structured Program for Developing the Psychomotor Skills of Institutionalized Children with Special Educational Needs. *Children*, *11*(1), 102. https://doi.org/10.3390/children11010102

Su, W. C., Amonkar, N., Cleffi, C., Srinivasan, S., & Bhat, A. (2022). Neural Effects of Physical Activity and Movement Interventions in Individuals With Developmental Disabilities–A

Systematic Review. In *Frontiers in Psychiatry* (Vol. 13). Frontiers Media S.A. https://doi.org/10.3389/fpsyt.2022.794652

Ulrich, D. A. (2000). Test of Gross Motor Development. In *Adapted Physical Activity Quarterly* (2nd ed.). PROED. https://doi.org/10.1123/apaq.3.2.186

Utley, A. (2007). Children with movement difficulties. *Disability and Rehabilitation*, *29*(1), 1–2. https://doi.org/10.1080/09638280600947500

Waruwu, M. (2023). Pendekatan Penelitian Pendidikan: Metode Penelitian Kualitatif, Metode Penelitian Kuantitatif dan Metode Penelitian Kombinasi (Mixed Method). *Jurnal Pendidikan Tambusai*, *7*(1), 2896–2910.

Wentz, E. E., Looper, J., Menear, K. S., Rohadia, D., & Shields, N. (2021). Promoting Participation in Physical Activity in Children and Adolescents With Down Syndrome. *Physical Therapy*, *101*(5). https://doi.org/10.1093/ptj/pzab032

Winders, P., Wolter-Warmerdam, K., & Hickey, F. (2019a). A schedule of gross motor development for children with Down Syndrome. *Journal of Intellectual Disability Research*, *63*(4), 346–356. https://doi.org/10.1111/jir.12580

Winders, P., Wolter-Warmerdam, K., & Hickey, F. (2019b). A schedule of gross motor development for children with Down syndrome. *Journal of Intellectual Disability Research*, *63*(4), 346–356. https://doi.org/10.1111/jir.12580

Yi, Y. J., & Ellis, N. (2023). Associations between environmental factors and adaptive skills of people with intellectual and developmental disabilities in educational settings. *Social Sciences & Humanities Open*, *7*(1), 100410. https://doi.org/10.1016/j.ssaho.2023.100410