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Original Article

The effect of Motor Coordination Learning (MCL) based on a combination of e-book and QR-Code media with sign language to improve Basic Movement Skill (BMS) in deaf children: An inclusion education research

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Abstract:
Background and problem: This research proposes a physical education learning media with a different approach to improving the basic movement skill (BMS) of deaf children, namely learning motor coordination using a combination of e-books and Quick Response Code (QR-code) materials. So, children can learn anywhere to improve their BMS. The provided e-books will make learning movement coordination easier for teachers and children. The code listed in the e-book is linked to the available sign language learning videos connected to the YouTube platform, where each learning explanation at different stages can be seen, including visual sign language explanations. Each creative process is described in this research, as well as the possible educational applications resulting from using the learning materials created for this research in the context of motor learning. Objective: The purpose of this research was to explore the effectiveness of Motor Coordination Learning (MCL) based on a combination of e-books and QR-code media with sign language in improving Basic Motor Skills (BMS) in deaf children. Methods: The approach employed in this study was quasi-experimental with a one-group pretest-posttest design. The Motor Coordination Learning Program, based on a combination of e-book and QR-code media with sign language, was integrated into physical education lessons at Special Education (SLB2) School in Padang from March 2023 to June 2023. The participants in this study were deaf male children (n = 10) within the age range of 7-13 years old, meeting the inclusion criteria. Participants who willingly participated obtained parental consent and completed the study until the end, constituting the treatment group. This group received the same treatment at the beginning of each learning session, with a frequency of 2 times per week. Data were collected using the Basic Motor Skills (BMS) instrument for fundamental motor skills. The data were analyzed using the Wilcoxon signed-rank test through IBM Co. USA Version 25 software. Results: The approach utilized in this study was a quasi-experimental design employing a one-group pretest-posttest design. Ten participants underwent MCL based on a combination of e-books and QR-code media with Sign Language over eight weeks. Following data analysis, results from the treatment group revealed an increase in students' Basic Motor Skills (BMS) from an average of 2.12 ± 0.27 to 3.22 ± 0.34. The inferential statistical test was conducted in this research that indicated a significant difference between the pre-test and post-test within each group, with a $P < 0.05$. Conclusion: Therefore, learning movement coordination based on a combination of e-book teaching materials and QR codes in sign language has been proven to improve the motor skills of deaf children. This learning method can be used by teachers and deaf children to obtain information on learning movement coordination quickly.
Keywords: Motor Coordination Learning, e-books, QR-code, sign language, basic movement skill, deaf children

Introduction

In a classroom dedicated to the education of deaf children, the enhancement of motor skills is crucial, serving as a fundamental training aspect to equip them with the necessary independence in their physical movements (Cardoso et al., 2018; Chaeroni et al., 2022; Haris et al., 2023; Komaini, 2017; Komaini et al., 2021; Pavlidis & Gargalianos, 2014). The limitation in acquiring motor learning information forms the basis for the necessity of developing an innovative motor learning approach that can be utilized by deaf children. While practical motor learning resources are scarce, in contrast to extensively researched conventional methods, this underscores the need for new ideas in facilitating motor skill development for children with hearing impairments.

Communication in the learning process of children with special needs, especially those who are deaf, involves

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specific requirements due to challenges related to auditory responses but can be addressed through visual elements (Westin et al., 2022). Additionally, individuals with hearing impairments often exhibit heightened enthusiasm and activity levels despite their limitations, which can be leveraged as strengths to design physical activity-based learning programs (Bellows et al., 2017; Vidoni et al., 2015). Teachers lacking competence in communication may lead to reduced learning achievements as information may not be effectively conveyed (Butler, 2014; Chan et al., 2020; Moraru & Cristea, 2013; Sridadi et al., 2021). This competence is directly linked to suboptimal improvements in motor skills through physical education, thereby serving as a primary factor explaining why the fitness and motor skills of deaf children tend to be below average (Sulistiyowati et al., 2022). The motor development challenges in deaf children have frequently been the subject of research efforts aimed at enhancing their quality of life. Deaf children often encounter difficulties in developing their motor skills, including the coordination of movements essential for communication through sign language. Sign language serves as the primary means of communication for the deaf community, and mastering it necessitates proficient motor coordination.

Although information and communication technology (ICT) has become an integral part of everyday life, there is a need to integrate these innovations into the educational context, particularly for deaf children (D'Isanto et al., 2017; Park & Park, 2021; Schmid & Petko, 2019; Wang & Hsu, 2014). E-books and QR codes, as evolving forms of technology, offer the potential to enrich the learning experience of deaf children in developing their motor skills, especially in sign language (Haris et al., 2023). In line with this, previous research indicates that innovative and enjoyable learning approaches can enhance children's motivation and engagement in the educational process (Kesim & Ozarslan, 2012; Komar et al., 2022). Using E-Book technology, children can access learning content engagingly tailored to their needs. QR codes serve as tools to facilitate sign language learning by directing children to additional resources, interactive videos (Tzanetakos et al., 2017), or specific exercises that can strengthen their motor skills.

The utilization of QR codes combined with e-books can enhance students' interest in learning anytime and anywhere (Haris et al., 2023). QR-codes are specially designed graphical codes with a quick response to connect to the intended internet platform. Based on its development, QR-codes have been applied in various functions and are widely used every day worldwide. QR codes also offer the benefit of storing a large amount of data. The design of the combination of QR-code technology and e-books involves digital information integration, encompassing models, images, videos, and audio demonstrations.

QR-code Android Book aims to mix reality with virtual environments, allowing users to interact with physical and digital objects. The different levels of understanding of students with special needs (Deaf) require teachers to be creative in conveying learning material to their students. This method enhances the function of conventional books by equipping them with markers and sign language movement props. With the animation of the Physical Activity movement technique, it is hoped that users (Deaf) can feel how easy and fast the QR-code application is rather than manual understanding. The Android-based Physical Activity learning application that can be installed on mobile devices simplifies the education process. The type of research being developed is media development research. As for research and development procedures, the QR-code Android Book that has been compiled is then validated by experts so that the content and appearance are appropriate. Therefore, the material is well conveyed and can be understood by students. Therefore, this research aims to make a product and validate Physical Activity learning media using digital technology based on the Design and Build Technology of the Android Book QR-code Application.

E-books are learning tools that can be utilized anywhere and anytime (Kesim & Ozarslan, 2012). E-books must be designed to meet the specific auditory needs of deaf children. Using sign language, images, and animations can enhance the understanding and engagement of deaf children. E-books should offer interactive elements to enhance the involvement and participation of deaf children. It is advisable to involve special educators and inclusive education experts in every stage of development to ensure that e-books meet curriculum standards and the needs of deaf children. The design of e-books should provide an active and engaging learning experience, encouraging exploration and building conceptual understanding. E-books should adhere to accessibility guidelines, providing a variety of information representations, expressive actions, and choices based on individual needs.

The standard issue encountered in the field is that deaf children tend to be passive, which can impact their future social lives. Based on this problem, the task of physical education teachers is to create an exercise program with a variety of coordinated movement exercises for deaf children, incorporating visual stimuli such as images, colors, and the form of a guidebook containing various coordination exercises to enhance the motor skills of the children. These coordinated movement exercises are compiled into a book with QR codes for practical access to instructional videos. This way, deaf children can be trained using a program aligned with the objectives and targets of the exercise program specifically designed for them.

The instructional e-book serves as a learning resource containing materials on motor coordination exercises, combined with sign language technology using QR-codes for a movement guidebook as an additional exercise task at school and home. The ease of utilizing sign language QR-codes, containing clear and easily understandable instructions for movement tasks for children with disabilities, represents an innovation in literature—lightweight, portable, and accessible anywhere. E-books are also portable, allowing them to be used anytime and anywhere. Consequently, learning becomes more comprehensive through blended video media and e-books designed by experts in media and disabilities. These facilitate easier understanding and accessibility wherever they are, motivating deaf children with disabilities to enhance the quality and delivery of information. Since not all teachers are proficient in sign language for the deaf, implementing sign language communication, whether direct or indirect, is necessary. The limited provision of communication media specifically designed for deaf children is a concern, resulting in a severe decline in motor skills. Thus, involving sign language experts (SIBI) in information delivery is crucial to address this issue.

This research aimed to develop motor coordination learning for special-needs children, specifically deaf people, to enhance their motor skills. Consequently, this study discusses a novel approach that integrates E-Books and QR-codes to assist deaf children in developing motor skills, particularly in learning coordinated movements for sign language. By combining these approaches, it is anticipated that deaf children can have a more enjoyable and practical learning experience, thereby improving their motor skills crucial for communicating using sign language. This research was expected to significantly contribute to developing innovative learning methods for children with special needs, particularly in the context of motor skill development for deaf children.

Material & methods

Research design

The approach employed in this research is a quasi-experimental design with a one-group pretest-posttest design (Montgomery, 2013). The treatment provided was MCL to enhance BMS, implemented at SLB2 Padang.

Measurement

Data was collected by measuring fundamental motor skills using the Basic Motor Skills (BMS) instrument twice, namely before the treatment (pre-test) and after the treatment (post-test). Validity and reliability were reported (v=0.89 and r=0.90) (Komaini, 2017) (Komaini, 2017).

Participants

Participants in this study were children with the sole disability of deafness, aged 7-13 years, without metabolic health issues. Participants and their parents agreed to participate in the entire research process. Based on these criteria, after screening participants using purposive sampling, 20 participants were obtained (n=20).

Procedure

In the initial stage of this research, observations were conducted at SLB2 Padang. Additionally, the infrastructure and tools used for the research and the required teaching staff were ready to be examined as part of the Motor Coordination Learning (MCL) program. Consent documents were provided for parents, and each participant had documentation for the measurements and treatments to be carried out.

Once all the research requirements were gathered, initial measurements (pre-test) were conducted at different times to determine the baseline abilities of all participants. All participants received the developed MCL, resulting in 9 variations of motor skill games delivered through a book with QR-codes in sign language over six weeks. The treatment was administered twice a week, totaling 12 sessions.

Refer to Figure 1 (in Appendix 1) for the product form and product illustration links. The MCL program can be accessed through the following link: https://drive.google.com/drive/my-drive. Meanwhile, the MCL program outline is available in **Appendix 2.**

The final stage of this research involves analyzing the data obtained descriptively and inferentially, and the researcher will report the findings in the research results.

The data analysis technique

The data analysis was tested descriptively and inferentially using the IBM Co. USA Version 25 software. Before conducting inferential tests, prerequisite tests were performed to determine data normality and homogeneity. Inferential hypothesis testing used a paired sample t-test to examine the pre-test and post-test BMS results.

Result

Based on the post-test data results in the field, we can obtain pre-test and post-test data with maximum scores of 2.5 and 3.70, respectively. Meanwhile, the minimum scores for pre-test and post-test are 1.68 and 2.72, respectively. BMS is improved between the average pre-test and post-test scores, namely, from 2.12 ± 0.27 to 3.22 ± 0.34. Based on the assessment of the distribution of improvements pre-test vs. post-test, there were 3 participants with BMS decrease (BSB) with a percentage value of 30%. Participants with the BMS improvement "Developing as Expected" (BSH) category were (n=1) during the pre-test, and it increased to (n=7) participants during the post-test with a percentage value of 70%. The most common BMS ability found during the pre-test was "starting to develop" (MB), while this ability was no longer found during the post-test in this study. BB was not found nor reported in the limited sample condition. For more details, please refer to Tables **1 and 2.**

Table 1. Description of pre-test and post-test statistical data

Group	N	Max	Min	Mean ± SD
Pre tes BMS	10	2.5	1.68	2.12 ± 0.27
Posttest BMS	10	3.70	2.72	3.22 ± 0.34

Table 2. Frequency distribution of pre-test and post-test data.

Kategori	Interval	Pretest		Posttest	
		Frekuensi	Percentage	Frekuensi	Percentage
BSB	76-100%	-	-	3	30%
BSH	51-75%	1	10%	7	70%
MB	26-50%	9	90%	-	-
BB	0-25%	-	-	-	-
Total		10	100%	10	100%

Information, BSB: Developing Very Well. BSH: Developing as Expected.
MB: Starting to Develop. BB: Not Developing Yet.

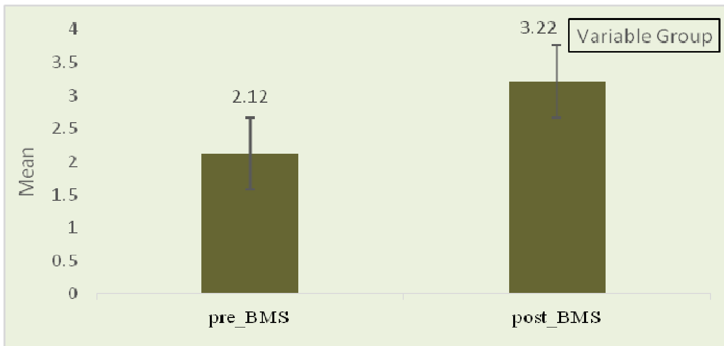

Figure 1. Graph of pretest-posttest improvement in the treatment group.

Before conducting hypothesis testing with inferential statistics, the data were first tested for normality and homogeneity. After analyzing normality, the pre-test and post-test normality values were 0.103 and 0.200 (Shapiro-Wilk). This was followed by the homogeneity values, which can be seen in **Table 3, Figure 1**, and **Table 4.** In line with this, the results of the inferential test using the paired sample t-test obtained P<0.05, as seen in **Table 5.**

Table 3. Normality data testing

	Normality test					
Variabel	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	*df*	*P*	Statistic	*df*	*P*
BMS (Pre-test)	0.241	10	0.103	0.908	10	0.270
BMS (Post-test)	0.122	10	0.200	0.948	10	0.643

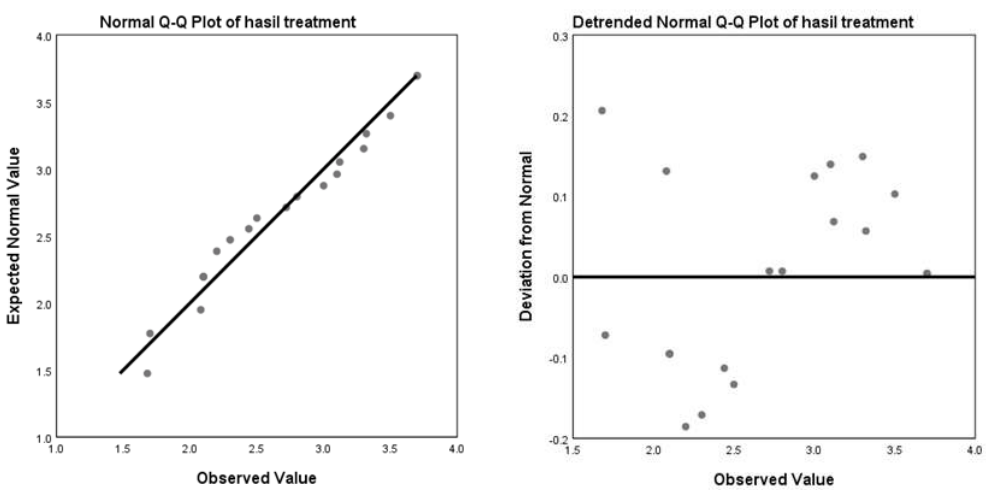

Figure 2. Normal Q-Q Plot Data Treatment

Table 4. Homogeneity data testing

	Independent Samples Test					
Data treatment	Levene's test for equality of variances		t-test for equality means			
	Statistic	*P*	*t*	df	*P*	*MD*
Equal variances assumed	1.165	0.295	-8.017	18	0.000	-1.106
Equal variances not assumed	0.122	10	-8.017	17.087	0.000	-1.106

Table 5. Paired Sample t test pretest and posttes BMS

Pair	Mean	SD	SE Mean	95% Confidence Interval of Difference		t	df	*P*
				Lower	Upper			
Pre-test BMS-Post-test BMS	-1.106	0.173	-3.925[b]	-1.230	-0.981	-20.117	9	0.000

Discussion

Previous research has extensively discussed the verification that both QR codes and E-Books are highly effective in supporting the learning process. It aligns with our earlier research, the "Development of the Physical Activity Learning through QR-code Android-Based and Teaching Books for the Deaf" (Haris et al., 2023). However, Motor Coordination Learning (MCL) specifically for improving Basic Motor Skills (BMS) has yet to be conducted.

A practical, efficient, and diverse learning media model is essential in motor skills training (Berk, 2011; Cheng & Tsai, 2013; Li, 2016). Efficient training contributes to the effectiveness of the learning process for teachers or instructors. A single physical activity exercise can achieve dual training objectives, enhancing both motor skills and physical fitness. Varied exercises are crucial in fostering children's motivation for sports learning. The diversity in exercises also amplifies the enthusiasm of deaf children, encouraging them to undergo the learning process to improve their motor skills (Schwab et al., 2019).

This research holds significant value for stakeholders such as teachers, lecturers, trainers, and school practitioners specializing in movement orientation for students with special needs. It aims to accelerate the development of the national education landscape. However, it is essential to note the research's limitation, which includes the absence of several developmental stages such as product trials, revisions, usage trials, and mass production. Nevertheless, the involvement of six experts, including expert practitioners, academic experts, and media experts, ensured the evaluation of the program and guideline book in the previous research (Haris et al., 2023). The emphasis is placed on the inclusive approach integrating technology and sign language, proving beneficial for the development of deaf children (Baranauskas et al., 2020; Brandes et al., 2020; Murakami et al., 2019; Schwingshackl et al., 2014). The crucial involvement of teachers and parents in supporting the implementation of Motor Coordination Learning (MCL) was also discussed. Additionally, a comparison with previous studies highlights the superiority of MCL in the context of gross motor skills.

In conclusion, this article posits that MCL utilizing e-books, QR-codes, and sign language can effectively enhance gross motor skills in deaf children within the framework of inclusive education. The practical implications of this research need further exploration through subsequent studies, including developing more specific learning strategies tailored to the individual needs of deaf children.

Conclusion

In conclusion, this research aimed to address the challenges faced by deaf children in improving their Basic Motor Skills (BMS) by proposing a unique approach through the integration of MCL with a combination of e-books and QR-code media enriched with sign language content. Over the eight weeks, the treatment group, which received MCL based on the innovative teaching materials, demonstrated a noteworthy increase in BMS scores, from an average of 2.12 ± 0.27 to 3.22 ± 0.34. The statistical analysis using the Wilcoxon signed-rank test indicated a significant difference between the pre-test and post-test results ($P<0.05$), affirming the effectiveness of the proposed learning method.

This research's findings underscore the MCL program's efficacy, emphasizing the positive impact on the BMS of deaf children. This innovative approach holds promise as an inclusive and accessible educational tool, contributing to the advancement of teaching strategies tailored to the unique needs of deaf learners.

This research provides a tangible and replicable model for educators, offering insights into integrating technology and sign language to enhance motor learning. This method is practical for teachers seeking innovative tools to facilitate information on motor learning movement coordination for deaf children. Integrating technology, educational materials, and sign language showcases the potential for a transformative and inclusive approach to enhancing BMS.

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Conflict Interest

We have no conflicts of interest to disclose.

Reference

Baranauskas, M., Jablonskienė, V., Abaravičius, J. A., & Stukas, R. (2020). Cardiorespiratory Fitness and Diet Quality Profile of the Lithuanian Team of Deaf Women's Basketball Players. *International Journal of Environmental Research and Public Health*, *17*(18). https://doi.org/10.3390/ijerph17186749

Bellows, L. L., Davies, P. L., Courtney, J. B., Gavin, W. J., Johnson, S. L., & Boles, R. E. (2017). Motor skill development in low-income, at-risk preschoolers: A community-based longitudinal intervention study. *Journal of Science and Medicine in Sport*, *20*(11), 997–1002. https://doi.org/10.1016/j.jsams.2017.04.003

Berk, R. A. (2011). Research on PowerPoint : From Basic Features to Multimedia. *International Journal of Technology in Teaching and Learning*, *7*(1), 24–35.

Brandes, B., Busse, H., Sell, L., Christianson, L., & Brandes, M. (2020). Protocol for a scoping review to identify and map intervention components of existing school-based interventions for the promotion of physical activity and cardiorespiratory fitness among school children aged 6-10 years old. *BMJ Open*, *10*(10), e037848. https://doi.org/10.1136/bmjopen-2020-037848

Butler, J. (2014). TGfU – Would you know it if you saw it? Benchmarks from the tacit knowledge of the founders. *European Physical Education Review*, *20*(4), 465–488. https://doi.org/10.1177/1356336X14534356

Cardoso, V. D., de Castro Haiachi, M., Filho, A. R. R., & Gaya, A. C. A. (2018). Financial support for paralympic athletes in Brazil. *Journal of Physical Education (Maringa)*, *29*(1), 1–10. https://doi.org/10.4025/jphyseduc.v29i1.2963

Chaeroni, A., Komaini, A., Pranoto, N. W., & Antoni, D. (2022). The Effect of Physical Activity Programs and School Environments on Movement Activities and Mental Health. *International Journal of Human Movement and Sports Sciences*, *10*(2), 131–137. https://doi.org/10.13189/saj.2022.100201

Chan, K. K. H., Xu, L., Cooper, R., Berry, A., & van Driel, J. H. (2020). Teacher noticing in science education: do you see what I see? *Studies in Science Education*, *00*(00), 1–44. https://doi.org/10.1080/03057267.2020.1755803

Cheng, K. H., & Tsai, C. C. (2013). Affordances of Augmented Reality in Science Learning: Suggestions for Future Research. *Journal of Science Education and Technology*, *22*(4), 449–462. https://doi.org/10.1007/s10956-012-9405-9

D'Isanto, T., Altavilla, G., & Raiola, G. (2017). Teaching method in volleyball service: Intensive and exenstive tools in cognitive and ecological approach. *Journal of Physical Education and Sport*, *17*(5), 2222–2227. https://doi.org/10.7752/jpes.2017.s5233

Haris, F., Ilham, Taufan, J., Aulia, F., Gusril, Komaini, A., & Pranoto, N. W. (2023). Development of the Physical Activity Learning through QR Code Android-Based and Teaching Books for the Deaf. *International Journal of Human Movement and Sports Sciences*, *11*(3), 683–690. https://doi.org/10.13189/saj.2023.110323

Kesim, M., & Ozarslan, Y. (2012). Augmented Reality in Education: Current Technologies and the Potential for Education. *Procedia - Social and Behavioral Sciences*, *47*(222), 297–302. https://doi.org/10.1016/j.sbspro.2012.06.654

Komaini, A. (2017). Peningkatan Keterampilan Gerak Dasar (Fundamental Motor Skills) Anak Melalui Pendekatan Bermain Murid Taman Kanakkanak Kota Padang. *Jurnal Sains Keolahragaan Dan Kesehatan*, *2*(2), 54. https://doi.org/10.5614/jskk.2017.2.2.6

Komaini, A., Hidayat, H., Ganefri, Alnedra, Kiram, Y., Gusril, & Mario, D. T. (2021). Motor Learning Measuring Tools: A Design And Implementation Using Sensor Technology For Preschool Education. *International Journal of Interactive Mobile Technologies*, *15*(17), 177–191. https://doi.org/10.3991/ijim.v15i17.25321

Komar, J., Chow, J. Y., Kawabata, M., & Choo, C. Z. Y. (2022). Information and Communication Technology as an enabler for implementing Nonlinear Pedagogy in Physical Education: Effects on students' exploration and motivation. *Asian Journal of Sport and Exercise Psychology*, *2*(1), 44–49. https://doi.org/10.1016/j.ajsep.2022.02.001

Li, Y. W. (2016). Transforming Conventional Teaching Classroom to Learner-Centred Teaching Classroom Using Multimedia-Mediated Learning Module. *International Journal of Information and Education Technology*, *6*(2), 105–112. https://doi.org/10.7763/ijiet.2016.v6.667

Montgomery, D. C. (2013). Design and Analysis of Experiments. In L. Ratts, L. Buonocore, A. Melhorn, C. Ruel, H. Nolan, & M. Eide (Eds.), *Design* (8th ed., Vol. 2). John Wiley & Sons, Inc. http://cataleg.uab.cat/record=b1764873~S1*cat

Moraru, M., & Cristea, G. (2013). Self-knowledge and Professional Development-sustainable Educational Condition of a Relationship. *Procedia - Social and Behavioral Sciences*, *89*, 94–97. https://doi.org/10.1016/j.sbspro.2013.08.816

Murakami, Y., Nguyen, T. T. M., Baratang, N., Raju, P. K., Knaus, A., Ellard, S., Jones, G., Lace, B., Rousseau, J., Ajeawung, N. F., Kamei, A., Minase, G., Akasaka, M., Araya, N., Koshimizu, E., van den Ende, J., Erger, F., Altmüller, J., Krumina, Z., … Campeau, P. M. (2019). Mutations in PIGB Cause an Inherited GPI Biosynthesis Defect with an Axonal Neuropathy and Metabolic Abnormality in Severe Cases. *The American Journal of Human Genetics*, *105*(2), 384–394. https://doi.org/https://doi.org/10.1016/j.ajhg.2019.05.019

Park, J. H., & Park, M. (2021). Smartphone use patterns and problematic smartphone use among preschool children. *PLoS ONE*, *16*(3 March), 1–12. https://doi.org/10.1371/journal.pone.0244276

Pavlidis, G., & Gargalianos, D. (2014). High performance athletes' education: Value, challenges and opportunities. *Journal of Physical Education and Sport*, *14*(2), 293–300. https://doi.org/10.7752/jpes.2014.02044

Schmid, R., & Petko, D. (2019). Does the use of educational technology in personalized learning environments correlate with self-reported digital skills and beliefs of secondary-school students? *Computers and Education*, *136*, 75–86. https://doi.org/10.1016/j.compedu.2019.03.006

Schwab, S., Wimberger, T., & Mamas, C. (2019). Fostering Social Participation in Inclusive Classrooms of Students who are Deaf. *International Journal of Disability, Development and Education*, *66*(3), 325–342. https://doi.org/10.1080/1034912X.2018.1562158

Schwingshackl, L., Dias, S., & Hoffmann, G. (2014). Impact of long-term lifestyle programmes on weight loss and cardiovascular risk factors in overweight/obese participants: a systematic review and network meta-analysis. *Systematic Reviews*, *3*, 130. https://doi.org/10.1186/2046-4053-3-130

Sridadi, Tomoliyus, Septiasari, E. A., Parijan, Yuliarto, H., & Ilham. (2021). Effect of technical training using a ball on the dribbling speed for football players aged 10-12 years. *International Journal of Human Movement and Sports Sciences*, *9*(4), 824–831. https://doi.org/10.13189/saj.2021.090429

Sulistiyowati, E. M., Suherman, W. S., Sukamti, E. R., Ilham, Sriwahyuniati, F., Budiarti, R., & Pranoto, N. W. (2022). Development of Early Childhood Skills by Guiding Tests in Sports Rhythmic Gymnastics. *International Journal of Human Movement and Sports Sciences*, *10*(2), 253–263. https://doi.org/10.13189/saj.2022.100216

Tzanetakos, N., Papastergiou, M., Vernadakis, N., & Antoniou, P. (2017). Utilizing physically interactive videogames for the balance training of adolescents with deafness within a physical education course. *Journal of Physical Education and Sport*, *17*(2), 614–623. https://doi.org/10.7752/jpes.2017.02093

Vidoni, E. D., Johnson, D. K., Morris, J. K., Van Sciver, A., Greer, C. S., Billinger, S. A., Donnelly, J. E., & Burns, J. M. (2015). Dose-Response of Aerobic Exercise on Cognition: A Community-Based, Pilot Randomized Controlled Trial. *PloS One*, *10*(7), e0131647. https://doi.org/10.1371/journal.pone.0131647

Wang, S. K., & Hsu, H. Y. (2014). Preparing teachers in science through technology for STEM education. In *STEM Education: How to Train 21st Century Teachers* (Issue January 2014, pp. 33–52).

Westin, T., Neves, J. C., Mozelius, P., Sousa, C., & Mantovan, L. (2022). Inclusive AR-games for Education of Deaf Children: Challenges and Opportunities. *Proceedings of the European Conference on Games-Based Learning*, *2022-Octob*, 597–604. https://doi.org/10.34190/ecgbl.16.1.588

Appedix Daily Activities Program Outline

MCL Program Framework

No	Program	Sub Program	Duration (Minutes)	Developed skills
1	Locomotor	Tidying Up Toys Running Game	45	Running movement
2		Floor Mopping Game	45	Pushing movement
3		Jumping to Pick Fruits from Trees Game	45	Jumping movement
4		Tree Climbing Game	45	Climbing movement
5		Going Up and Down the Stairs Game	45	Balance
6		Springboard Jumping Game	45	Jumping motion
7	Control Object	Carrying a Glass on a Tray Game	45	Balancing movement
8		Stone Throwing Game	45	Throwing movement
9		Throwing and Catching Balloon Game	45	Catching movement
10		Hitting Objects Game	45	Striking movement