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Original Article

The effect of the electric cube assistive technology device on the special needs children's basic movements

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Abstract
Inclusive education in physical education is a hot topic today. Educators and researchers are competing to conduct research and development in order to improve the quality of physical education learning for children with special needs. One form of support for them is by providing assistive technology that can stimulate and help them carry out physical activities.The objective of this study is to discover the effectiveness of electric cube on the children with special needs' basic movement. This research is to develop technology-based tools to provide knowledge and skills to adaptive physical education teachers who teach students with disabilities. This study uses experimental research approach. The research design in this study is a randomized control group pretest-posttest design. Using 10 children with mild mental disabilities as a control group and 10 children with mild mental disabilities in the experimental group. This research was conducted in the Malang city and Malang regency for 2 months with 24 times treatments. Based on the output table of "*Independent Samples Test*" it is revealed that the value of Sig. (2-tailed) is 0.026 <0.05, so as a basis for decision making in the independent samples t test, it can be seen that H_o is rejected and H_a is accepted. Therefore, it can be concluded that there is a significant difference in the basic movements final test results between the experimental group and the control group. The conclusion of this study, even though the results show that there is a significant difference, we still need to study further about special needs children considering that there are still few existing studies related to this topic.
Key Words: Assistive device, Electric cube, Physical fitness, Special needs children

Introduction

Children with special needs whose learning needs differ from normal learners can be instructed to use technology-assisted devices to make them access education more easily. Assistive technology devices can be used to insert any item, equipment, or product system, whether commercially acquired, modified, or adapted, which is used to enhance and maintain the functional abilities of people with disabilities.

Omedc (2011) stated that assistive technology refers to teaching and learning tools created for people with special needs to facilitate their learning. For example, a deaf child may need a hearing aid, an ear making machine, a sound synthesizer, a language skills library, a diagnostic kit, an impedance audiometer, and so on. On the other hand, children with learning disabilities will need the following to learn effectively; alphabet synthesizers, electronic games, test kit batteries, photometers, toys, bottle caps, word cards, paperboard, computers, nerf balls, color paints, and so on. Those with visual impairments need a set of tools to access education more easily. These include: sticks, abacus, Braille machine, thermoform machine, digital recorder, Braille paper, Braille computer, electronic digital typewriter with memory, optacon, telescope and reading machine (Adcninyi, 2008). Assistive technology tools used to describe both products and services for special needs children can be categorized as low technology, medium technology and high technology depending on the sophistication level (Cascly, Hayford and Lynch, 2003; Sears 2007). Low technology devices are often not electronic. They are easy to make and get like bowls with lip communication boards, sticky notes, pen holders, and word car. They are easy to make or acquire like bowls with lip communication boards, sticky notes and pen holders, word car. Intermediate technology devices include audio books, disposable sound output devices, tape recorders, speaking calculators, visual timers and wheelchairs. They require basic instructions or minimal skills to use and are simple to operate. High technology on the other hand is a complex device that is often used to accommodate certain disability functions. Such devices include sound outputs, prosthetic limbs, electronic page-turners, virtual reality systems and computer hardware and software. These technological tools may be useful in inclusive classrooms for the special needs children's benefits (Evans, 2010; Bryant, 2010).

The use of assistive technology in educating children with special needs is a matter of need, not just a privilege. People with special needs deserve good attention, and need special practices to fulfill their basic learning needs so that they can develop to their full potential. Assistive technology has the potential to make

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significant improvements in special needs people's lives which will compensate their physical or functional limitations and also enabling them to improve their social and economic integration into the larger society (Nwachukwu, 2000). Different forms of special needs require different assistive technologies. For people with mobility challenges, improved sensor control allows motor movement to control mobility devices such as electric wheelchairs that allow them to move in independently schools and communities. The key to successful use of assistive technology is by creating a good compatibility between the variety of available devices and the various physical, cognitive, and sensory challenges faced by children with special needs (Schlosser, 2008). Thus, in facilitating physical fitness training, children with disabilities can use computer-based instructional assistive technology. This electric cube is believed to be able to help improving the special needs children's basic movements. This study is important to do to explain solutions that can help encourage formal and informal learning environments for students with mild mental retardation through technology-based game media, especially smart cubes, and cellphone applications which are expected to be practical learning alternatives. The device developed in this research will support the functionality of several Assistive Technology (AT) devices for people with autism and mild mental retardation and propose alternative game media to facilitate movement for free. In addition, this study will analyze user feedback from parents and educators which can be input to improve product quality in this study.(Murvanidze, 2014; Viktor et al., 2022) The influence of assistive technology on students with disabilities is alleged to have a positive impact. However, achieving this requires knowledge on the part of the user, and the involvement of parents and educators greatly influences the use of assistive technology (Laughlin et al., 2018; Simpson et al., 2009). The AT process may require complex matters, but should not cover the potential value for students with disabilities. Services exist to ensure that students are fully supported during the selection, acquisition, and use of the necessary devices. In physical education, devices are used by students to increase their functional capacity to access and achieve learning outcomes. Education educators are advised to work closely with all stakeholders so that decisions embody practical, useful, and individually selected functionality for each student's learning outcomes. The literature reveals that the most prominent barrier to the use of technology is the lack of skills of qualified professionals, particularly physical education teachers for students with special needs. Several technological assistive studies in physical education have been carried out, one of which is in helping students with visual impairments (Lieberman et al., 2014; Rahmat et al., 2021).

Collaboration between teachers of blind students, O&M (Orientation and Mobility) instructors, and physical education teachers can facilitate the inclusion of all areas of the expanded core curriculum (ECC). With this team extended to parents, educators, and students themselves, all visually impaired children can have adequate exposure to all components of ECC and reach their full potential. This research is to develop technology-based tools to provide knowledge and skills to adaptive physical education teachers who teach students with disabilities, especially mild mental retardation or inclusive schools so that they can carry out the teaching and learning process optimally and provide motivation for teachers to teach and make simple technology that can be applied.

Material & methods

This study used an experimental research approach. The research design used a randomized control group pretest-posttest design. 10 children in each control and experimental group.

Participant The subjects in this study were 20 children with mild mental disability aged 3-10 years old in Malang city.

Procedure **Cube Products**

The products used in this experiment were Smart cubes (PA CUBE TOYS). The cube system consists of; Board, Push button, Sound, Light. Cube packaging are made of acrylic hardcase and stickers

The commands embedded in the push button include the following:

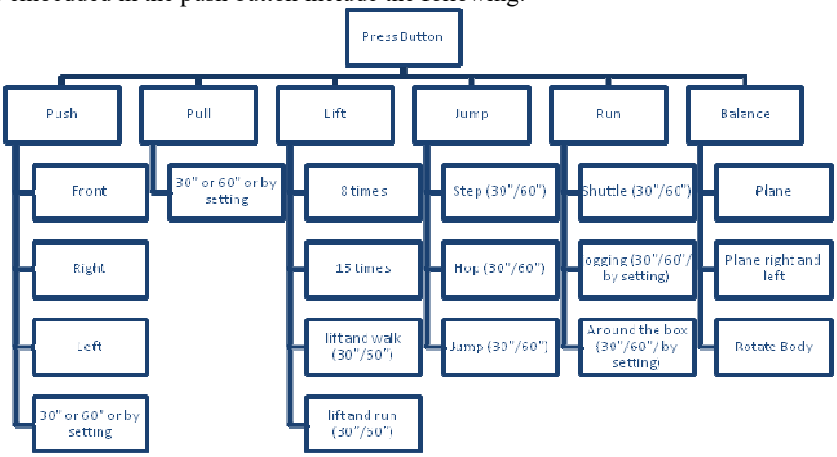

Figure 1. Command diagram for each press button

This cube works by utilizing sensor and system which connected to a laptop or a tablet which can provide a stronger and clearer stimulus for physical activity to children with special needs. When the child or teacher throws the cube, the cube receives a stimulus and turns on the system to initiate physical activity as displayed on a tablet or laptop. The cube working system is illustrated in Figure 2.

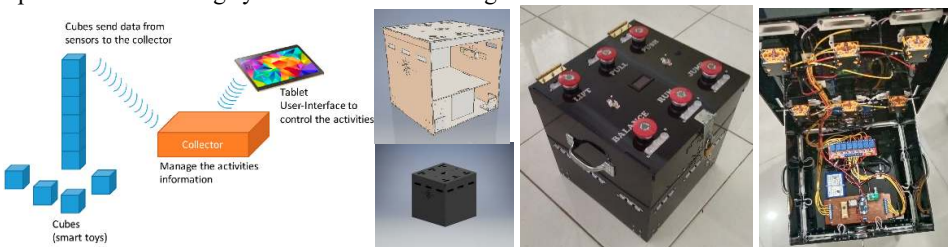

Figure 2. The cube working system and the prototype

The smartphone application is used to set the electric cube in terms of the volume and intensity of each exercise. The smartphone application uses an Android-based programming language. The application connects to the electric cube with a Bluetooth network. There are six main menus in the application according to the type of exercise, namely push, pull, jump, lift, run and balance. Each menu determines the exercise volume and duration starting from 30 seconds, 60 seconds, and so on.

This electric cube was tried by the experts, in addition, the expert also saw how this cube was used by the students. Physical education experts gave an assessment with a percentage of 85.71%, which means that the product is very good and worth to test, while according to the lecturer in Adaptive Physical Education courses, the smart electric cube gets a score of 89.29%, which means it is very good and feasible to use. According to information technology experts, this smart electric cube got a score of 82.14 which means it is good and worth trying out in an actual class.

Data collection and analysis

Instruments which were used for pre-test and post-test used field-based gross motor competence assessments – Test of Gross Motor Development-2 (TGMD-2) (Downs, Boddy, McGrane, Rudd, Melville & Foweather, 2020). The pretest-posttest control group design data in this study were analyzed using the SPSS computer application.

Result

The effectiveness test was conducted on 20 students with mild mental disability in Malang City and Malang Regency. Each student got a pretest and a posttest of basic movements skills consisting of ball throwing, walking straight on the track, 30 meters sprinting, and jumping forward. During the test, each student had two chances and the best score was taken. All test item scores were then combined and averaged. In the experimental group, students used physical activity aids in the form of smart electric cubes, while the control group used pre-existing media.

To find out the difference in the quality level of the final scores in the experimental group and the control group, the following *independent sample test t test* was used. The results of *Independent Sample Test* on the basic movements ability variables of students with mild mental disabilities are presented in the table 1.

Table 1. Description Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Basic movements Posttest	Experiment	10	36.9375	6.12208	1.08224
	Control	10	33.1875	6.85811	1.23003

Based on the Table 1, it is known that the average value of the experimental group's final test results of basic movements was 36.9375, while for the control group was 33.1875. Therefore, it can be concluded that there is a difference between the results of the final basic movements test in the experimental group and the control group. Furthermore, to prove whether the difference is real (significant) or not, it is interpreted through the Table 2.

Table 2. Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Basic movements Posttest	Equal variances assumed	1.303	.158	2.189	62	.026	3.75000	1.63836	.47496	7.02504
	Equal variances not assumed			2.189	61.011	.026	3.75000	1.63836	.47391	7.02609

Based on the table 2, it is known that the value of *Sig. Levene's Test for Equality of Variances* is 0.158 > 0.05, which means that the data variance between the experimental group and the control group is homogeneous or the same, so the interpretation of the output table above is guided by the values contained in the "*Equal Variances Assumed*" table.

Based on the "*Independent Samples Test*" output table in the "*Equal Variances Assumed*" section, it is known that the Sig. value (2-tailed) is 0.026 <0.05, so as a basis for decision making in the independent samples t test, it can be concluded that H_o is rejected and H_a is accepted. Therefore, it can be concluded that there is a significant (real) difference in the basic movements skills final test results between the experimental group and the control group.

Discussion

This study shows that there is a significant difference in basic movements skills final test results between the experimental group and the control group. This means that the electric cube has a positive effect on the physical fitness of children with special needs. assistive technology can support the learning and communication of students with various disabilities (Borg et al., 2011; Michaels & McDermott, 2003; P. Akpan Ph.D. & A. Beard Ed.D., 2013). Meanwhile, Alammary emphasized that Assistive Technology plays a vital role in the lives of special needs children (Alammary et al., 2017).

Wehmeyer et al (2004) stated that the use of relevant technology for students with disabilities will go beyond how technology is used at the moment. Because the program of students with special needs involves both core academic content and skills areas. Thus, in addition to using technology for traditional instructional purposes such as computer-assisted instruction, students with disabilities can benefit from technology to support learning in a variety of life skills areas to promote academic progress and achievement.

This study provides an example of how the smart cube as a tool for mild mental retardation can be integrated into the physical education curriculum. These examples can be achieved by collaboration between parents, instructors, and physical education teachers, and can be developed by other instructors who teach prospective teachers of students with intellectual disabilities. For these components to be successfully included, the authors suggest five steps: working with parents, pre-teaching (integration of the cube in lesson planning), training educators (cube operation manual and its features), incorporating peer tutors (trial/trial) boundary practicum), includes a program for using cubes outside of school hours.(Dimmick, 2022; Petrova et al., 2022)

The involvement of parents in the process of planning and implementing smart cubes in the curriculum is very important. Parents of mentally retarded children can provide physical education teachers with ideas related to the interests of families and children outside the school environment (physical activity). Parents can also strengthen the learning provided at school by practicing movements and skills with their children in the home environment. Teachers must share curriculum and student success with parents on an ongoing basis.

Children with mental retardation need more instruction and practice time to learn new concepts and movements at the pre-learning. Some of the difficulties experienced by mentally retarded students in learning new skills are their difficulties in capturing the skills or concepts being taught. Blind children need pre-teaching, teaching, and re-teaching to acquire skills. This teaching cycle is also very important in learning skills and concepts related to physical education.

Physical education teacher training for mental retardation is needed to ensure that movement skills are covered in physical education and to facilitate students. It is the role of the instructor of the mentally retarded student together with the physical educator to design an Individualized Education Program in this area and to organize and integrate the electronic cube into learning. Educators can help integrate the use of the electronic cube in supporting student progress during physical education instruction. Instruction changes can be made based on this performance data. In addition to educators, peer tutors can provide age-appropriate support in physical education and can be used in conjunction with educators if needed.

When it comes to including smart cubes in physical education teacher education programs, we recommend that smart cubes be included in teacher preparation programs for mentally retarded students as early as possible. The smart cube and its features should also be part of an educational program for physical education teachers. If a practice education professional preparation program teaches strategies for using smart cubes in the classroom, these prospective teachers may be more likely to include this medium in their entire classroom. If parents of mentally retarded students and instructors collaborate with physical education teachers, this professional group may be very successful in incorporating smart cubes into lessons and daily activities. Thus, physical activity can become a lifestyle rather than a school subject.

Incorporating the smart cube program after school has been confirmed as a support to stimulate physical activity outside of school. in collaboration with mentally retarded professionals, physical education teachers can continue to contribute to the use of smart cubes through school-based physical activity and after-school sports programs (for example, intramural sports, fitness clubs, or sports clubs). It is important for all school personnel involved in the education of blind students to work together in improving students' abilities during these activities.

Conclusions

Researchers have collaborated with physical education experts specifically for children with disabilities and microcontrollers/software and hardware programming, we have finally succeeded in creating a product that we call a smart cube as a physical activity aid for children with mild mental retardation.

This smart cube has gone through the stages of designing, collecting materials, assembling, limited trials, and feasibility trials until we implement it in actual learning, the results of which we present in this article.

the results of the implementation of the smart cube show that there is a significant difference between the results of the final test of basic movement skills which is significant (real) between the experimental group and the control group with a Sig value. the (2-tailed) value is 0.026 < 0.05.

Although this study shows that there are significant differences in the final basic motor skills test results between the experimental and control groups, the contribution of future researchers is important to support the current results. Given that there is still little research on the effectiveness of using assistive technology in children with special needs, especially those discussing physical activity.

Even though this current study shows that there is a significant difference in the results of the final test of basic movements skills between the experimental group and the control group, the future researchers' contributions are important to support this current results. Considering that there are still few existing studies on the effectiveness of assistive technology usage in children with special needs, especially those that discuss physical activities.

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References

Adcninyi, E. O. (2008). New perspectives in special needs education for national development. *18th Annual National Conference of the National Association for exceptional children held at Educational Resources Centre.* Abuja.

Alammary, J., Al-Haiki, F., & Al-Muqahwi, K. (2017). The impact of assistive technology on down syndrome students in Kingdom of Bahrain. *Turkish Online Journal of Educational Technology*, *2017*(November Special Issue IETC), 759–778.

Allison, D. B. (1991). Brief report: Comparative effects of antecedent exercise and lorazepam on the aggressive behavior of an autistic man. *Journal of Autism and Developmental Disorders, 21*, 89–94. doi:10.1007/BF02207001

Borg, J., Lindström, A., & Larsson, S. (2011). Assistive technology in developing countries: A review from the perspective of the Convention on the Rights of Persons with Disabilities. *Prosthetics and Orthotics International*, *35*(1), 20–29. https://doi.org/10.1177/0309364610389351

Bryant, B. R. (2010). Assistive technology and support provision. *A selective review of the literature and proposed areas of Application Exceptionality, 75*(4), 203-213.

Cascly-Hayford and Lynch, P. (2003). *ICT and special needs education in Africa* . (Imfundo disability education Australia, Human opportunity commission) Retrieved February 19, 2022, from http://www/hrcx.gov.an/disabilityrights/cducation/cducation html education Australia.

Dimmick, D. (2022). Evaluation of teaching games to understand how to improve the motivation levels of children with special needs. *Journal of Physical Education and Sport*, *22*(4), 879–883. https://doi.org/10.7752/jpes.2022.04111

du Toit, R. K. (2018). A global public health perspective: facilitating access to assistive technology . *Optometry and Vision Science, 9*(95), 883-888.

Erim, G. &. (2017). Determining the motor skills development of mentally retarded children through the contribution of visual arts. *Universal Journal of Educational Research, 8*(5), 1300–1307.

Evans, C. W. (2010). Using high and low technology to enhance self and peer assessment and feedback for pre-service teachers. *Journal of Special Education Technology, 25*(4), 55-60.

Groff, D. G. (2009). Influence of adapted sport on quality of life: Perceptions of athletes with cerebral palsy. *Disability and Rehabilitation, 31*, 318–326.

Hillier, A. M. (2011). A pilot study: Short term reduction in salivary cortisol following low level physical exercises and relaxation among adolescents and young adults on the autism spectrum. *Stress and Health, 27*, 395–402.

Kings-Sears, M. E. (2007). Premises, principles and processes for integrating technology into instruction. *Teaching Exceptional Children*, 6-14.

LaLonde, K. B. (2014). Increasing physical activity in young adults with autism spectrum disorders. *Research in Autism Spectrum Disorders, 8*, 1679–1684.

Laughlin, M. K., Murata, N. M., Gonnelli, M., & Larranaga, J. (2018). Assistive Technology: What Physical Educators Need to Know. *Journal of Physical Education, Recreation and Dance*, *89*(3), 38–45.

https://doi.org/10.1080/07303084.2017.1417930

Lieberman, L. J., Haegele, J. A., Columna, L., & Conroy, P. (2014). How students with visual impairments can learn components of the expanded core curriculum through physical education. *Journal of Visual Impairment and Blindness*, *108*(3), 239–248. https://doi.org/10.1177/0145482x1410800307

Menear, K. S. (2015). Promoting physical activ ity for students with autism spectrum disorder: Barriers, benefits, and strategies for success. *Journal of Physical Education, Recreation & Dance, 86*, 43–48. doi:10.1080/07303084.2014.998395

Michaels, C. A., & McDermott, J. (2003). Assistive Technology Integration in Special Education Teacher Preparation: Program Coordinators' Perceptions of Current Attainment and Importance. *Journal of Special Education Technology*, *18*(3), 29–44. https://doi.org/10.1177/016264340301800302

Murvanidze, E. (2014). Effectiveness of specific physical exercises in cases of ataxic cerebral palsy. *Journal of Physical Education and Sport*, *14*(2), 260–262. https://doi.org/10.7752/jpes.2014.02039

Niklasson, M. N. (2017). Catching-up: Children with developmental coordination disorder compared to healthy children before and after sensorimotor therapy. *PLoS ONE, 10*(12), e0186126.

Nonis, K. P. (2014). The gross motor skills of children with mild learning disabilities. *International Journal of Special Education, 2*(29), 92–97.

Nwachukwu, K. E. (2000). The place of Assistive Tcchnology(AT) in special needs education in Nigeria. *The Journal of the National Council of Exceptional children, 2*(7), 311-378.

Omedc, A. A. (2011). Reforms in special education for optimum educational attainment by persons with special needs for National Sustainability. *Journal of Emerging Trends in Educational Research and Policy Studies, 2*(4), 296-300.

P. Akpan Ph.D., J., & A. Beard Ed.D., L. (2013). Overview of Assistive Technology Possibilities for Teachers to Enhance Academic Outcomes of All Students. *Universal Journal of Educational Research*, *1*(2), 113–118. https://doi.org/10.13189/ujer.2013.010211

Petrova, A., Bala, T., Masliak, I., & Mameshina, M. (2022). The effect of CrossFit exercises on the physical health level of 16–17-year-old boys. *Journal of Physical Education and Sport*, *22*(4), 955–961. https://doi.org/10.7752/jpes.2022.04121

Rahmat, A., Sumpena, A., & Hidayat, T. (2021). *Original Article Survey on the Application of Assistive Technology in Physical Education*. *1*(October), 58–63.

Simpson, C. G., McBride, R., Spencer, V. G., Lodermilk, J., & Lynch, S. (2009). Assistive Technology: Supporting Learners in Inclusive Classrooms. *Kappa Delta Pi Record*, *45*(4), 172–175. https://doi.org/10.1080/00228958.2009.10516540

Schlosser, R. W. (2008). Effects of augmentative and alternative communication intervention on speech production in children with autism: A systematic review. *American Journal of Speech Language Pathology, 3*(17), 212 - 230.

Solish, A. P. (2010). Participation of children with and without disabilities in social, recreational and leisure activitie. *Journal of Applied Research in Intellectual Disabilitie, 23*, 226–236. doi:10.1111/j.1468-3148.2009.00525.x

Sorensen, C. a. (2014). Benefits of physical activity for adolescents with autism spectrum disorder: A comprehensive review. *Review Journal of Autism and Developmental Disorders, 1*, 344-353. doi:10.1007/s40489-014-0027-4

Sowa, M. a. (2012). Effects of physical exercise on autism spectrum disorders: A meta-analysis. *Research in Autism Spectrum Disorders, 6*, 46–57. doi:10.1016/j.rasd.2011.09.001

Svensson, I. N. (2021). Effects of assistive technology for students with reading and writing disabilities. *Disability and Rehabilitation: Assistive Technology, 2*(16), 196-208.

Viktor, P., Vladyslav, R., Andrii, Y., Yelena, P., Yaroslav, K., & Svetlana, P. (2022). Special coordination exercises in the track and field athletics training program for pupils with special needs. *Journal of Physical Education and Sport*, *22*(3), 645–651. https://doi.org/10.7752/jpes.2022.03081

Wehmeyer, M. L., Smith, S. J., Palmer, S. B., & Davies, D. K. (2004). Technology Use by Students with Intellectual Disabilities: An Overview. *Journal of Special Education Technology*, *19*(4), 7–21. https://doi.org/10.1177/016264340401900402