EFFECTS OF ADAPTED COMPUTER USE ON MATHEMATICS PERFORMANCE OF STUDENTS WITH CEREBRAL PALSY IN JOYTOWN SPECIAL SECONDARY SCHOOL KIAMBU COUNTY, KENYA

Betty Mulavi[1i],
Franciscah Irangi Wamocho[2],
Molly Ogalloh[3]
[1]Masters' Student,
Department of Special Needs Education,
Kenyatta University,
Kenya
[2]Dr., Senior Lecturer,
Early Childhood and Special Needs Education Department,
Kenyatta University,
Kenya
[3]Dr., Lecturer,
Early Childhood and Special Needs Education Department,
Kenyatta University,
Kenya

Abstract:
The paper reports some of the key findings of a study that explored the effects of adaptive computer use on the mathematics performance of students with cerebral palsy in Joytown Special Secondary School for the Physically Handicapped in Kiambu County, Kenya. In the study, a quasi-experimental design was adopted utilizing a sample size of 32 students with cerebral palsy. Purposive and stratified random sampling techniques were adopted in selecting the sample size. The research study applied Amabile and Kramer's progress theory and the primary data collection methods were classroom observation checklists, interview guides and pre-test and post-test. The research data was analyzed using SPSS version 22 and primary data analyzed per the study objectives. The findings on the impacts of adapted computer use on mathematics performance of students with cerebral palsy are reported. The study findings demonstrated that adapted computer use increases the academic independence and performance of students. This confirms that the integration of assistive technology in mathematics learning can be a compensatory tool for children with cerebral palsy despite the motor and communication dysfunctions resulting from their disabling condition. On the basis of the study findings, recommendations are provided.

---

[i] Correspondence: email mulavibetty@gmail.com

Keywords: assistive technology, adapted computer use, mathematics performance, students with cerebral palsy

1. Introduction

Today, the World Health Organization statistics estimate that 15% of the world's population have mild, moderate or severe disabilities. Among the 15%, adolescents and children with disabilities form 5% of the population (Olusanya, Davis & Hoffman, 2019). Among these, are students with cerebral palsy (CP). The statistics of adolescents living with CP are increasing annually and their moderate and severe exceptionalities impose motor and communication dysfunctions. This is a result of non-progressive brain damage in the early stages of the child's life. According to Embley (2019), assistive technologies increase the chances of acquiring mathematics skills among students with CP in the learning process.

Cerebral palsy is a major common cause of motor disabilities in childhood. Currently, the number of students joining special secondary schools in Kenya with different forms of CP is on the increase (African Population and Health Research Center, 2016). According to the National Institute of Health NIH (July 2013), abnormal brain development or injury to the brain during prenatal, perinatal, and postnatal periods can result in cerebral palsy. Most cases of cerebral palsy that were reported pointed out that the damaged part in the brain was responsible for body coordination, posture, and movement. However, there is no cure. The physical limitations associated with the cerebral palsy condition affect students' abilities to perform various tasks like their non-disabled peers. As a consequence, assistive technology is always considered a way of compensating and providing alternate means for performing this task in a classroom environment (Embley, 2019). The United Nations Convention on the Rights of Persons with Disability (UNCRPD) advocates for the Right to Quality Education for all children, even exceptional students.

The No Child Left Behind Act of 2001 as a catalyst has improved school facilities in addressing the educational barriers of students with cerebral palsy (No Child Left Behind, 2013). Most academic institutions across the globe have embraced the urgency of the adoption of AT in education to create a learning environment that can benefit all exceptional students. Assistive technologies have created more possibilities for students with CP to overcome the challenges they face while interacting with the curriculum and classroom content (Ahmed, 2018). According to Embley (2019), assistive technologies create greater independence for exceptional students by enabling them to accomplish the tasks they had difficulties performing. Besides, assistive technology has changed the ways exceptional students interact with the curriculum. According to the Republic of Kenya document (2009), the Ministry of Education with other multiple partners came up with the SNE policy framework to increase access to specialized technology and facilities among exceptional students as they receive special education services. However, minimal changes have been adopted in teaching and instructing mathematics to students

with CP. In most cases, the students are subjected to the regular educational curriculum with their non-disabled peers with little adaptations made by their special needs teachers.

2. Literature Review

Assistive technologies have created more possibilities for students with CP to overcome the challenges they face while interacting with the curriculum and classroom content (Ahmed, 2018). According to Embley (2019), assistive technologies including adapted computers create greater independence for exceptional students by enabling them to accomplish the tasks they had difficulties performing. Besides, assistive technology has changed the ways exceptional students interact with the curriculum. A study by Bruno, Lewis, Kaldenberg, Bahr and Immerfall (2020), in Washington State (USA) evaluating how students enrolled in compressive post-secondary schools learnt higher-level written text revealed that the use of adapted computer speech synthesis software was effective. The study using sixth-grade and third-grade learners concluded that the use of adapted computers increased reading comprehension among the students. The current study was done in Kenya and the focus was placed on the use of adapted computers and the mathematics performance of students with CP.

A study by Burt, Graham and Hoang (2020), examining the effects of multimedia-based computer-assisted instructions in learning new words established that the use of computer-assisted instructions improved the vocabulary knowledge of the students. The study was focused on forty students from year 7 and year 10 in Australia. The researchers utilized pre-test and post-test. Both groups significantly improved their scores in posttests implying that the assistive aid was an effective teacher. The current study focused on students with CP using a sample size of 32 students in form two and form three.

A study by Adebesi, Liman and Longpoe (2015), using a descriptive survey design investigating the role of AT on students with learning disabilities in Nigeria, established that the use of AT increased students' independence in classroom tasks, increased the mastering level of difficult classroom concepts, enabled students to work side by side with their peers and increased access to educational options by increasing high levels of independence. The present study focused on students with CP to explore the effectiveness of AT on mathematics performance.

A study by Wairimu (2019) on the effectiveness of AT on mathematics performance of students with visual impairments found out that AT increased the mathematics performance of students with Visual Impairments. This study was conducted in special primary schools having students with Visual Impairments in Kenya and involved the use of a descriptive survey research design. Observation checklists, interview guides and observation schedules were utilized as data collection tools. The present study focused on students with CP in Joytown Special Secondary for students with physical disabilities.

3. Methods

The reported findings were obtained from a research study that adopted a quasi-experimental design. The design was relevant to the study as it is used in determining the causal effect of a long-lasting treatment (Cook, 2015). The researcher used pre-test and post-test to collect the raw quantitative data. The pretest enabled the researcher to obtain quantitative data before the introduction of the treatment which involved the use of adapted computers. After 12 weeks of exposure to the treatment, the researcher gave a posttest to the selected sample to determine whether adapted computers help students with cerebral palsy to improve and overcome the challenges they face during mathematics lessons and their overall performance. The locale of the study was Joytown Special Secondary School in Kiambu County, Kenya. The choice of the study locale was based on the fact that the school happened to have been sampled by the African Population and Research Centre in 2016, in a fact pseudo study that was conducted in different special schools having students with cerebral palsy. The findings revealed that some of the challenges students with cerebral palsy experienced while interacting with classroom content included; challenges in time management, organization and writing difficulties due to the spasticity of the muscles on the affected limbs. Recommendation on the need to implement assistive technology in classrooms and further research was provided.

The study targeted form two and form three students with cerebral palsy since they are conversant with adapted computers. Purposive, and stratified random sampling techniques were adopted in selecting 16 forms two and 16 forms three students with cerebral palsy out of 57 targeted students with cerebral palsy in the two classes.

Table 1: Sampling Grid

	Target Population	Sample size	Female	Male
Form Two CP Students	28	16	8	8
Form Three CP Students	29	16	8	8
Total	57	32	16	16

The primary data collection methods were classroom observation checklists, interview guides and pre-test and post-test.

3.1 Logistic and Ethical Consideration
Before conducting research, the researcher obtained an introductory letter from the Graduate School, Kenyatta University. The introductory letter was utilized during the acquisition of a research permit from the National Council for Science and Technology at the Ministry of Education in Nairobi. After obtaining this permit, the researcher submitted a copy of the research authorization and permit letters to the County Education Directors and County Commissioners of the study locale. The researcher visited the school to seek research consent from the head of the institution. The need for consent was affirmed by Lankshear and Knobel (2011).

At the start of the research study, the researcher presented the objective of the research study and allowed participants to present themselves voluntarily. The researcher assured confidentiality to the study participants before collecting data. The researcher used pseudo names for the study participants. Besides, the participants were guaranteed that the collected information was to be destroyed upon analyzing data to avoid misappropriation of the data.

3.2 Data Collection Techniques

The researcher negotiated with the principal to be allocated two lessons per week in the school timetable (Monday and Friday) for a period of 12 weeks. An arrangement was made to acquaint the target population with the study. A pre-test was done on the selected 16 forms two and 16 forms three students with CP during mathematics lessons in their classroom before the initiation of the treatment. The researcher then introduced the treatment (using an adapted computer) to the students with CP for a period of twelve weeks. During the assigned period (Monday and Friday) from 9:30 to 10:10, the learner's behavior towards the adapted computer was observed to collect the primary data. At the end of twelve weeks, a posttest was issued.

3.3 Data Analysis

The research data was analyzed using SPSS version 22 since its product is guaranteed. The primary data was analyzed in correspondence with the study objectives. The quantitative data presented in frequencies and percentages were analyzed through descriptive statistics in a bid to explore the variables used in the study.

4. Discussion and Research Findings

4.1 Impacts of Adapted Computer Use on Mathematics Performance of Students with CP

The study sought to explore the impact of adapted computer use on the mathematics performance of students with cerebral palsy. The researcher administered a pretest and a posttest at an interval of 12 weeks. The pretest was utilized in gathering information about students' needs and strengths in different concepts of mathematics. The pretest was done in two hours and the results were scaled as follows.

Table 4.1: Scoring Procedure for the Pretest and Posttest

Criteria	Pre-test	Post-test
Fail	1-5	5-10
Pass	5-25	10-25

After introducing the 12 weeks treatment the researcher administered a posttest to evaluate the effectiveness of adapted computers in improving the mathematics performance of students with cerebral palsy. The study findings for the pre-test and post-test are presented in Table 4.2 as follows:

Table 4.2: Statistics

Statistics		Pretest	Posttest
N	Valid	32	32
	Missing	0	0
Mean		8.66	17.03
Median		6.00	13.50
Mode		6	12[a]

A total of 32 (100%) study participants undertook a pre-test. The test was marked and scored. The pretest average mean was 8.66 while the median was 6.00. After administering treatment, a post was administered and scored. The post-test results have a mean of 17.03 and the median was 13.50. The mean of the posttest was slightly higher than the mean of the pretest thus indicating an improvement in performance.

The improvement in performance by students with cerebral palsy in form two and form three in the posttest after administering the treatment reveals that the use of adapted computers is effective in improving the mathematics performance of students with cerebral palsy. The study findings are in line with various studies that were included in the literature review of this study. The study findings concurred with a study by Kisanga and Kisanga (2020), investigating the role of assistive technologies in fostering learning and student participation. The study findings revealed that the use of assistive technology increased students' independence in classroom tasks, increased mastering level of difficult classroom concepts, enabled students to work side by side with their peers and increased access to educational options by increasing high levels of independence.

5. Recommendation

Due to the limited scope of the current research study, the research was unable to carry out extensive research on students with CP and their mathematics performance at all academic levels. Therefore, the following are the recommendations from the current study. It is important to evaluate the special needs curriculum to ensure that the curriculum content is in line with the new trends of technology so that students with cerebral palsy at all levels can benefit thus improving their general performance. The study recommends the government and the Ministry of Education prioritize the provision of assistive technology to students with cerebral palsy, so they can learn effectively. Lastly, there is a need for further research on the effect of adapted computer use in other levels of education and subjects.

6. Conclusion

Based on research findings, it is logical to infer that adapted computer use increases the mathematic performance of students with cerebral palsy by increasing levels of

participation and access to classroom content and materials. This stresses the Importance of integrating assistive technology in classes. Further, there is a need to provide adapted computers to students with cerebral palsy upon joining the school to help them acquire abstract and mathematics solving skills that are key to improving mathematics performance.

Acknowledgement

Conflict of Interest Statement

The authors declare no conflicts of interest.

About the Authors

Betty Mulavi is a master's student in the Department of Special Needs Education at Kenyatta University, Kenya. She has specialized in physical and multiple disabilities. Research interests are in the areas of Technology and disability, and inclusive education.
Dr. Wamocho, Franciscah Irangi is a senior lecturer in the Department of Early Childhood and Special Needs Education at Kenyatta University, Kenya. She has published quite a number of research articles in peer-reviewed journals. Her areas of specialization include orthopedic disabilities, other health and multiple impairments & guidance and counseling for students with special educational needs. Research interests are in the areas of inclusive education, Behavior management, vocational rehabilitation, guidance and counseling.
Dr. Ogalloh, Molly is a lecturer in the Department of Early Childhood and Special Needs Education at Kenyatta University, Kenya. She has specialized in physical and multiple disabilities and cerebral palsy and has also published in peer-reviewed journals.

References

Adebisi, R. O., Liman, N. A., & Longpoe, P. K. (2015). Using assistive technology in teaching children with learning disabilities in the 21st century. Journal of Education and Practice. 6, 24, 14-20. Retrieved from http://files.eric.ed.gov/fulltext/EJ1078825.pdf.

African Population and Health Research Center (2016, December 16). Challenges facing Special Needs Education in Kenya.

Ahmed, A. (2018). Perceptions of using assistive technology for students with disabilities in the classroom. *International Journal of Special Education*, 33(1), 129-139.

Cook, T. D. (2015). Quasi-experimental design. *Wiley encyclopedia of management*, 1-2.

Embley, C. G. (2019). Coming Forward to Learn. *Journal of Thought*, *53*(1 & 2), 55-72.

Kisanga, S. E., & Kisanga, D. H. (2020). The role of assistive technology devices in fostering the participation and learning of students with visual impairment in higher education institutions in Tanzania. *Disability and Rehabilitation: Assistive Technology*, 1-10.

McNicholl, A., Casey, H., Desmond, D., & Gallagher, P. (2021). The impact of assistive technology use for students with disabilities in higher education: a systematic review. *Disability and Rehabilitation: Assistive Technology*, *16*(2), 130-143.

No Child Left Behind (2013). Retrieved from http://www2.ed.gov/nclb/landing.jhtml.

Olusanya, B. O., Davis, A. C., & Hoffman, H. J. (2019). Hearing loss grades and the international classification of functioning, disability and health. *Bulletin of the World Health Organization*, *97*(10), 725.

Papadakis, S., Kalogiannakis, M., & Zaranis, N. (2018). The effectiveness of computer and tablet-assisted intervention in early childhood students' understanding of numbers. An empirical study conducted in Greece. *Education and Information Technologies*, *23*(5), 1849-1871.

Wairimu, C. M. (2019). *Effectiveness of Assistive Technology on Teaching Mathematics to Learners with Visual Impairments in Special Primary Schools in Kenya* (Doctoral dissertation, Kenyatta University).