International Journal of Science and Research Archive

eISSN: 2582-8185

Cross Ref DOI: 10.30574/ijsra

Journal homepage: https://ijsra.net/

(RESEARCH ARTICLE)

Learner perception on tactile materials as a correlate of performance in mathematics: The case of Thika high school for the Blind, Kiambu County, Kenya

Loise Mumbua Musango *, Margaret Wangui Murugami and Joel Chomba Wamunyi

Department of Early childhood and special Needs Education, Kenyatta University, Kenya.

International Journal of Science and Research Archive, 2024, 12(01), 613–624

Publication history: Received on 01 April 2024; revised on 10 May 2024; accepted on 13 May 2024

Article DOI: https://doi.org/10.30574/ijsra.2024.12.1.0838

Abstract

Mathematics is considered the foundation of scientific and technological growth, making one of the most important subjects taught in formal schools. Yet learners with visual impairment continue to perform poorly in Mathematics due multiple factors, among them unfavorable perceptions on the subject. Drawing from the social constructivism theory, this study aimed to establish learner perception on tactile materials as a correlate of performance in Mathematics among learners in Thika High School for the Blind. The objectives were to investigate general performance of mathematic among the learners who are blind and assess learners' perception on the mathematic tactile learning materials in relation to their performance in Mathematics. This study used a case study research design. The target population comprised 80 learners who are blind in the school. Stratified random sampling was used to select the learners 24 who are blind according to class and gender. Questionnaires were used to collect data. Quantitative data was collected, coded and organized. Data analysis was through descriptive summaries and correlational analyses. There was a weak positive relationship between learners' perception in learning Mathematics and performance in Mathematics (r = 0.203, p = 0.342). The majority the students indicated doing their homework daily when given by the teacher, getting homework marked daily, and doing homework alone daily. Therefore, this study recommends the need for the Ministry of Education to initiate strategies to enhance positive perceptions toward Mathematics among learners who are blind.

Keywords: Tactile learning resources; Blind; Performance in Mathematics; Perception; Visual impairment.

1. Introduction

Mathematics is considered the foundation of scientific and technological growth, making one of the most important subjects taught in formal schools (Algani, 2022). The benefits of Mathematics to individual learners and society cannot be overemphasized. At individual level, Mathematics supports analytical thinking and logical reasoning processes, improves problem-solving skills, and enhances critical thinking and creativity (Hagan *et al*., 2020). Mathematical learning has been linked to significant improvements in the brain's plasticity, various cognitive functions, emotional health, overall life quality, and development indices (Zhang *et al*., 2021). Besides, Mathematics knowledge is essential for the learning of many other subjects, opens multiple career paths to an individual, and is a pre-requisite for several courses. Hence, persons with good math skills are likely to excel in many academic, work, and other life aspects.

The benefits notwithstanding, Mathematics can be challenging to learn. The difficulties are primarily due to the processes involved in learning the subject. Mathematics requires students to engage in multiple forms of representation simultaneously, including mathematical laws and formula, their derivation, and use. Learners also engage in various calculations, graphics, and conceptual understanding at abstract levels. The complexities involved in these processes repel many students, while others struggle to link specific math topics, such as those involving theories and abstract

* Corresponding author: Musango Loise Mumbua

representations, to their day-to-day activities (Aguilar, 2021; Ukobizaba *et al*., 2021). These and other factors make Mathematics one of the most unpopular subjects among students in nearly all education attainment levels.

Students' academic performance in a subject reflect their understanding and appreciation of the subject and its content. Negative perceptions about Mathematics have long-term effects on learners' performance in the subject. Research suggests that individuals with negative attitudes toward Mathematics re likely to perform poorly in the subject (Daud *et al*., 2020; Hagan *et al*., 2020). Learners who are blind share the same difficulties learning Mathematics with their sighted peers. However, their inability to see present them with additional obstacles, which may influence their perception and performance in the subject (Aljundi & Altakhayneh, 2020). In their study, Cobb, Wood, Yackel, Nicholls, Wheatley, Trigatti and Perlwitz (2006) identified the core areas of concern as fear and failure of Mathematics among learners with VI in the United States of America (USA).

In South Africa, Maguvhe (2015) conducted a study to investigate the teaching of Mathematics and Science to students who are blind and those with visual impairment. The case study drew on the experience of one blind male technician, who had great ambitions in the pursuit of science and technology, but with little support. The aim of the study was to understand the teaching and learning playing field. The focus was on what could be done to increase the involvement of visually impaired and halfway located students in Science and Mathematics training. The findings of the study indicated that the blind and partially sighted learners have the same mental capacity to comprehend Mathematics and Science. Maguvhe suggested that blind and partially sighted learners merely need to be accommodated appropriately to enable them to perform as well as their sighted counterparts in those sciences. Varieties of technologies are now available to allow for the participation of visually impaired and halfway located students in Science and Mathematics training.

In Kenya, education for learners with VI is twofold, integrated programs and residential schools. In both cases, Mathematics is a compulsory subject. Mathematics as a subject has proven to be a fundamental component in the overall grade since in any career course in addition to areas of interest; Mathematics grade attained is also assessed. Teachers indicate that Mathematics is very challenging to learners with visual impairment hence they perform poorly (Mwangi, 2014). The Ministry of Education in Kenya made Mathematics a compulsory and examinable subject for all learners. Therefore, learning of Mathematics is not only important to learners who are sighted but also to the learners who are blind. Mwangi (2014) suggests that examinations in Kenya are very crucial to learners, parents, and the nation, as each stage of education is a ladder to the next and a step to the development of a career. Therefore, any factor affecting learners' academic performance in Mathematics, such as perception, may have widespread impacts on the country's social and economic health.

Learners' perception on mathematics is the product of many factors. As pointed out previously, the subject's complex nature repels many students and makes it unpopular. The perceived ease of use of various learning materials may also influence perceptions on learning materials (Hagan *et al*., 2020). This may be particularly true of learners who are blind who rely on various assistive devices in addition to the basic materials used in Mathematics lessons. As Emerson and Anderson (2018) point out, the trend toward more visually based Mathematics materials is a significant obstacle to the participation of learners who are blind or visually impaired.

Tactile materials are among the most valuable assistive devices for learners who are blind. Tactile teaching and learning resources include methods, learning aids and strategies to learn. They are a means of conveying non-textual information to people who are blind or visually impaired through representations of pictures, maps, graphs, diagrams, and other forms. They exploit people's sense of touch, which is often overlooked in classroom settings, and allow educators to enrich the learning experiences of students who are blind (Phutane *et al*., 2023).

There are many reliable tactile resources such as Talking calculators and Brailler, which enhance the ability of individuals with sight loss to interact with learning content. Studies on how learners perceive these materials may provide useful information to Ministry of Education, Special Education officials, policy makers and other stakeholders to formulate respective policies and set strategies in place that may elevate the performance of Mathematics of students who are visually impaired. The exploration discoveries may contribute to the better performance of students who are visually impaired.

1.1. Statement of the Problem

Mathematics plays vital roles for individuals and societies. However, learners with visual impairment continue to perform poorly in Mathematics due to inadequate resources. Additionally, Mathematics is a complex subject and attract negative perceptions among many students. Students' perceptions on Mathematics may be influenced by the subject's

nature and the learning or materials it demands. Tactile materials are among the most valuable assistive devices for learners who are blind. Teachers, administrators, and policymakers should appreciate learners' perceive these materials for informed decisions. However, there is limited research on how learners who are blind perceive these materials and how such perceptions influence academic performance.

1.2. Purpose of the Study

This study aimed to establish learner perception on tactile materials as a correlate of performance in Mathematics among learners in Thika High School for the Blind.

Objectives

- To investigate general performance of mathematic among the learners who are blind.
- To investigate learners' perception on the mathematic tactile learning materials in relation to their performance in Mathematics.

1.3. Hypotheses

- H_{10}: There is no significant relationship between learners' perception on the mathematics tactile materials and performance in Mathematics.
- H_{11}: There is a significant relationship between learners' perception on the mathematics tactile materials and performance in Mathematics.

1.4. Theoretical and Conceptual Frameworks

This study adapted the theory of Social Constructivism by Vygotsky (1978) which is concerned with how appraisal should be used to augment both the student's learning and the teacher's understanding of student's progress. Constructivist model encourages the learners to actively participate in their own process of learning Mathematics with adequate Mathematics tactile teaching and learning resources for good performance while inadequate Mathematics tactile teaching and learning materials results to poor performance (Ormrod, 1995).

Constructivist classroom enable both teacher and learners think of knowledge as a dynamic, ever-changing view of the world. The learners therefore should have the ability to successfully stretch and explore, understand the content rather than memorizing (Ormrod, 1995: Owino, 2011). The key assumptions of this theory are that this study adopted that information is not passively accumulated, but rather, is the result of active cognizing by the individual hence this helps learners who are blind to be able to make their calculations in their minds better than their counterparts who are sighted; Cognition is an adaptive process that functions to make an individual's behavior more viable given a particular environment; Cognition organizes and makes sense of one's experience, and is not a process to render an accurate representation of reality and Knowing has roots in both biological/neurological construction, social, cultural, and language based interactions. Constructing a meaning is an active and continuous process therefore learning may involve some conceptual changes (Owino, 2011).

Social constructivism theory emphasizes that, learners who are blind should be provided with adequate tactile Mathematics materials to explore and familiarize, creating way for questions that lead to more questions hence improve their Mathematics concepts. There is a lot of cover in social constructivist study hall, except for the more noteworthy accentuation set on learning through social collaboration, and the worth put on social foundation (Owino, 2011). For Vygotsky, culture gives the kid the psychological instruments required for improvement. This theory also notes that human beings have the ability to perceive real objects that have a sense and meaning beyond shapes that learners who are blind can understand and describe through external and internal speech in our environment (Owino, 2011).

Learners construct a new meaning using Mathematics tactile teaching and learning resources like: Braille Charts and Braille Graphs, Talking Calculators, Abacus, embossers, Measurement tools like rulers, Modified Instruments and equipment like collapsible cube and Tactile diagrams properly. Students use request techniques to pose inquiries, research a subject, and utilize an assortment of materials to discover arrangements and answers. Instructors are relied upon to give an intuitively favorable condition to fruitful learning through direction and backing. Vygotsky argued that there is a moving target when the learners interact with materials to gain new knowledge in Mathematics. Vygotsky argues that teachers have a more elevated level of information than the students along these lines they give basic direction during the learning procedure. In this theory teachers are key who are required to provide initial guidance to learners so that they can develop new ideas in problem solving situation.

Basing on this theory interaction between the visually impaired learners and the teachers, availability and usage of Mathematics materials is pertinent to good performance in Mathematics. Teachers should be well trained to enable them understand how to guide learners who are blind to use the tactile Mathematics materials improve their performance.

The conceptual framework (Figure 1) depicts the hypothesized relationships between the research variables. Learners' perceptions on Mathematics tactile materials were predicted to have direct influence on their academic performance. The relationship between the two variables can be modified by other factors, including teacher training, availability, and time.

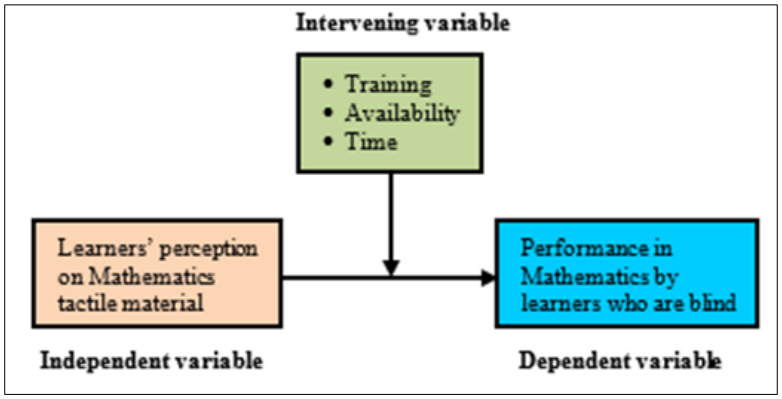

Figure 1 Conceptual Framework

2. Empirical review

2.1. Perception of Learners who Are Blind on Tactile Learning Mathematics Materials

Guimaraest (2005) suggests that perceptions are important in learning Mathematics since they create mental set or demeanor of preparation to react and the mental premise of frames of mind and changelessness. Frames of mind are not simply latent. They are an aftereffect of past encounters. They outline conduct and guide its structure and way. The segments of frames of mind are: a psychological segment (sentiment data or quality of conviction or mistrust; a full of feeling segment (passionate part of like or despise) and an activity (co-nature conduct segment of propensity or preparation to react) (Mohammed & Waheed, 2010).

Perceptions of learners who are blind towards Mathematics may affect their performance, interests and careers. Particularly a few students who are visually impaired have very negative assessment about Mathematics in view of negative practices of educators or wrong encounters. These students who are visually impaired have some preference, for example, Mathematics is a complicated exercise and just the individuals who have math intuition can learn it. However, teachers can increase positive experiences of learners towards Mathematics resulting to change of negative attitudes of learners who are blind into positive (Koc & Sen, 2006).

In Africa, perception of learners who are totally blind in tactile Mathematics learning resources has affected their performance and is brought about by the tactile learning Mathematics resources used as they are not widely used and available while in developed sates like USA, Britain and South Africa perception of learners who are totally blind in tactile Mathematics learning resources are usually positive due to wide range of resources and readily available.

Nevertheless, there are analogies among the other used strategies which this present study investigated and used. Tactile Mathematics resources also impact on the perceptions towards Mathematics performance, for example when the resources are readily available and knowledge on its usage help the learners to perform better in Mathematics. The researcher therefore agrees with the related literature.

2.2. General Performance of Mathematics by Learners who are Visually Impaired

Mathematics performance has always been given great importance in education. The Cockcroft report (1982) conducted in USA identified that each youngster should ponder Mathematics at school. Orton (1994) focused on that for there to be a successful method for advancing realizing there ought to be nonstop obligation of educators to search out and practice what they accept to be the best methods for advancing learning.

Under accomplishment in Mathematics has become the examination focal point of most Mathematics teachers. The disturbing issue in Mathematics could be examined from the social viewpoints and every individual perspective (Belbase, 2006). The social perspective incorporates learning condition which has the job to urge students to be free and figure out how to cultivate regard among them in delivering various methodologies in critical thinking (Bishop, 1998).

Difficulties in figuring out how to peruse and compose Braille in Kenya exist in the territory of receiving of materials for understudies with visual disabilities. Albeit a few subjects, for example, Sciences, Social Studies and Mathematics examined in grade schools had prospectuses adjusted for understudies with visual impedances in which complex psychomotor exercises were supplanted by progressively reasonable ones, most schedules utilized as a rule instruction classes don't have facilities as far as adjusted exercises for students with visual disabilities (Ormrod, 1995). Absence of assets makes it difficult to give required class level Mathematics course books and materials to be utilized with Braille machines. That made it incredibly hard for understudies with visual weaknesses to peruse and compose Braille as smoothly as required. In spite of the fact that Education Assessment and Resource Center (E.A.R.C) were engaged with the recognizable proof of students with visual impedance, there is have to create serious early mediation administrations for babies and kids with visual hindrance. The advantages of early intercession can't be over underscored.

The State Board of Education (1997) advises that Braille Mathematics norms are sent in “following structure” with the goal that instructors, guardians, and heads can without much of a stretch see the contrasts between learning Mathematics utilizing print (visual medium) and learning Mathematics utilizing Braille (material medium). The Braille Mathematics benchmarks are coordinated with the Mathematics Content Standards for California Public Schools in USA.

The Braille Mathematics strategies that have been added address setting up Braille math problems and the mechanics of reading, use of the abacus as a calculation tool, use of tactile graphing devices and use of Braille math symbols. In a technologically advanced society it is essential for learners with visual impairments to have early and continuous experience interpreting and preparing tactile graphics. These are basic abilities that students who are visually impaired need to ace. The extra techniques obviously exhibit that Braille students must get progressing, orderly, every day guidance via prepared instructors of the visually impaired throughout the learners‟ educational program.

A lot of thought and exchange occurred during the advancement of these techniques as for the request where the math device and Braille scientific images are educated and at what evaluation levels. Despite the fact that there is incredible variety by and by the choice ought to rely upon the individual understudy's needs and qualities, the levels being taught, and the textbooks being used. For example, one might think that teaching the abacus is outdated or unnecessary. The abacus is an important and essential tool for mathematical calculations as is the braillewriter, the slate and stylus, or the talking calculator (Hansen, 2005).

In secondary school and middle school and, the successful utilization of particular innovation (PC and online wellsprings of data and Braille electronic note takers, scanners, screen perusers, embossers, and and material charting gadgets Braille/print interpretation programming,) becomes fundamental for getting to data and acquiring advanced mathematical concepts. It is important to note that learners must learn a myriad of new Braille math symbols for algebra, geometry, trigonometry, mathematical analysis, and calculus.

Particularly at the high school level, the teacher of learners with visual impairments must work in close coordination with the general education Mathematics teachers. It is essential that blind learners have the specialized Braille skills and knowledge of Mathematics to compete with their sighted classmates. With the advent of high stakes testing for all high school learners in Kenya, blind learners deserve and require the tools and services that ensure success. The creation of Braille Mathematics standards in Kenya by KICD sends a clear message: Learners who are blind or visually impaired and their teachers are to be held accountable for meeting the Mathematics content standards to the same extent as are sighted learners. This study explored the overall performance in Mathematics by learners who are totally blind (Wanjohi, 2003).

Kiplagat, Role, & Makewa (2012), conducted a study to establish the relationship between pupil‟s academic performance and Mathematics conducted in Western Kenya whereby 280 class 8 pupils and 74 Mathematics teachers were involved. They made use of casual comparative research design. Stratified, random and purposive sampling techniques were used to get the sample for the study. They collected their data using a self-constructed questionnaire and data was analyzed using both descriptive and inferential statistics.

The findings of this study suggested that educators from high performing schools evaluated appraisals in Mathematics, teachers' use of learning resources, teacher preparations and teaching strategies, higher than the low performing schools. This study was conducted in public primary schools whereby the respondents did not have impairment. The current was a case study which involved learners who are blind, Mathematics teachers and the head teacher unlike the above study which did not involve the principal.

3. Materials and methods

This study employed the case study design using quantitative methods to assess the relationship between perceptions on tactile materials and learners' performance in Mathematics. The researcher selected a single school and a sample to represent the target population. This design in its actual sense, investigates and explores contemporary genuine marvel through itemized logical examination of a predetermined number of people or conditions, and their connections (Orodho, 2010). The case chosen for the study was Thika High School for the Blind (THSB) in Kiambu County, Kenya. The school was selected because it is the first school for learners with VI to be established in Kenya. Besides, it has a high population of learners who are blind and a long history serving and educating learners with VI in the country, especially in Mathematics. Being a national school, it has a solid foundation and has proved some effort in sourcing. The target populations comprised learners who are Totally Blind at THSB. The school had 80 learners (36 boys and 44 girls) who are Totally Blind at the time of the study. All the 80 were eligible for inclusion. Stratified random sampling was employed to select the learners. The learners were stratified according to class and gender and thereafter simple random sampling was used to select 24 learners, constituting 30% of the target population.

The study used both primary and secondary sources to obtain data for analysis. Two primary variables (one dependent and one independent factors) were included in the analysis, as per the objective (Figure 1). The dependent variable was academic performance in Mathematics. The data on this variable was retrieved from school documents. Three independent variable was learners' perception on Mathematics tactile materials. Learner perception data was obtained from students through questionnaires for learners. The questionnaire had closed and open-ended items. While the structured section was easy to fill and kept the respondent on the subject, the unstructured sections of the questionnaire allowed them to express themselves freely without restriction.

A pilot study was conducted at St Lucy Secondary School for the Blind, Igoji, Meru County. The school was selected because it has similar characteristics as THSB. The researcher sampled 12 learners who are blind for the pilot. The results of the pilot study were used to evaluate the quality of the research instruments. Reliability was assessed using the test-retest method. The questionnaires were administered to the group members twice with a break interval of two weeks between the first and the second administrations. After administering the second test instrument, the results were correlated using Pearson's product moment correlation and a correlation co-efficient of 0.75 was obtained and considered high.

Data collection involved administering the questionnaires and examining school records for learners' performances. After notifying the administration on intention of collecting data, respondents were assembled and given questionnaires. They were assisted in filling in the questionnaires since the questionnaires were in print. Secondary data was retrieved from school documents. In collecting data, professionalism was adhered to and data collected within two months with the help of two research assistants who were had specialized in Braille and special needs education.

The collected data was organized, coded, and cleaned to ensure it was free of errors. In the case of quantitative data, the researcher numbered the questionnaires appropriately. This was followed by the coding process to mark and categorize information such as gender, age, and education attainment. Statistical Package for Social Sciences (SPSS) program was used to analyze the data. The presentation of the results was through charts, tables, graphs depicting frequencies and percentages.

4. Results and discussion

4.1. Participant Characteristics

A total of 24 learners participated in the study by answering questionnaires. Their demographic characteristics included age, level of study, preferred course of study and confidence in Mathematics. They were as shown in Table 1.

Table 1 Characteristics of Learners of Learners in the Sample

Characteristic	Frequency	Percent
Age		
14-17 years	7	29.2
18-21 years	14	58.3
22-24 years	3	12.5
Level of Study		
Form one	6	25.0
Form two	6	25.0
Form three	6	25.0
Form four	6	25.0
Math grade in Class Eight		
A	1	4.2
B	5	20.8
C	15	62.5
D	3	12.5
Preferred course		
Science	13	54.2
Arts	11	45.8
Level of Confidence in Math		
Very confident	2	8.3
Confident	16	66.7
Not confident at all	6	25.0

As shown in Table 1, 14 (58.3%) learners were between 18-21 years, while 3 (12.5%) were in the age range of 22-24 years. The other 7 (29.2%) were in the age range of 18-21 years. It is worth noting that all the learners in the sample were older than expected age at this level of education. Specifically, those in 22-24 should have been in postsecondary institutions. A possible explanation is that they either enrolled in school late or repeated several classes, hence, delaying at the lower levels of their education (there are often no repetitions in secondary schools in the country). An exploration of their performance in Mathematics before joining secondary education revealed that 15 (62.5%) attained a grade C in KCPE. Six (25%) obtained between grades A and B, and only 3(12,5%) had a D score. The implication is that learners who are blind perform well in Mathematics at the primary level because none indicated failure or grade E.

When asked what they preferred to pursue at the secondary school level, 13 (54.2%) learners preferred to pursue a science course in the future and Mathematics is often classified as a science course. Furthermore, 18 (75%) indicated being confident or very confident in Mathematics. This affirms Maguvhe's (2015) suggestions that learners who are blind have the same mental capacity to comprehend Mathematics and merely need to be appropriately accommodated to enable them to perform as well as their sighted counterparts in Mathematics.

4.2. Learners Perception on the Mathematic Learning and Performance in Mathematics

This objective sought to investigate the learners‟ perception Mathematics learning and how it affected their performance in Mathematics. To answer this objective, the respondents were provided with statements on various aspects of learning and were to rate on a five point Likert scale items as follows: strongly disagree (SD), disagree (D), neutral (N), agree (A), strongly agree (SA). The findings were as shown in Table 2. The values in brackets are corresponding percentages.

Table 2 Learners Perception on the Mathematics Learning

Perception	VA	A	NS	IA	VIA
Being a blind learner does not interfere with my active participation in Mathematics	8 (33.3)	7 (29.2)	0 (0.0)	5 (20.8)	4 (16.7)
Student-teacher interaction improves my understanding of Mathematics concepts	5 (20.8)	14 (58.3)	0 (0.0)	1 (4.2)	4 (16.7)
Teachers' gender influences my active participation in math teaching and learning process	4 (16.7)	4 (16.7)	0 (0.0)	8 (33.7)	8 (33.7)
The number of learners in class affect the teaching of Mathematics	4 (16.7)	4 (16.7)	0 (0.0)	11 (45.8)	5 (20.8)
Parents do not like learners who are blind to attend schools	1 (4.2)	1 (4.2)	1 (4.2)	6 (25)	15 (62.5)

As shown in Table 2 above, more than a half (58.3%) of the respondents agreed that student-teacher interaction improved their understanding of mathematical concepts. Almost similar number (62.5%) of the respondents strongly disagreed that parents do not like learners who are blind to school, while slightly less than a half (45.8%) of the respondents disagreed that the number of learners in class affect the teaching of Mathematics. Learners' perception on the Mathematics learning is an important issue to note and identify immediately the learner commence schooling or learning Mathematics. This issue when dealt with it at an early stage may be reversed or corrected effectively hence improving on Mathematics performance.

Khoush-Bakht, Kayyer, (2005), Ferrell (2005), Driscoll, (2005), FEMSA, (1997), Fennema, & Sherman, (1976) and Yunus, & Ali, (2009) are in tandem with the finding of this study noting that learners perception on the Mathematics learning need to be nurtured at an early stage and strengthened regularly by practicing. To further answer this objective, Pearson product moment correlation coefficient was run between perception of learners towards Mathematics learning and performance to test the null hypothesis that there is no statistically significant relationship between learners' perception in learning Mathematics and performance in Mathematics.

There was a weak positive relationship between learners' perception in learning Mathematics and performance in Mathematics (r = 0.203, p = 0.342). This implied that leaners' perception towards Mathematics was associated with a high performance in Mathematics. However, the relationship was not statistically significant at the 95% confidence level. From the findings, the null hypothesis was thus not rejected.

4.3. Performance of Mathematics Related Tasks among the Learners who are Blind

This objective sought to find out the frequency with which the learners performed Mathematics related tasks. This objective also sought to find out the extent to which various individuals surrounding the learners encouraged them to study Mathematics. Learners were asked to rate the frequencies at which they performed Mathematics-related tasks use a five-pint scale as follows: daily, 2-3 days, once per day, once per week, and once per month. The findings are as shown in table 3 below.

From Table 3 below, the majority (87.5%) of the respondents indicated doing their homework on a daily basis when given by the teacher, close to three quarters (70.8%) indicated getting homework marked daily, with in excess of a half of the respondents (62.5%) indicated doing homework alone on a daily basis. A few (29.2%) of the respondents noted that they approached the teacher for help once a week.

Table 3 Frequency of Performance of Mathematics-Related Tasks

Task performance	Daily	2-3 days	Once per day	Once per week	Once per months
Receiving homework from the teacher	21 (87.5)	1 (4.2)	2 (8.3)	0 (0.0)	0 (0.0)
Getting homework marked	17 (70.8)	2 (8.3)	1 (4.2)	3 (12.5)	3 (60.0)
Doing homework alone	15 (62.5)	4 (16.7)	2 (8.3)	3 (12.5)	0 (0.0)
Doing homework in groups	12 (50.0)	9 (37.5)	2 (8.3)	1 (4.2)	0 (20.0)
Approaching the teacher for help	4 (16.7)	5 (20.8)	3 (12.5)	7 (29.2)	1 (4.2)
Receiving individual help from Mathematics teacher	3 (12.5)	7(29.2)	6 (25.0)	3 (12.5)	5 (20.8)

The findings of this study, are consistent with Stephens (1985), and Thomas (2006), who noted that frequency of performance of Mathematics related tasks affects students' achievements and attitudes using integrated learning systems with co-operative pairs on the tasks. Hence, the more frequent practice on Mathematics the better the improvement in Mathematics study. This also improve on the cognitive growth of the learner on learning Mathematics. Respondents were also asked about their social motivation to study Mathematics. They were to indicate whether they were motivated very much (VM), much (M), little (L) or very little (VL). Table 4 depicts their responses to this item.

Table 4 Social Motivation to Study Mathematics

Task performance	VM	M	L	VL
Peers/classmates	3 (12.5)	14 (58.3)	3 (12.5)	4 (16.7)
Class teacher	16 (66.7)	7 (29.2)	0 (0.0)	1 (4.2)
Career teacher	15 (62.5)	7 (29.2)	1 (4.2)	1 (4.2)
Mathematics teacher	14 (58.3)	5 (20.8)	2 (8.3)	3 (12.5)
Other Mathematics teacher	12 (50.0)	10 (41.7)	1 (4.2)	1 (4.2)
Principal	15 (25.0)	3 (12.5)	2 (8.3)	4 (16.7)

From Table 4.12 above, majority of the respondents (66.7%) indicated that their class teacher encouraged them very much to study Mathematics, more than a half (62.5%) indicated that their career teacher and their principal encouraged them very much to study Mathematics, while only a few (12.5%) indicated that their peers encouraged them very much.

Yunus, & Ali, (2009) explains that motivation in the learning of Mathematics from various aspects encourages learners to learn Mathematics. Hence, great impact in Mathematics performance as they are aware of the skill and knowledge to be applied during Mathematics lessons.

5. Conclusions and recommendations

Learners' perceptions on Mathematics play vital roles in their academic performance in the subject. This study aimed to establish learner perception on tactile materials as a correlate of performance in Mathematics among learners who are blind in THSB. Data on students' perception were obtained through questionnaires administered to learners, while performance data were retrieved from school records. Descriptive summaries and correlation analyses were conducted to address the research objectives.

It was found out that more than a half of the respondents agreed that student-teacher interaction improved their understanding of mathematical concepts. Most of the respondents strongly disagreed that parents do not like learners who are blind being enrolled in the school, while less than half of the respondents disagreed that the number of learners in class affect the teaching of Mathematics. Hence, learners' perception on the Mathematics learning does negatively affect their Mathematics performance.

The findings showed that majority of the respondents indicated did their homework daily, oftentimes individually and teachers marked the work consistently. Just a few of the respondents approached the teacher for help once a week. Majority of the respondents indicated that they were encouraged to study Mathematics by their class teacher, career teacher and the principal while only a few indicated that their peers encouraged them to do the same. This may indicate learners' perception on the performance of Mathematics related tasks.

Teachers of Mathematics did not ensure active and working discussion groups throughout the learners' educational process. Usually, teachers should continuously remind the other teachers to relate Mathematics with other regular subjects during instruction. They should further concentrate attention towards individual challenges in acquisition of Mathematic computational skills, slow manipulation of tools, poor concept formulation and incompetence in relating mathematical concept to the timing and manipulation of apparatus. Teachers, MOEST, and other relevant stakeholders should develop and implement relevant strategies to enhance perception on Mathematics among learners who are blind.

A similar study should be carried out in other regions to establish whether the study findings apply to other areas to enable generalization of the findings of this study to help improve on performance of Mathematics among learners who are blind. Further research can also be done in rural settings and among private schools so that informed generalization of relationship between tactile materials and performance in Mathematics among learners in Thika High School for the Blind.

Contribution to knowledge

The study makes a notable contribution to the literature on education for learners who are blind, especially perceptions toward Mathematics among learners who are blind. Generally, there is limited research on tactile materials for teaching Mathematics to learners who are blind in Kenya, and few studies have examined the influence learners' perceptions on the influence of these materials on their academic performance. The current findings offer insights into the perception Mathematics among learners who are totally blind and how such perceptions correlate with learners' performance.

Compliance with ethical standards

Acknowledgements

I wish to express my sincere appreciation to all individuals whose contribution made the completion of this thesis possible. First and foremost, my appreciation and gratitude go to my supervisors: Dr. Murugami and Dr. Chomba for the scholarly guidance, assistance tireless devotions and encouragement throughout the course of my studies. My special thanks go to my lecturers in the Department of Special Education at Kenyatta University; particularly to the former chairperson Dr. Nelly Otube for the moral support and encouragement. Furthermore, I wish to appreciate the management of Thika School for the Blind for allowing me to collect data in the school. In addition, my appreciation goes to the learners for giving vital information for the study. Also, I wish to thank my friends who helped me edit and print my work. Finally, I wish to express my personal gratitude to my loving family for their financial assistance..

Conflict of interest

The authors declare no conflict of interest pertaining to the research.

Statement of informed consent

Informed consent was obtained from all participants.

References

[1] Aguilar, J. J. (2021). High school students' reasons for disliking mathematics: the intersection between teacher's role and student's emotions, belief, and self-efficacy. International Electronic Journal of Mathematics Education, 16(3), em0658. https://doi.org/10.29333/iejme/11294

[2] Algan, Y. M. (2022). Role, need and benefits of mathematics in the development of society. Journal for the Mathematics Education and Teaching Practices, 3(1), 23-29.

[3] Aljundi, K., & Altakhayneh, B. (2020). Obstacles to blind students' learning maths in Jordan from students' and teachers' perspectives. International Education Studies, 13(8), 1-5. https://doi.org/10.5539/ies.v13n8p1

[4] Belbase, S., (2006). *My journey of learning and teaching mathematics from traditionalism to constructivism: A portrayal of pedagogic metamorphosis* (unpublished dissertation). Kathemandu University, Nepal.

[5] Bishop, E. V. (1998). *Teaching the visually limited child. Spring field.* Charles Thomas Press.

[6] Cobb, P., Wood, T., Yackel, E., Nicholls, J., Wheatley, G., Trigatti, B., & Perlwitz, M. (2006). Assessment of a problem-centered second-grade Mathematics project. *Journal for Research in Mathematics Education, 22*(1), 3–29.

[7] Cockcroft, W. (1982). *Mathematics counts*. Her Majesty‟s Stationary Office.

[8] Daud, A. S., Adnan, N. S., Aziz, M. K., & Embong, Z. (2020). Students' perception towards mathematics using APOS theory: A case study. Journal of Physics Conference Series, 1529(3), 1-8. http://dx.doi.org/10.1088/1742-6596/1529/3/032020

[9] Driscoll, M. (2005). *Psychology of learning for instruction.* Allyn & Bacon.

[10] Emerson, R. W., & Anderson, D. (2018). What mathematical images are in a typical mathematics textbook? Implications for students with visual impairments. Journal of Visual Impairment & Blindness, 112(1), 20–32. http://dx.doi.org/10.1177/0145482X1811200103

[11] FEMSA. (1997). *Promoting the participation and performance of girls in science, Mathematics and technology subjects: Phase I Research findings*. FEMSA Newsletter.

[12] Fennema, E., & Sherman, J. A. (1976). Fennema-Sherman mathematics attitudes scales: Instruments designed to measure attitudes toward the learning of mathematics by males and females. *Catalogue of Selected Documents in Psychology, 6*(1), 31-45.

[13] Ferrell, K. (2005). The role of the consumer in the education of blind children, from the perspective of an educational program for teachers of the blind. *The Braille Monitor*, 48. https://nfb.org/sites/default/files/images/nfb/publications/bm/bm05/bm0510/bm051004.htm

[14] Guimaraest, H. M. (2005). Teachers and students' views and attitude towards new Mathematics curriculum. *Educational Studies in Mathematics, 26*(4), 347-365.

[15] Hagan, J. E., Atteh, E., & Lawer, V. T. (2020). Students' perception towards mathematics and its effects on academic performance. Asian Journal of Education and Social Studies, 8(1), 8-14. https://doi.org/10.9734/AJESS/2020/v8i130210

[16] Hansen, A. (2005). Shape and space. In A. Hansen (ed.), *Children's errors in Mathematics: Understanding common misconceptions in primary schools* (pp. 76-102). Exeter:

[17] Khoush-Bakht, F., & Kayyer, M. (2005). A survey on motivational model of math learning in elementary learners. *Journal Psychology 9*(1), 67-81.

[18] Kiplagat, P., Role, E., & Makewa, L. N. (2012). Teacher commitment and Mathematics performance in primary schools: A meeting point. *International Journal of Development and Sustainability, 1*(2), 286-304.

[19] Maguvhe (2015). The teaching of Mathematics and science to students with visual impairment. Cambridge, United Kingdom: Cambridge University Press.

[20] Mwangi, J. (2014). *Pedagogical challenges facing mathematic teachers of learning with visual impairment at Thika primary school for the blind* (unpublished thesis). Lagos University, Nigeria.

[21] Ormrod, J. E. (1995). *Human Learning* (2nd ed.). Hoboken, NJ: Prentice Hall.

[22] Orodho, A. J. (2010). *Techniques of writing research proposal and reports.* Nairobi, Kenya: Kanezja Publishers.

[23] Orton, A. (1994). Learning mathematics: implications for teaching. In A. Orton & G. Wain (Eds.), *Issues in teaching mathematics* (pp. 35 – 57). London, United Kingdom: Cassell.

[24] Owino, V. O. (2011). *Studies in cognitive growth*. New York, NY: John Wiley & Sons Publishers.

[25] Phutane, M., Wright, J., Castro, B. V., Shi, L., Stern, S. R., Lawson, H. M., & Azenkot, S. (2022). Tactile materials in practice: Understanding the experiences of teachers of the visually impaired. ACM Transactions on Accessible Computing, 15(3), 1–34. https://doi.org/10.1145/3508364

[26] State Board of Education. (1997). *Psychological implications. visual impairment and blindness*. Washington, DC: Department of Veterans Affairs employee Education System.

[27] Stephens, B. (1985). *Cognitive processes in visually impaired. education of the visually handicapped*. Cambridge University Press.

[28] Thomas, J. (2006). The effects on students' achievements and attitudes using integrated learning systems with co-operative pairs. *Journal of Educational Technology Research and Development, 45*(3), 51-64.

[29] Ukobizaba, F., Ndihokubwayo, K., Mukuka, A., & Uwamahoro, J. (2021). From what makes students dislike mathematics towards its effective teaching practices. Bolema Boletim de Educação Matemática, 35(70), 1200-16. http://dx.doi.org/10.1590/1980-4415v35n70a30

[30] Vygotsky, L. S. (1978). *Mind in society*. Cambridge, MA: Harvard University Press.

[31] Wanjohi, K., (2003). *Attitudes towards visually impaired children by sighted peers and teachers in integrated schools*. Unpublished M.Ed Thesis. Egerton University.

[32] Yunus, A. S. and Ali, W. Z. (2009). Motivation in the learning of mathematics. *European Journal of Social Sciences, 7*(4), 93-101

[33] Zhang, Y., Liu, S., & Shang, X. (2021). An MRI Study on Effects of Math Education on Brain Development Using Multi-Instance Contrastive Learning. Frontiers in psychology, 12, 765754. https://doi.org/10.3389/fpsyg.2021.765754