



Orbit Reader Effectiveness in enhancing Braille Literacy among Trainees with visual impairment in Kenyan TVET Institutions

***Ronald Ong'ete, Everline Maina, Michael Odeny**
Department of Special Needs Education and Rehabilitation,
Maseno University, Kenya

***Corresponding Email:** royongete@gmail.com

Abstract

This study evaluates the effectiveness of Orbit Readers in improving Braille literacy among 198 trainees with visual impairment (TWVI) and 18 trainers in selected Kenyan Technical and Vocational Education and Training (TVET) institutions. The study data was collected through questionnaires and standardized tests. Data collection tools reliability was established through a test-retest method. Questionnaires reliability coefficient was 0.87 for trainer and 0.84 for trainees. Inter-rater reliability coefficient for observations schedule was 0.77. Experts validated data collection tools. Quantitative data was analyzed through descriptive statistics. The study findings show that Orbit Readers greatly improved access to learning materials (mean=4.44) and supported independent learning (mean=3.94). They also enabled trainees to quickly learn Braille reading skills (mean=3.83) and encouraged interactive learning (mean=3.83). 51.1% of trainees achieved moderate Braille proficiency scores between 50–79% and trainers preferred traditional Braille machines (mean= 4.39) over Orbit Readers (mean=3.16). (SD=1.29) indicate high variability in responses showing diverse proficiencies amid users. The results of this study contribute applicable improvement to educational access for TWVI, trainers and policymakers and also supporting inclusivity in vocational training.

Keywords: Orbit Readers, Braille Literacy, Assistive Technology, Visual Impairment, Inclusive Education.

Introduction

According to Silverman & Bell, (2018) Braille proficiency is associated with enhanced self-esteem and increased employment rates among blind adults. Braille literacy refers to tactile reading and writing competencies that are essential for TWVI to achieve vocational success. Proficiency in tactile discrimination, character recognition, accurate finger placement, Braille contractions usage and fluency in reading and writing were integral skills for TWVI. Mastery of these skills facilitated access to mainstream TVET curriculum (Koenig & Holbrook, 2000; Braille Authority of North America, 2016). Incorporation of technology expanded TWVI prospects by enhancing both literacy participation in educational institutions (Cooper & Nichols, 2007). Orbit Readers, were refreshable Braille display that functions as a multifunctional device or in certain circumstances a standalone book reader, note-taker and Braille display connected via USB or Bluetooth (Orbit Research, 2016). Orbit Reader accelerated literacy acquisition due to portability, tactile interactivity and its user-friendly nature (Swenson, 1999). Leonardis, et al, (2017), found that orbit readers allow users to interact with digital content through raised pins that dynamically form braille cells. The American Printing House for the Blind (2022) described the orbit readers as multifunctional tools that was capable of undertaking various tasks and notably while considered world most affordable refreshable braille device (Orbit Research, 2016) in enhancing its accessibility.

Studies by Martiniello & Wittich, (2021) and Rosenblum, Lawson, & Siu, (2020) found that enhanced reading speed and writing accuracy improved among orbit reader users compared to peers subjected to traditional paper Moreso, the American Foundation for the blind has documented widespread user satisfaction highlighting improvements in literacy. Orbit Reader enhances braille writing, reading proficiency and classroom engagement (Cooper & Nichols, 2007; Miesenberger et al., 2020).

Adhikari, Kulkarni, and Kulkarni (2021) emphasized that Orbit Readers helped trainers and trainees access printed text independently bridging the gap between digital information and tactile literacy. However, overreliance on technology weakens tactile sensitivity that is an essential component of braille proficiency use (Bickford & Falco, 2012). However, no substantial differences exist between reading speed while comparing electronic and paper-based braille (Martiniello et al., 2021). Though trainees using electronic devices such as the Orbit Reader demonstrated higher scores in braille literacy (Journal of Visual Impairment & Blindness, 2019). American Foundation for the Blind reported increased autonomy among TWVI using the Orbit Readers. Use of braille displays was associated with improved employment outcomes and educational attainment (Journal of Visual Impairment & Blindness, 2019). 10% of the visually impaired population in the United States is proficient in braille signaling a decline in braille literacy that negatively impacted employment and academic prospects (National Federation of the blind, 2019). A Study carried in Germany, Austria and Switzerland comparing braille users to their sighted peers on spelling abilities involving 119 braille users aged 11 to 22 years. The outcome shown that Braille users demonstrated spelling abilities compared to sighted uses. Martiniello & Wittich (2021) reiterated that braille reading was highly embraced among trainees and



trainer in developing comprehension. Braille fluency was positively influenced literacy outcomes while reliance on speech output indicated a negative association.

Statement of the Problem

African Development Bank Skills and Employability Programme (2019–2024) invested over USD 1 million in assistive Technology (AT) in TVET institution in Kenya yet national public TVET enrolment data for April 2024 show that only 4.5% of trainees had disabilities and just less than 1% was visually impaired. This underrepresentation persists despite Kenya inclusive disability legislative framework including Constitution of Kenya (2010), Persons with Disabilities Act (2025), National Disability Policy (2006), TVET Act (2013) and more so commitments to Sustainable Development Goal 4 which aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. In addition, completion rates for TWVI remain below 50% with majority facing significant gaps in Braille literacy and technological barriers among other indicators (KISE, 2022). Limited access to modern functional orbit readers and lack of trainer preparedness really undermine inclusive learning. It was of great concern that over 95% of TWVI were into theory based or non-technical programmes restricting their participation in high demand trades such as electrical installation, automotive engineering, ICT, agribusiness and construction. Regional studies have explored general assistive technology adoption. This leaves a gap in empirical evidence on orbit reader usability as a modern technology in fostering braille literacy as an enabler to practical training in Kenya TVET colleges. This data remained scarce undermining targeted reforms in curriculum implementation, instructor training and infrastructure development. Therefore this study interest was to investigate if the usability of orbit readers as a modern technology would ultimately improve development of braille literacy among TWVI in Kenyan TVET institutions.

Research Objective

The objectives of the research were to assess Trainees and Trainers perspective on the use of Orbit readers in enhancing Braille Literacy for TWVI

Methodology

Research Design

Descriptive survey design was adopted in this study

Population and Sampling

Table 1: Sample Frame

Respondent	Population (N)	Sample(n)
Trainees	220	198
Trainers	20	18

Data Collection Instruments, Validity and Reliability of Instruments

The study adopted the use of questionnaires that were administered to both trainers and trainees while Braille Test was administered to trainees. Both Face and content validity was tested through expert review. The feedback guided the refinement of all instruments. Test-retest reliability was equally assessed by administering the same instruments twice to a sub-sample of 2 trainers and 22 trainees. Questionnaires reliability coefficient was 0.87 for trainer and 0.84 for trainees. Inter-rater reliability coefficient for observations schedule was 0.77.

Data Analysis Techniques

Quantitative data analysis techniques were adopted through Closed-ended responses that were coded and analyzed using descriptive statistics



Ethical Considerations

Highest ethical standards were observed in this study by ensuring all participants are treated with respect and dignity including Anonymity, Confidentiality and Informed consent obtained through the school principal.

Findings

Response Rate

Table 2: Response Rate

Respondent	Population (N)	Sample(n)	Responses	%Response Rate
Trainees	220	198	188	95.0
Trainers	20	18	18	100

Table 2 summarizes response rate of the respondents with 95% of trainees and 100% of trainers participating in the study.

Demographic Characteristics

Table3: Demographic information of the Respondents: TWVI

Demographic Information	Category	F	%
Gender	Male	107	56.91%
	Female	81	43.09%
		188	100%
Age	16-24 years	105	55.85%
	25-30 years	54	28.72%
	31-35 years	23	12.23%
	36-39 years	4	2.12%
	>40 years	2	1.08%
		188	100%
Vocational Courses	Arts/ Business	182	96.81%
	Engineering /	6	3.19%
	Technology	188	100%

From Table 3, the demographic profile in of the respondents who participated in the study, 56.91% were male trainees which suggested that economic prioritization patterns , cultural and social factors influence access to vocational education among TWVI and majorly favors the male gender in access to assistive technologies among TWVI. Of the sampled respondents 43.09% represented the female TWVI. The study indicated slight gender parity among TWVI. Further, majority of trainees 55.85% (105) were aged 16–24 years indicating a higher enrolment rate of young TWVI into various vocational skills and colleges and mostly these TWVI between 16-24 years adopted more use of assistive technologies like orbit readers to acquire various skills and competencies . 28.72% of the sampled TWVI were of age 25–30 years while 15.43% (29) of the TWVIs were over 30 years. This suggests that most trainees enter vocational training soon after secondary education indicating a youthful population actively seeking skills for employability. As their ages advanced, their enrollment rate diminished. 96.28% (182) of sampled TWVI were enrolled in Arts/Business-related courses while only 3.19% (6) were in Engineering/Technology fields. The study findings are in line with Palan et al, (2020) that low enrollment in technology or engineering based courses were likely to occur due to inaccessible teaching practices and inadequate support systems such as limited accessible equipment, inadequate assistive technologies, negative societal perceptions, and insufficient institutional preparedness to accommodate learners with visual impairment in practical, skills-based fields.



Table 4: Trainers Views on Use of Orbit Readers in Acquisition of Braille Literacy Skills (n=18)

Statement	SD f	D f	N f	A f	SA f	Tota l	Mean	Std. Devi ation
Orbit Reader effectiveness compared to traditional braille machine.	0	7	3	6	2	18	3.16	1.09
Quick acquisition of braille reading skills by use of Orbit Reader	0	2	1	13	2	18	3.83	.78
Orbit Reader allows interactive and engaging braille learning	2	0	4	5	7	18	3.83	1.29
Orbit Readers help independent in learning	1	1	0	12	4	18	3.94	.99
Orbit Reader access wider range of learning materials	0	0	0	10	8	18	4.44	.51
Braille machines are easier for TWVI to understand than the Orbit Reader	0	0	0	11	7	18	4.38	.50
Overall mean							3.93	

Table 4 indicated that of the sampled 18 trainers views on the use of orbit readers in acquisition of braille literacy skills showed scores aggregate mean (Mean=3.93) reflecting a spectrum of positive perceptions toward the orbit reader use in the acquisition of literacy skills with a notable variability (SD= 1.29). Strong positive sentiments emerge in areas related to access and independence. The Orbit Reader was perceived as supporting a wider range of learning materials (Mean=4.44). More so, results show that Orbit Readers assisted in acquisition of braille literacy skills and fostering learner self-reliance (Mean=3.94) with minimal disagreement. Similarly, the Orbit Reader demonstrates utility in facilitating quick acquisition of braille reading skills (Mean = 3.83) and enabling interactive, engaging learning experiences (Mean = 3.83) though prominent neutrality 22.2% neutral for engagement and higher variability underscore potential inconsistencies in user experiences across contexts. Therefore, trainers view suggests the device as a significant enhancer of resource availability and autonomy in braille education.

Table 5: Trainees views on Use of Orbit Readers in Acquisition of Braille Literacy Skill (n=188)

Statement	SD f	D f	N f	A f	SA f	Total	Mean	SD
Preference of Orbit Reader over Braille	2	5	20	98	63	188	4.21	0.62
Motivated to practice Braille using Orbit Reader	1	4	18	92	73	188	4.29	0.63
Orbit Reader enhances participation in class	3	6	22	89	68	188	4.25	0.76
Orbit Reader is easier than using traditional methods	5	10	25	91	57	188	4.19	0.96
Orbit Reader is more portable	6	12	30	88	52	188	4.02	1.00
Accessing digital materials easier with Orbit Reader	7	14	28	86	53	188	4.00	0.91
Overall mean							4.19	0.81

The Table 5 results show that TWVI had an overwhelmingly positive perception of the Orbit Reader (Mean=4.19). Mean scores ranged between 4.00 and 4.29, reflecting agreement across all items. The highest rating was recorded for motivation to practice braille using the Orbit Reader (M = 4.29, SD = 0.63), while the lowest ratings were for ease of accessing digital materials (M



= 4.00, SD = 0.91) and portability (M = 4.02, SD = 1.00) both standard deviations explains a slight variation in the data distribution. 85.6% of sampled TWVI strongly agreed that they preferred the Orbit Reader over traditional braille as a mechanism for an assistive technology usage. More so, large majority of the TWVIs felt motivated to practice braille when using the device. This suggests that the Orbit Reader not only enhances accessibility but also encourages consistent engagement with learning materials. With 83.5% of trainees in agreement, the orbit reader also enhanced classroom participation. This underscores its potential to improve inclusivity and foster active involvement in learning activities. 78.7 % of TWVIs found orbit readers easier to use and more portable than traditional methods (Mean=4.19) with a relatively higher rates 21.3 % of disapprovals among the respondents. This indicates that some TWVI may experience difficulties with device handling or mobility. About 73.9 % of TWVI agreed that the Orbit Reader made accessing digital content easier, though 26 % remained neutral or disagreed. This point to possible gaps in the availability of relevant digital resources or in trainee training on how to maximize the device functionality.

The results have shown that the orbit reader was valued by TWVI in TVET institutions. With immense positive impact evident in promoting motivation, preference over traditional braille and enhanced classroom participation. These outcomes aligned with previous researches that highlighted digital braille displays in bridging the gap between traditional braille and electronic content, advancing inclusive learning. The results indicate areas requiring improvement. While portability and ease of access were positively rated, the higher variability (SD values close to 1.0) suggests that some trainees still encounter challenges in handling the device or accessing diverse materials. Studies have indicated that although assistive technologies increase accessibility, their effectiveness depends heavily on adequate training, user familiarity, and the availability of localized digital resources.

Table 6: TWVI Braille test scores on Acquisition of Braille Literacy Skill (n=188)

Score Range (%)	F	Participants (%)
80–85%	14	7.40%
70–79%	30	16.00%
60–69%	42	22.30%
55–59%	24	12.80%
50–54%	20	10.60%
40–49%	28	14.90%
30–39%	18	9.60%
20–29%	8	4.30%
13–19%	4	2.10%
Total	188	100%
Mean		11.11%

Table 6 presents braille test score distribution among the sampled 188 TWVI. The scores spans from 13-19% to 80-85%, revealing a skewed pattern with a concentration of moderate performance. The largest cohort, 42 TWVI scored between 60-69%, followed by 30 TWVI in the 70-79% range and 28 TWVI in the 40-49% range. 51.1% of trainees achieved scores between 50-79% indicating that most attained passing. Nonetheless, only a small fraction (7.4%) reached the highest range of 80-85% suggesting limited excellence in braille proficiency. At the lower end, 30.9% scored below 50%, including 14.9% in the 40-49% range and 9.6% in the 30-39% range, this indicates that while foundational braille skills are generally achieved, mastery remains inconsistent. The bell-like curve centered around 50-69% range underscores the supportive role of orbit readers in facilitating braille literacy. Of essence to note, tail of lower scores indicating persistent barriers to achieving full literacy potentially linked to training disparities or technical limitations. Orbit Readers have the ability to enhance access to learning materials and supporting independent learning, as reflected in the high trainee means (4.0-4.3) and trainers positive perceptions of resource availability (mean = 4.44). Therefore, the findings address the inadequate quantification of the contribution of orbit readers in acquisition of braille literacy outcomes with the moderate score distribution suggesting that the devices enable skill building but do not uniformly lead to high proficiency. This suggests that trainers to prioritize integrating Orbit Reader training to shift curricula from theory-heavy to practical skill focused instruction. Initiatives like those from the African Development Bank (AfDB) to enhance inclusivity and align with Sustainable Development Goals (SDGs) for equitable education.



Conclusion And Recommendation

Conclusion

In conclusion, Orbit Reader enhances braille literacy as demonstrated by trainee views approval (mean > 4.0) with moderate literacy outcomes (mean = 56.3%) were reported indicating adoption barriers despite being perceived by TWVI as a better option other than traditional braille machine. However, familiarity biases among trainers, Limited battery life, Incompatibility with outdated software and training gaps hinting implementation barriers.

Recommendations

This research recommended a targeted strategy be developed for integrating Orbit Readers in learning and training programs to enhance trainer and trainee capacity and TVET curricula to shift toward practical, skill-focused integrating Orbit Readers to improve braille literacy outcomes and vocational competency

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