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Evaluating Indigenous ICT-Aided English Language Material for ESL Dyslexic Learners: A Mixed-Methods Study

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Abstract

The twenty first century has witnessed significant growth in the integration of Information and Communication Technology (ICT) in all areas of life, including language learning. In the case of second language teaching, most materials are based on Western pedagogical frameworks. Such generically developed and commercially produced materials overlook the cognitive needs and demands of dyslexic ESL learners and limit their language learning outcomes (Irshad & Ghani 2017). The current study investigates the impact of Indigenous Information and Communication Technology (ICT) aided English language material on the language learning outcomes of English as a Second Language Dyslexic Learners. Using a mixed-methods approach, quantitative assessment of language performance of dyslexic ESL learners was triangulated with qualitative insights from the teachers and observations of the participants. Purposive sampling was carried out to find dyslexic ESL learners through a screening check-list by Ashraf and Najam (2014). Quantitative findings revealed statistically significant improvements in reading comprehension, decoding skills, and vocabulary development ($t = -2.333$; $p < 0.05$). Qualitative data in the form of observations and teacher interview supported these results showing increased engagement, improved participation, and noticeable progress in learners' reading behaviors during ICT-assisted lessons. Despite some physical and technical challenges faced by dyslexic ESL learners due to ICT-aided material, this study supports the integration of technology in fostering inclusive language education for dyslexic learners.

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1. INTRODUCTION

Supporting dyslexic learners is vital for achieving the goals of inclusive education in this multicultural world. Approximately 10% of the world's population (Shaywitz et al., 2019) is affected by dyslexia (a learning disorder), making it a neglected population. For dyslexic learners, reading and writing in their first language is difficult and becoming proficient in a second language (such as English) means dealing with the cognitive challenges of dyslexia and linguistic challenges of a new language. The use of technological tools has opened new opportunities and possibilities for language learning and teaching. Moreover, technology has enriched the communication process and easy retrieval of information, leading to the enhanced importance of a global language. The increasing dominance of a global language (English) mean; marginalizing such a large population, which will further worsen the situation.

English, a recognized global language is taught as a compulsory subject, and serves as the second language (L2) in the Pakistani academic set-up since the early years of formal schooling. Pakistan's National Education Policy (MFEPT, 2017) asserts that English should be taught as a compulsory subject from grade one and as a medium of instruction from grade five for subjects of science and mathematics. Dyslexic learners, as a part of main-stream schools, also have to learn English. While encountering their problems in L1, they are burdened by the addition of learning English as a second language. According to Yusri et al. (2018), a learner with difficulties in acquiring a first language (L1) also faces problems in learning a second language (L2) because learning a second language (L2) takes its shape from first language (L1). Poor language skills in L1 affect the same in L2, resulting in a lack of motivation among second language learners with dyslexia, and their drop off from school.

Shaywitz et al. (2019) reported that individuals with dyslexia have to struggle hard for reading, writing and spelling due to difficulties in processing of sounds and symbols of language. Moreover, Tunmer and Greaney (2010) emphasized that the word recognition, correct spellings and pronunciations are the major problematic areas of dyslexic learners. Similarly, Youman and Mather (2013) also argued that reading and short memory are the major difficulties which are faced by the dyslexics. Dyslexia is an overall language learning problem (Hill,2016) and does not only affect dyslexic children to learn their native language but second or foreign language too which requires the acquisition/learning of a new set of sounds and symbols. It was found through a survey by Research Triangle Institute (2016) that dyslexic primary school children in Pakistan have low levels of reading skills in Urdu and English language as compared to their age matched learners. Dyslexic learners are already deficient in Urdu (L1), which is a diacritic language (Farukh & Vulchanova, 2014) where presence of diacritics make reading easier. In contrast, learning English as a second language (L2) in such situation puts extra burden on dyslexic learners. English is an alphabetic and less transparent language with deep orthography (Sotiropoulos & Hanley, 2017) which worsens the situation for dyslexics. Learners with dyslexia have to struggle hard to pronounce, decode and comprehend such languages which do not have one to one correspondence in grapheme to phoneme decoding. Molnar S.C. (2013) also claimed that difficult orthography makes English language to be more difficult in an ESL environment. Likewise, irregular spellings (mismatch between sounds and graphemes) create great hurdles for dyslexics to read and write English language (Swedish Dyslexia Association, 2012).

Information and Communication Technology (ICT) is promising for supporting second language learners with dyslexia in ESL classrooms by developing certain software, technologies and specific language materials. Brenchley and Costello (2018) claim that there are multiple technological

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applications for disabled learners. Speech-to-text software is one of the best technological applications that can help students with dyslexia bypass their struggles with handwriting and spelling, allowing them to focus on the content of their writing (Gregori-Giralt et al., 2020). Similarly, dyslexia-friendly fonts improve dyslexic learners' reading speed and comprehension by making the text more readable, as claimed by Baskent and Van Leeuwen (2013). Likewise, computer-assisted materials allow learners to find multiple ways to complete their assigned tasks (Smith, 2018). Commercially prepared computer-assisted materials are abundantly available in today's market, but limited knowledge of assessment and interventions is still challenging and require attention. Moreover, most computer-assisted materials (available in the market and on the Internet) are generally prepared and based on foreign culture and needs. Online English language learning materials follow a one-size-fits-all-design approach. Such generic materials cannot cater to the demands of indigenous learners (Howared & Major, 2004; Irshad & Ghani, 2017) and learners with reading disabilities. Research supports that culturally relevant and indigenously familiar content can more effectively cater to the linguistic and cognitive needs of dyslexic learners (Tariq & Latif, 2016; Anjum & Mansoor 2020).

1.1. Theoretical Framework

Computer-assisted language learning (CALL) provides a rich linguistic environment that is the key to learning language, as claimed by Rosa and Obillos (2016). Moreover, dyslexic learners also need extrinsic tools to be motivated, as reported by Theobald (2006), and CALL offers a number of ICT applications that help enhance learners' motivation to a great extent, as stated by Babalola and Baker (2019). ICT has proposed a solution to the problems and difficulties faced by students, who lack motivation and studies being restricted due to linguistic issues. ICT-assisted language learning supports the modern principles of language learning in which interaction, individualization and motivation are of great importance. Furthermore, it activates multisensory learning. ICT-assisted language learning is based on the cognitive theory of multimedia learning, as presented by Richard Mayer and Moreno in 2003.

According to Mayer's Multi-Media theory (2003) of cognitive learning, pictures and words are presented to learners at once through multimedia, which are processed through dual channels (ears and eyes), and organize verbal and pictorial models in working memory. Second, each route processes some information (within a limited capacity) at a given time in short-term memory/working memory, which is responsible for language learning. Finally, both models integrate prior knowledge retrieved from long-term memory. The integration process occurs in the working memory to offer segmented chunks of information to learners during multimedia learning. Language learning and working memory operate in coordination. In summary, Multimedia learning activates more than one sense (referred to as MultiSensory Language Learning Technique) to learn a language; and support dyslexic learners through multiple channels. Contents based on the cognitive theory of Multimedia Learning aim to improve second language learning among dyslexic ESL learners. Such materials assist dyslexic ESL learners in retaining new learning by connecting it with their previous knowledge (processing), as is the case in the current study.

1.2. Objectives

This research meets the following objectives:

1) To evaluate the impact of indigenously developed ICT-aided materials on English language learning outcomes of dyslexic ESL learners
2) To identify the potential challenges faced by dyslexic ESL learners due to the ICT-aided indigenous materials

1.3. Research Questions

The current study answers following research questions:

1) Does indigenously developed ICT-aided materials improve the English language learning outcomes of dyslexic ESL learners?
2) What potential challenges are encountered by dyslexic ESL learners owing to the integration of ICTs while learning English?

1.4. Research Hypothesis

It is hypothesized that the integration of indigenously developed ICT-aided materials significantly improves the English Language Learning outcomes of dyslexic ESL learners.

2. LITERATURE REVIEW

In a multilingual country, such as Pakistan, where more than 73 languages are spoken (Mahboob, 2002) and English has been taught as a subject since the early years of academic career, and has to be learnt by dyslexic learners too (Anjum & Mansoor, 2020), who are deficient in word recognition and comprehension.

Dyslexia is a learning disorder that has been defined by researchers in multiple ways (Flaugnacco et al., 2015). Theorists explain dyslexia according to their perspective (Smythe & Everatt, 2002). The most common definition of dyslexia, as given by The International Dyslexia Association (2002), is a neurobiological learning disability. It is evident from this definition that dyslexia is a learning disorder that is associated with the brain, and results in language disability, specifically reading. Snowling (2013) cites that the core feature of dyslexia is word decoding, which in turn impacts spellings and the development of fluency. Word recognition, poor spelling and decoding result from phonological deficits which, in turn, affects the reading comprehension, vocabulary and background knowledge of the learners (Gori & Facoetti 2014; Bachmann & Mengheri, 2018).

Language learning by dyslexics is a major concern worldwide, as stated by Mather et al. (2020). Efforts by multiple organizations on international level such as; International Dyslexia Association, European Dyslexia Association etc. schools, clinics and social media are reported by the researchers. Many areas related to teaching and learning in dyslexics, such as vocabulary development (Duff et al., 2014), reading fluency and accuracy (Lockiewicz & Jaskulaska 2016; Kalindi et al., 2015), and reading comprehension (Bellochhi et al., 2017; Farukh & Vulchanova, 2016) have been studied and researched in advanced countries.

In contrast, dyslexics are unobserved and ignored in Pakistan (Jumani et al., 2011) because of lack of screening in the early stages. The absence of screening facilities in the early years was one of the major reasons for poor statistical data regarding the number of dyslexic learners (Ashraf & Majeed, 2011; Asharf & Najam 2017; Farukh & Vulchanova 2014). Ashraf and Najam (2017); and Khalid and Anjum (2019) have drawn attention to the presence of dyslexia among Pakistani learners, but the exact number of dyslexic learners is not available, as mentioned by Haidry and Sana (2017). Moreover, Ashraf and Majeed (2011) estimated that almost 5.37% of secondary school students in Pakistan are likely to have dyslexia. Similarly, Naz and Habib (2015) concluded that the number of dyslexic learners in Pakistani schools was approximately 10-18% of the total population in their study.

Research on the learning skills of dyslexic learners is a well-worked domain around the world; but is ignored in Pakistan. Some organizations like; the Institute of Dyslexic Education and Attitudinal

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Studies (IDEAS) and the Center for Assessment and Remedial Education (CARE) are working on dyslexic learners in Pakistan. Some of the studies in the Pakistani context; regarding techniques to manage dyslexic learners have been presented by Jummani et al. (2011), Khan (2013), Tariq and Naz (2017), Tariq and Latif (2015,16), Shiraz et al. (2020), and Anjum and Mansoor (2020). Jummani et al. (2011) found a significant difference among learners of the experimental group when remedial techniques were tested for four months on dyslexic ESL learners at the elementary level. Tariq and Latif (2015) found improvements in dyslexic learners' writing skills while testing the impact of a mobile application on the writing skills of the dyslexic learners. Another study conducted by Shiraz et al., (2020) suggested that dyslexic learners need to be educated to use their verbal working memory to enhance their learning efficacy.

Teachers in schools mainly focus on learners' literary skills such as reading and writing. Less focus has been given to cognitive skills training. Interventional studies on children with dyslexia that focus on improving cognitive skills are limited. Computer-based programs can introduce cognitive skills (attention, memory and executive function), but are ignored. Smith (2018) claims that computer assisted language learning (CALL) offers multifaceted platforms to learners.

In addition to teachers, learners and materials, computers have become a fourth pillar of teaching-learning process. Technological mastery and Internet literacy are major demands of the 21st century (Horstein, 2008). The advent of technology has given rise to ICT, a technological tool for storing, retrieving and disseminating information. ICT provides positive feedback on students' attitudes towards learning a language. With the help of ICT tools, learners can make second language learning a fruitful and intriguing activity.

Indigenous computer-assisted materials have a great impact on enhancing the speaking skills of ESL learners at an intermediate level in Pakistan by developing computer assisted materials (Hussain, 2016). One of the most recent studies substantiated the efficiency of indigenously developed computer-assisted materials to improve the English language reading skills of Pakistani ESL learners with dyslexia in mainstream public schools in Pakistan (Anjum & Mansoor, 2020). Integration of ICTs with local content (as prescribed by the Punjab Textbook Board) to develop indigenous material according to the needs of dyslexic learners has the potential to support them in learning the language, as reported by Anjum and Mansoor (2020). However, there is limited research on the effectiveness of using Information and Communication Technology (ICT) in second-language learning for learners with dyslexia in Pakistan. This study aims to fill this gap by evaluating improvements in the language learning outcomes of dyslexic learners through indigenously developed ICT-aided material. It also aims to explore the the potential challenges faced by the dyslexic ESL learners while learning English through ICT-aided indigenous materials.

3. METHODOLOGY

This study used a convergent mixed-methods research design. In a convergent design, quantitative and qualitative data are collected during the same phase of the research, analyzed separately, and then merged to obtain a comprehensive understanding of the phenomenon (Creswell, 2021). This design was appropriate because the study aimed to measure the improvement in learners' language performance through pre- and post-tests, while simultaneously exploring their classroom behaviors, engagement levels, and challenges through observations and interviews. A sequential design was not selected because the purpose was not to allow one dataset to determine the direction of another. Instead, both forms of data were needed concurrently to triangulate findings and understand not only whether improvement occurred, but also how learners experienced ICT-integrated instruction (Biesta, 2012).

ISSN (P): 3006-6522
ISSN (E): 3006-6530

3.1. **Participants**

A small sample size (03) of three Pakistani dyslexic ESL learners at the elementary level (grade VI only) was selected for the current study, which was conducted for the pilot testing of tools. A very small sample size (2-5) is adequate when the purpose of the pilot study is the development of instruments and refinement of protocols, as stated by Hertzog (2008). Moreover, Lancaster et. al. (2004) opined the same when a pilot study focused on testing the feasibility and research tools. The study used a purposively selected sample based on the choice criteria of the researcher; selection of participants after screening for dyslexia through the Learning Disabilities Checklist by Asharf and Najam (2014).

One male teacher; with MA (English), B.Ed. degrees and more than 10 years of teaching experience at the elementary level, was invited to participate in the study. He was informed of the objectives of the study. The rationale for the intervention was discussed with him prior to the administration of the plan. He willingly participated in the study and the researcher acted as an observer. The teacher's role in this study was to deliver ICT-integrated lessons according to the intervention plan, facilitate learners' engagement during classroom activities, and support students when they face difficulty in reading or with equipment. He also provided qualitative insights through a semi-structured interview regarding students' progress and classroom behavior.

3.2. **ICT Integrated Material Development and Administration Procedure**

The material was developed from an English textbook for Grade VI, as prescribed by the Punjab Textbook Board Lahore. Grade VI English subject teachers were consulted to select the chapters to be taught. They suggested two chapters based on difficulty level of the lessons (the most difficult for learners, as per their experience). The material was developed using Microsoft Power-point with multimodal presentation (having images and sound). The researcher integrated the presentation slides with voice over narration and developed videos (8…10 minutes video for one lesson). The intervention continued for six weeks (35 minutes daily, five classes each week) where dyslexic ESL learners were taught in the computer lab of the school through ICT-aided indigenously developed material. They were also provided with the same lesson on WhatsApp numbers after class, for reinforcement purposes. WhatsApp is one of the most commonly used applications used for reinforcement purposes (Ramdhani & Nandiyanto, 2021) as it facilitates and encourages learners through digital scaffolding. In a recent study, Ehsan et al. (2023) also supported the use of WhatsApp as a reinforcement channel alongside formal teaching as an unpaid app that only requires Internet connection.

3.3. **Research Procedure**

Before the start of the intervention, dyslexic ESL learners were tested through a pre-test comprising reading comprehension passage followed by three short questions (2 marks each) and four matching column items (1 mark each) worth 10 marks. The comprehension passage was selected from the English Textbook of Grade VI. During the intervention period, dyslexic ESL learners were taught through ICT-aided indigenously developed material for a period of 6 weeks where they were taught 35 minutes each day (six days a week). After the intervention period, the same test was administered as a post-test using the same marking criteria.

3.4. **Data Collection**

The mixed-methods nature of this study employed both types of data collection. Data collection was conducted between September and November 2024, despite uncertain circumstances and intermittent disruptions during study period (six weeks intervention period). Quantitative data were gathered through a pre-test/post-test (quasi-experimental), and qualitative data were gathered

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ISSN (E): 3006-6530

through semi-structured interviews with the teacher and participants' observations. The semi-structured interview was conducted using a four-question interview schedule (with follow-up probes) focusing on the teachers' perceptions of dyslexic ESL learners, their challenges, strategies to deal them, and the usefulness of ICT-aided materials in English learning, while classroom observations were guided by an observation checklist that recorded learners' engagement, decoding behavior, vocabulary use, and response to ICT-aid tasks. These tools guided the systematic recording of learners' responses during the six-week.

3.5. **Validity and Reliability**

The current study had a small sample size (N=03), so it was necessary to investigate whether the data were compiled with relevant evidence to ensure validity (De Winter, 2013). To ensure the validity of the quantitative phase, the test items used in the pre-test and post-test were aligned with the Grade VI English curriculum outcomes and reviewed by two subject specialists for content validity. In addition, the stability of the instrument was supported through pilot administration before the intervention, and internal reliability was measured using Cronbach's alpha, which showed an acceptable value of 0.815, which is in line with Muijs (2010) that is a test with a measure of ≥ 0.7 is internally consistent and reliable. In this study, triangulation verifies the findings by comparing test scores with interview and observational data. Using more than one source of evidence reduced bias, because improvements were confirmed through both numerical results and participant accounts. Biesta (2012) claims that the convergence of evidence collected through different methods enhances the validity of research data. The validity of the data was verified by checking the internal reliability of the test (Cohen et al., 2011). The trustworthiness of the qualitative data was ensured through prolonged engagement during the six-week intervention, member checking with the teacher to confirm interpretations, and maintaining an audit trail of observation notes and coding decisions.

3.6. **Ethical Consideration**

The study adhered to the British Educational Research Association (BERA) Ethical Guidelines, ensuring protection from harm, respect for privacy, anonymity, voluntary participation, and transparency in reporting. Special care was taken because the participants were vulnerable learners; therefore, their identities were concealed, data were securely stored, and all procedures were explained to the parents and teacher to guarantee informed understanding. This study followed the international and institutional ethical guidelines for working with vulnerable learners. Formal permission was obtained from the school administration, including written consent from the principal, academic coordinator, participating teacher, and parents of all three dyslexic ESL learners. Participants were informed about the purpose, procedures, and use of data in a simple age-appropriate language. They were assured of confidentiality, privacy, voluntary participation, and the right to withdraw at any stage without any academic consequences. All personal identifiers were removed during transcription, and pseudonyms were used to ensure anonymity. Data were stored securely on password-protected devices and used solely for academic and research purposes. The teacher's interview and observational notes were handled in accordance with ethical reporting standards.

4. DATA ANALYSIS

Descriptive and inferential statistics were employed to describe and infer the results; using the SPSS software for precise quantitative data. A probability level of 5% was considered to be statistically significant. Descriptive statistics; the mean and standard deviation were calculated. Moreover, an inferential test and; paired sample t-test were also run to determine the significance

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value. The Table 1 below indicates the results.

Table 1.

Mean scores of Pre-test and Post-test

	Mean	N	Std. Deviation
Pre-test	3.0000	3	1.73205
Post-test	5.3333	3	1.52753

Table 1 shows the results from paired sample statistics which were used to compare the means of the two related groups. The mean value for the pre-test was 3.0000, whereas the post-test mean value was 5.3333, indicating an increase in the mean score after invention. A high post-test value indicates potential improvement after the intervention.

Table 2.

Paired Sample t-test

	Paired Differences			Significance	
	Mean	Std. Deviation	t-value	One-sided p	Two-sided p
Pre-test/Post-test	-2.33333	.57735	-7.000	.010	.020

A paired-sample t-test was used to explore patterns in the data, but due to the very small sample size (N = 3), the results were interpreted cautiously and treated as indicative rather than generalizable. Table 2 presents the results of the inferential statistics. A paired-samples t-test was used to compare pre-test and post-test scores. This indicates that the mean difference between both scores is -2.33333, which indicates that overall post test scores are higher by 2.33 points as compared to the pre-test score. Similarly, the value of the standard deviation of the differences was 0.57735, which indicates the difference between the paired scores and the mean difference. Additionally, the Table 2 also shows that the significance value of one-sided p (0.010) and two-sided p (0.020) are less than 0.05 ($0.010 < 0.05$, $0.020 < 0.05$) which clearly indicates the significance of the results (statistically significant for one and two-sided tests, respectively). A significance value (p) of less than five shows a statistically significant improvement in the pre-test and post-test scores. However, the small sample size (N=3) suggests cautious interpretation of the results. The findings presented in Table 2 corresponds to the earlier study by Anjum and Mansoor (2020) who claimed that computer-aided indigenous material has the potential to improve the English language of dyslexic learners.

Qualitative data, comprised observations of the participants (N=3) and interviews with the teacher (N=1). The participants of the experiment were observed by the researcher during the intervention period and the teacher was interviewed. Conducting an auto-coded thematic analysis of semi-structured interviews with teachers and participants' observations of the learners using NVivo provided a deeper insight into the role of ICT-aided indigenous material in the language learning of dyslexic ESL learners. The term 'auto-coded' refers to NVivo's automatic coding feature, which groups frequently occurring words and patterns; however, all auto-generated codes were manually reviewed and refined by the researcher to ensure meaningful themes. Thematic analysis of the interviews revealed the following themes and sub-themes, and each theme was clearly

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distinguished based on its unique meaning as shown in Figure 1 below.

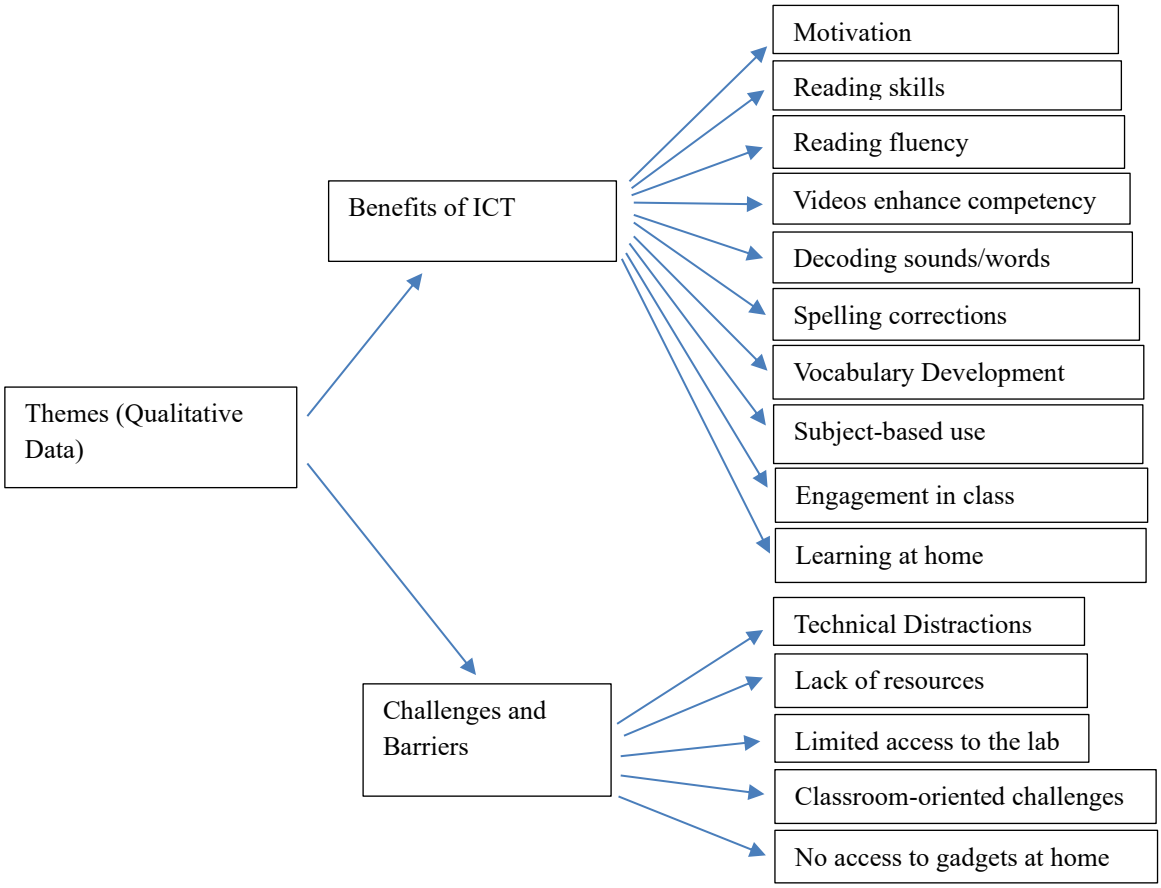

Figure 1. Thematic View of Qualitative Data

Figure 1 provided the list of themes and code along with a brief definition (e.g., 'motivation' refers to the teacher's description of how ICT materials increased students' willingness, interest, and confidence to participate in learning). Two central themes are benefits of ICT-aided material in English learning and challenges/barriers. The benefits of ICT-aided text include sub-themes such as; reading skills, vocabulary development, motivation, engagement, independent learning, and subject based use of the material. The central theme of challenges and barriers; includes four sub-themes; technical distractors, technological barriers, classroom-oriented challenges, and students-based challenges.

Qualitative analysis of participants' observations yielded interesting findings, as shown in Table 3. At large, dyslexic learners responded positively when they were taught through ICT-aided language learning materials. Table 3 shows the individual performance of the purposively selected participants (of the experimental group), who were observed by the researcher throughout the intervention period.

Table 3.

Representation of Individual differences of the participants

	P1		**P2**		**P3**		**Total**	
Impact of ICT Integrated material	Yes	No	Yes	No	Yes	No	Yes	No

ISSN (P): 3006-6522
ISSN (E): 3006-6530

		P1		P2		P3		Total	
on English Language Learning									
1	Engagement in class								
i	Participate actively	✓		✓			✓	02	01
ii	Motivated in learning English through ICTs	✓		✓		✓		03	---
iii	Interested in using ICT while learning language	✓		✓		✓		03	---
iv	Ask questions when needed	✓		✓			✓	02	01
v	Remain silent		✓		✓	✓		01	02
vi	Require support	✓		✓		✓		03	---
vii	Require support from peers		✓	✓		✓		02	01
viii	Require support from teacher	✓		✓		✓		03	---
ix	Use ICT integrated content independently	✓		✓			✓	02	01
x	Proficient to use ICT integrated contents	✓		✓			✓	02	01
2	Decoding skills								
i	Recognize common vowels	✓		✓		✓		03	---
ii	Recognize consonants	✓		✓		✓		03	---
iii	Use common consonant patterns	✓		✓		✓		03	---
iv	Use common vowel patterns		✓	✓			✓	01	02
v	Demonstrate knowledge of prefixes/suffixes	✓		✓		✓		03	---
vi	Demonstrate knowledge of compound words	✓		✓			✓	02	01
3	Vocabulary development								
i	Recognize new vocabulary words	✓		✓		✓		03	---
ii	Understand new vocabulary items	✓			✓		✓	01	02
iii	Use vocabulary in context		✓	✓			✓	01	02
iv	Recall new vocabulary items	✓		✓			✓	02	01
v	Use new vocabulary words	✓			✓		✓	01	02
4	Reading Comprehension								
i	Understand the meaning of		✓		✓		✓	---	03

ISSN (P): 3006-6522
ISSN (E): 3006-6530

		P1		P2	P3		Total	
	words in context							
ii	Answer questions	✓		✓	✓		03	---
iii	Able to summarize the text	✓		✓		✓	02	01
iv	Point out the main ideas	✓		✓		✓	02	01
v	Retell the text	✓		✓		✓	02	01
vi	Improvement in reading speed	✓		✓	✓		03	---
vii	Enhanced fluency	✓		✓		✓	02	01
viii	Recognize multiple uses of word	✓		✓		✓	02	01
ix	Recognize homonyms	✓		✓		✓	02	01
x	Improved phonics	✓		✓	✓		03	---
xi	Better phonemic awareness	✓		✓		✓	02	01
xii	Comprehend simple sentence	✓		✓		✓	02	01
Barriers								
1	Physical							
i.	Space	✓		✓	✓		03	---
ii	Noise	✓		✓	✓		03	---
iii	Student oriented		✓	✓	✓		02	01
iv	Others	✓		✓	✓		03	---
2	Technical							
i	Distractors	✓		✓	✓		03	---
ii	Limited access	✓		✓	✓		03	---
iii	Lack of resources		✓	✓	✓		02	01
iv	Others	✓		✓	✓		03	---

Participant 1, P1, is a Grade VI male learner identified with dyslexia through the Learning Disabilities Checklist. He showed relatively stronger engagement and motivation compared to the other participants. Quantitatively, his post-test scores improved more noticeably in reading comprehension and vocabulary. Qualitatively, classroom observations revealed that he participated actively, asked questions when needed, and frequently sought access to ICT-based materials through WhatsApp. However, he struggled with applying vowel patterns and vocabulary in context, indicating uneven progress across skills.

Participant 2, P2, was a male Grade VI learner who demonstrated moderate improvement. Quantitative results show gains in decoding and reading fluency, but limited improvement in vocabulary understanding and contextual usage. Qualitative observations revealed that, although he participated in class activities, he faced challenges in understanding word meanings and required teacher support for unfamiliar items. His overall engagement was consistent, but less enthusiastic than P1.

Participant 3 (P3) a Grade VI male learner who showed minimal improvement. Quantitatively, his

ISSN (P): 3006-6522
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post-test scores increased only slightly compared with those of P1 and P2. Qualitative data indicated that he remained mostly silent, hesitanted to participate, and relied heavily on teacher and peer assistance. He faced persistent challenges in vocabulary, decoding, and comprehension tasks; and required additional scaffolding to use ICT-aided content.

Overall, Table 3 shows a greater number of positive responses, indicating an inclination of the participant towards the positive impact of ICT-aided indigenous material. Most of the participants looked motivated during the class and showed interest in learning while learning a language through ICT-aided indigenous material. The same was reported by the teacher, in response to a question during the interview. He was asked, "Do you think that ESL dyslexic learners are benefitted from the ICT-aided material?"

> *"Yes, definitely… Because dyslexic learners are motivated. They experience new environment. This high motivation improves their learning capacity and memorization."*

Table 3 also indicates that no participants was capable of understanding words in the context. It was also shown that all participants needed support from either their teacher or peers. It is always difficult for them to work independently, and they are not proficient in ICT-aided contents. One of the three participants overcame this problem; however the percentage was very low. The provision of videos to the dyslexic ESL learners through WhatsApp provides them with the opportunity to work independently at home and in accordance with their availability. This idea is also supported by Foutsitzi and Caridakis (2019) and Azmi (2017) who opined that the planned integration of ICT helps students become active and independent learners by addressing different learning styles and needs.

Decoding skills were measured by recognizing vowel and consonant sounds and using vowel/consonant patterns. All of the participants showed maximum inclination towards recognition and use of consonant sound and patterns, but two out of three found it difficult to use common vowel patterns that indicates the complex nature of vowel patterns. The relationship indicates a positive relationship between reading skills and the use of ICT-aided indigenous material that improves reading skills by augmenting their reading comprehension, reading fluency, word recognition, and pronunciation through videos. As stated by the participant;

> *"They face challenges in reading, learning skills, spelling and letter identification…ICT-integrated can help address issues such as word mixing, word recognition, pronunciation……"*

The above statement indicates that ICT-integrated materials have the potential to encounter the major challenges faced by dyslexic ESL learners. ICT-aided indigenous material can cater the needs of the dyslexic ESL learners in reading comprehension, vocabulary development, decoding skills, and engagement in class, as shown through observations and interview data.

All participants demonstrated good knowledge of prefixes, suffixes and other factors used to measure vocabulary development, as shown in Table 3. All participants were able to identify new words. The same can also be projected from the interview data as reported by the teacher.

> *"When we present pictures related to words, students link the image to the word, which helps them remember it and stay engaged in the class."*

Table 3 shows that all dyslexic learners have to face different types of barriers when they were taught through ICT aided indigenous material. Major problems include; physical barriers, classroom related barriers, students-oriented barriers and technical distractor etc. As stated by the interviewee:

> *"Several challenges arise, including limited access to the lab, the lack of*

ISSN (P): 3006-6522
ISSN (E): 3006-6530

> *well-equipped labs, and the high student-to-teacher ratio… they are often distracted by other content, such as dramas, games, and videos, which causes them to waste time and lose focus."*

It was also observed that poorly designed spaces to accommodate ICT equipment and facilitate learning, connectivity, power supply, noise, poor condition of furniture, and congested spaces were some of the physical barriers that participants had to face. Moreover, participants also faced students-based problems such as; disturbance by peers, distance from the screen and weak eyesight.

All participants faced distractors and technical barriers such as; quality of sound, access, and connectivity. One of the three participants reported the unavailability of devices at home that could be used to play the videos. Data gathered through semi-structured interviews also highlighted the same issue, which can be studied through the statement of the interviewee.

> *"All learners are not fortunate enough to have such resources…. it's not feasible for students to visit the lab on a daily basis."*

Another aspect can be viewed from the words of the interviewee; the learners lack resources that is one of the main challenges that they face while being taught through ICT-aided indigenous material.

In short, quantitative data gathered through experiment and qualitative data taken from interviews and observations converge to reinforce each other's results. Significant differences in the mean values of pre-test and post-test indicated a significant improvement in language learning outcomes of dyslexic ESL learners through ICT-aided indigenous material, whereas qualitative data provided a deeper insight into the factors that contribute to the development of English language learning outcomes through ICT-aided indigenous material. The major factors contributing to the improvement in language learning outcomes were reading comprehension, decoding skills, vocabulary development, and engagement in class. The results from the qualitative and quantitative data were further supported in the literature to attain triangulation in data analysis. Moreover, the results from qualitative data also revealed that dyslexic learners face physical and technical challenges during the teaching learning process through ICT-aided indigenous material.

5. DISCUSSION

This study set out to consider how ICT-aided English language material developed in-house would enhance the learning outcomes of dyslexic ESL learners, and to identify the issues they face when learning using technology. The quantitative findings revealed an evident improvement in reading comprehension, decoding and vocabulary, as represented by the posttest scores. Even though the sample size was small, the statistically significant upward mean score indicated that the ICT-aided contents enabled learners to process written input, learn vocabulary and comprehend textual meaning more efficiently than the traditional environment.

The statistical results were supported by the qualitative results. Lessons in multimedia form were found to be more engaged, interesting, and attentive; thus, students showed better accomplishments and continued attention. The issue of motivation proved to be one of the key aspects, and learners reacted positively to the visual and audio stimuli, which made the process of decoding easier and helped recall the vocabulary. The teacher's interview also revealed that pictures, sounds, and repetitive exposure using videos assisted the learners in relating unfamiliar words with concrete representations, enhancing understanding, and remembering. These results are in line with Mayer's cognitive theory of multimedia learning, which postulates that the dual-channel processing enables the learners with limited working memory capabilities.

ISSN (P): 3006-6522
ISSN (E): 3006-6530

These findings also demonstrated some individual differences. Two of the learners made significant progress in reading fluency, vocabulary recognition, and decoding whereas one learner still depended heavily on teacher and peer support. This difference shows that even though learning can be reinforced using ICT, learners with dyslexia still need a differentiated scaffold. The observational data also indicated that ICT-assisted material enhanced the chance of independent learning. This was particularly noticeable when the learners re-watched the lesson videos at home, reinforced consolidation, and repeated practice.

Thus, the study found that there are various challenges to overcome despite these advantages. Inaccessibility to well-equipped computer laboratories, unreliable connections, noise, problems with sitting position, and lack of equipment at home posed obstacles to regular interaction. Students were occasionally distracted by non-educational material on gadgets, and one student was unable to concentrate, even when receiving multimedia training. These limitations demonstrate that ICT is not as useful as addressing the limitations posed by infrastructural issues or supportive learning conditions.

Overall, the results indicate that the materials of ICT-aided indigenously can significantly improve reading competency, vocabulary acquisition and decoding among dyslexic ESL learners, especially when the content is culturally relevant and visually abundant. Nevertheless, proper integration depends on sufficient resources, systematic teacher support, and the proper management of distractors. This research adds to the accumulating body of literature that states that inclusive education can be facilitated by localized technology-enhanced instruction, particularly in areas where the number of dyslexic learners is under-represented and under-serviced.

6. CONCLUSION

The results of the experiment revealed significant difference of mean values (2.3333) of pre-test and post-test, significance value of one-sided p (0.010) and two-sided p (0.020) which are less than 0.05 ($0.010 < 0.05$, $0.020 < 0.05$). This clearly indicates that the results are statistically significant for one and two-sided tests respectively. A significance value (p) of less than five shows a statistically significant improvement in the pre-test and post-test scores. Moreover, the difference in the mean scores of pre-test and the post-test (-2.333) clearly indicates that ICT-aided materials have a significantly positive impact on enhancing the reading skills of dyslexic ESL learners at the elementary level. The findings of this study support this hypothesis. The hypothesis stated that the integration of ICT with traditional language teaching will have a significant impact on the English language learning of dyslexic ESL learners at the elementary level. However, the small sample size (N=3) suggests cautious interpretation of the results. The result obtained through the experiment nullifies the zero hypothesis and supports it.

Moreover, thematic analysis of the interviews and observation also reinforced the same by providing deeper insight into the factors that contribute to the improvement in language learning outcomes and challenges faced by dyslexic ESL learners when they were taught using ICT-aided indigenous materials. ICT-aided indigenous material improves the language learning outcomes of dyslexic ESL learners by improving their reading comprehension, decoding skills, vocabulary development, and engagement in class. The results of the interviews and observations reveal that the study is in line with the findings of Stark et al. (2016), who opined that learners' reading skills can be enhanced through phonemic awareness, phonic, vocabulary and oral reading fluency. The current study also supported the findings of Anjum and Mansoor (2020) and Tariq and Latif (2016), who opined that ICT-aided indigenous material has the potential to enhance reading skills of

ISSN (P): 3006-6522
ISSN (E): 3006-6530

dyslexic ESL learners at the elementary level.

6.1.Limitations and Delimitations

The current study has following limitations and delimitations:

1) For pilot testing, the sample size was limited to three dyslexic ESL learners and one teacher at the elementary level.
2) The small sample size (N = 3) means that the results should be interpreted cautiously, as the estimates may not generalize well.
3) Only one interview in qualitative data might limit the results.
4) The observation checklist and interview questions need to be amended to obtain the same data from the two different tools.
5) Only experimental group was observed.

Data Availability:

The data that support the findings of this study are available upon request from the corresponding author. The data were not publicly shared because of privacy and ethical considerations.

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Conflict of Interest:

The authors declare that there is no conflict of interest, financial or otherwise, related to this work.

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