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Cognitive and Socioeconomic Influences on Bilingual Literacy Development in Pakistan: A Multidimensional Approach

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Abstract

This research investigated the cognitive and neurological aspects of bilingual literacy acquisition in Pakistan and the roles of bilingualism, culture, gender difference, social status, and scripts. A mixed-methods research design was employed. Literacy was assessed using questionnaires on a sample of 200 Urdu English bilingual student and 30 semi structure interviews were also conducted from different economic backgrounds rural as well as urban. Descriptive and inferential statistical techniques were used to compare the relationships between the literacy outcomes and the demographic factors into which participants were grouped while the qualitative data were analyzed thematically to identify culturally related beliefs influence educational access. Credited on Theory of Bilingual Advantage, Socioeconomic and Cultural Capital Theory, and Digital Literacy Theory, study showed that, students being bilingual in Urdu and English language have better executive control and cognitive flexibility; evidencing the bilingual advantage. The current study showed inequality in access to education on the basis of socioeconomic status and gender meaning that learners in ward school especially in rural areas have low literacy levels and poor cognitive skills. Digital literacy interventions demonstrated that media invite the user to 'play' with the virtual stimuli increase cognitive activation by exercising the neural pathways necessary for new linguistic learning. The findings showed that cultural expectations, especially patriarchal perceptions of girl's ability to receive education, compound trouble for the rural girls and amplify

gaps in literacy. There are policy implications focused on gains to education policy, equal status with information policy, and culturally appropriate practices. This study adds to the current knowledge of bilingual literacy in Pakistan by presenting an examination of contextual factors that affect literacy comprehension, including cognitive, cultural and socio-economic factors. The study provides important implications to the policy makers, teachers and other relevant stakeholders to plan interventions to promote cognitive and academic improvement of all the students in Pakistan.

Keywords: bilingual literacy, cognitive development, neurological, Urdu-English bilingualism, socioeconomic disparities, gender disparities, cultural influences, digital literacy, Pakistan, educational policy

Introduction

Literacy development in a Pakistan context is therefore a product of a multilingual and multicultural society with interplays of cognitive, socio-economic, gender and cultural factors. Pakistan's policy on separate language literacy, that uses both Urdu and English as the major languages hereby place extra cognitive burden on students but may also enhance on executive control and cognitive switch. Previous research has associated the benefits of bilingualism with the growth of better cognition including better attentional control as well as problem solving skills (Bialystok et al 2012). However, the same difficulties make cognitive load advantageous since it complicates for , for instance, children with no access to sources that could help enhance bilingual literacy. These cognitive challenges are further worsened by aspects of socioeconomic and cultural nature including; girls in rural setting, drop out from school early due to cultural fashion and hardship. Therefore, acknowledging the complexity of the literacy processes that should be investigated concerning bilingual literate Pakistanis, the details of the cognitive and neural processes should also be taken into account.

Need for bilingualism for literacy in Pakistan: Bilingualism and the cognitive benefits that it holds for the country. The evidence available reveals that, for the bilinguals, they end up having improved cortical plasticity, which in the long run brings about enhanced neural reserve and plasticity (Kroll & Bialystok, 2013). Such neurological is advantageous to the Bilingual learners especially since it improves memory, attention, and control processes. The benefits of learning two languages may also assist students to avoid the some of the difficulties that are encountered when

learning languages in Pakistan that are Urdu and English. But the argued cognitive advantages of bilingualism are not equally available to all students, especially those from low-income families, because they may not afford conducive bilingual education. It has serious implications and impacts on cognitive acquisitions, learning achievements and sustainable futures of literacy in Pakistan.

This paper shows that poverty significantly affects the literacy level of the people in Pakistan as well as gender inequality. Amid the exam, students enjoyed more educational facilities and better quality of teaching in Urdu as well as English in urban zones. While there is a great deal of research evidence demonstrating the benefits of bilingual literacy development for students from the privileged upper middle-class background, the limited availability of material resources in the low-income rural schools means that a majority of the students in such schools never get to have a chance at the valuable bilingual literacy developmental process. Various variables indicate that social-economic disadvantaged children are often affected by poor teach facilities, large class sizes, and limited support for learning bilingual literacy (Khan et al., 2020). Most of these socioeconomic differences have an effect on the learning outcome since, children in the disadvantaged area might in most cases may not get a chance to engage in the quality interaction related to language and thought that lead to such increase in cognitive flexibility. Moreover, academic achievement, comprehension and motivation can be affected if the two languages are not supported by sufficient direction due to lack of cognitive resources which might lead to student stress and disengagement hence the need to develop the students' literacy skills in the first language.

Another significant factor is Gender: illiteracy in female audience of Pakistan especially in villages where culture doesn't allow female child to be educated. In Pakistan gender gaps in education are evident and girls are unable to access education that would enable them to gain adequate literacy (Qadir & Parveen, 2019). Such barriers, as early marriage prescription, restricted education for girls also provide cognitive constraints that affect educational and life opportunities. Other research in literature shows that girls in rural areas do not only experience limited education chances but also do not have a chance to gain cognitive benefits of bilingual as they have little schooling chance as well. Thus, gender gaps in literacy attainment also have other positive effects

related to cognitive development, and girls from rural area are deprived of them because of low income and traditional gendered norms and values.

The emergence of digital literacy organizations could therefore be helpful in trying to address some of the literacy related obstacles that affect minority groups in Pakistan. Digital literacy programs bring in technology enabled learning tools which can be complementary and perhaps enhance conventional teaching methodologies and offer learner and cognitive engagement (Lee et al., 2016). , the study has established that digital literacy enhances learning by boosting cognitive learning because it provides different learning climates that enhance the brain exercising especially among the bilingual learners. Efforts to introduce digitally enabled literacy in Pakistan have started demonstrating positive effects in improving the access of relevant materials to the targeted schools away from large cities so prevalent all across the developing world. These programs have the potential of eradicating literacy differences and offering cognitive experience which enhances bilingualism and literacy in weak-resource contexts. Digital tools in education need to be focused on students who do not have access to the traditional tools and resources of classroom learning; the engagement in technology lessons will provide exposure to Urdu and English literacy through fun-based assignments.

Turning to cultural aspect, it is also part and parcel of the study as culture greatly influences literacy and more especially girls from rural areas are often infringed with cultural issues that deny them right education. That is why female education in some regions of Pakistan remains low due to cultural attitudes – girls' literacy rates are lower, and there is a general limitation on their opportunities for developing their thought processes (Ali & Ali, 2021). Lack of education to these girls not only hinders the level of literacy but also hampers mental development since literacy is an aspect of the human brain functions such as memory comprehending and thinking. Thus, the only way of eradicating disparities in learning achievement regarding cognitive and literacy development, especially for low income and ethnic minority students, is wiping out cultural-barriers that inhibit their learning capabilities.

Therefore, this proposal would like to investigate the cognitive and neuropsychological processes involved in bilingual literacy processing in Pakistan while taking into considerations socioeconomic, gender, and cultural differences. This research aims at identifying the nature of

relationship between the above factors, with the view of contributing towards understanding the difficulties faced and prospects offered for literacy improvement in Pakistan. The outcomes of the study will contribute to the promotion of educational policy, raising questions about the possible ways of providing equal opportunities for access to literacy education and developing cognition via the use of digital literacy projects. In the end, this study indicates the requirement to advance an integrative analytical model on Pakistani literacy development that covers the cognitive, social, and cultural facets of the bilingual literacy in order to build an efficient and effective education framework in the country.

The second research domain to be explored in the subsequent sections of this paper entails the cognitive and neural points of view with regards to bilingualism; the influence of sociocultural and gender gaps; the effectiveness of modern programs that support digital literacy; and the effects of cultural differences on literacy. In doing so, this paper will draw upon research from these areas to offer integrated knowledge of bilingual literacy development in Pakistan as well as specific advice on facilitating literacy across the diverse context of education.

Problem statement

While many initiatives to enhance literacy performance have been deployed in Pakistan; it was identified that literacy rates remains a problem in the country specifically in rural and poor population. Urdu English bilingual students face certain complexities in their thinking process that may or may not be advantageous while learning depending on the tools at their disposal. The current social-economic and gender differences make it worse, because women and girls education is limited and that hinders their ability to learn to read. In addition, culture in some areas worldwide hinders children from attaining education more often young girls from acquiring education to reduce literacy level. Previous interventions in digital literacy for improving the access to bilingual education present promising results but lack aggregate data focusing on the impact of bilingual education on the cognition and neural processing, The present study aimed to facilitate one year bilingual education programme and to investigate the relationship between the socioeconomic status and sex of children with regards to their developing cognition and neural activation patterns. This research seeks to fill this gap by focusing on the cognitive and neural substrates of bilingual literacy; development in Pakistan and exploring how these domains influence literacy; acquisition

and development, and how these factors may be harnessed to increase access to literacy education for all.

Scope of the study

The subject area of this study includes the cognitive and neural processes of bilingual literacy among students of Pakistan with reference to Urdu-English bilinguals. Concerning, it analyses the effects of socioeconomic, gender and culture on literacy attainment especially in relation to other factors that determine the cognitive processes and educational results. The purpose of the study is to embark on the evaluation of the bilingual literacy using a number of interdisciplinary fields such as neuropsychology and cognitive psychology, sociolinguistics. Furthermore, the study assesses the efforts in digital literacy and its impact on efforts to address and close literacy deficiencies in contexts of limited resources particularly among the disadvantaged groups in the rural settings. Overall, the findings of this study reveal ways in which Pakistan might offer different developments and problems for the process of learning to read to various literacy policy and practice stakeholders to explore targeting in ways that will generate differential improvements in literacy and cognitive development for Pakistani bilingual learners from diverse socioeconomic backgrounds.

Research Questions

1) What role does digital literacy play in supporting cognitive engagement and bilingual proficiency for students in resource-constrained environments within Pakistan?
2) How do socioeconomic, gender, and cultural factors influence the cognitive and neural dynamics of bilingual literacy development among Urdu-English bilingual students in Pakistan?
3) How do cultural norms and gender-based educational disparities impact the literacy and cognitive outcomes of bilingual learners, particularly girls, in rural areas of Pakistan?

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Literature Review

Theoretical Framework

The theoretical underpinnings of this study encompass cognitive psychology, sociolinguistics and Educational Neuroscience in order to investigate the cognitive and neural processes as the child learns bilingual literacy. The models underlying the framework – Theory of Bilingual Advantage, Socioeconomic and Cultural Capital Theory, and Digital Literacy Theory. These theories together provide an understanding of how bilingualism, socio economic status, gender and culture influences the literacy and cognitive skill development in the context of Pakistani children.

Theory of Bilingual Advantage

According to the Theory of Bilingual Advantage, bilingual improves cognitive skills; thus, including selective attention, attention shift, and working memory. Bialystok et al. (2012) note that it is usual for bilinguals to excel in dual task or in tasks that are accompanied by distractions by virtue of this, they have constant practice in having to focus attention and avoid interference because of the two languages that they use. This theory has provided the basis for appreciating the cognitive interactions that bilingual students in Pakistan face since they have to switch between using Urdu and English in their classrooms. Kroll and Bialystok (2013) stated that, bilingualism's cognitive advantage is realized through neuropllusctcism, meaning that bilinguals build recruit new neural connections to support better general cognitive coping ability. In this study, the Theory of Bilingual Advantage assists in interpreting the cognitive gains that the bilingual learners in Pakistan may gain subject to acknowledging the cognitive load that the learner experiences while operating under the dual linguistic systems.

Socioeconomic and Cultural Capital Theory

Bourdieu's, Socioeconomic and Cultural Capital Theory is quite appropriate for understanding how SES and culture influences literacy. Bourdieu built a social theory which claimed that economic and cultural capital is the stock of resources which is accumulated in the course of economic status, social relations and cultural education. However, how these children gain access to quality schooling, educational resources and support for literacy learning is a reflection of the kind of socioeconomic capital that is available to them within their homes and

families as well as in school, while the value and importance accorded to education in their societies is a function of cultural capital. Due to compulsory education policies across the Pakistan and particularly in rural areas, there are stark imbalances in socioeconomic status and the quality of bilingual schooling remain low which subsequently results in the student's literacy and cognitive function (Khan et al., 2020). It is essential to raise awareness about the part that the background and cultural expectations have on students' educational and cognitive processes when schools are understaffed and underfunded. Cultural capital also applies to literacy in the case of Pakistan where patriarchal culture and unfavorable gender disparity hinders female students; especially those in rural areas from accessing education. Qadir and Parveen (2019) argue that gender roles across cultures in Pakistan cut the education chances of girls, and in extension, their literacy and cognition. Based on the Socioeconomic and Cultural Capital Theory incorporated in this study, the study examines how restricted access to economical capital and approved cultural norms about learning bear it out on the bilingual literacy and cognitive ability of Pakistani students.

Digital Literacy Theory

According to the theory of Digital Literacy Theory, learning through technology improves cognitive involvement and the constructivist professional development of modified environments for learning. By performing a set of skills, digital literacy enables a student to use digital resources to interact with content and achieve educational outcomes (Mayer, 2014). With digital media, children in early bilingual literacy are offered opportunities to experience more than one language through technology appeals in the multimedia presentations. Lee et al., (2016) stated that improvement of digital literacy leads to abilities that foster an enhanced cognitive load and enhanced memory in relation to bilingual learners' who might require more resources in cognitively demanding processes due to the requirement of learning two languages simultaneously. The lack of conventional teaching aids in the rural settings makes the children in Pakistan to embrace digital learning initiatives as viable solutions for eradicating low literacy levels by providing solutions such as Free School for students in underprivileged provinces and districts and Free School for students.

The Integration of Digital Literacy Theory in to this framework is important to underlining that the use of digital technologies can help to overcome literacy disadvantages related to the level of SE and Sex. The theory emphasize the need to embrace use of digital platforms to offer cognitive aspect as well as learning activities that can enhance bilingual literacy to the children with little or no access to the standard reading resources. In this study, attempting to advance understanding of the role of technology for narrowing the gap in bilingual learner's education and improving their cognitive and linguistic skills in Pakistan, I propose to focus on the use of digital literacy.

In this theoretical framework, the author relies on the Theory of Bilingual Advantage, Socioeconomic and Cultural Capital Theory, and Digital Literacy Theory to outline a complex understanding of the bilingual literacy learning context in Pakistan. Collectively, the theories delineate cognizance for learning and language bilaterally, the contextual differences affecting learner achievement of literacy, and how new and improved digital literacy can foster engagement. Such an integration is critical for understanding the processes through which bilingual literacy emerges in various contexts and for studying the Pakistani context to develop and evaluate interventions that would support equity in and access to literacy learning.

Cognitive and Neural Aspects of Bilingual Literacy

Literacy in two languages is linked with more benefits in cognition than monolingual reading, including better performance in executive control, attention and even flexibility of thoughts. Research shows that in switching attention and controlling interference bilinguals tend to perform better than monolinguals because bilinguals are always in touch with two language systems (Bialystok et al., 2012). In Kroll and Bialystok (2013) the authors also stress that bilingualism is beneficial for neuropllasticity as this term refers to brain's ability to reset and create new connections. Such flexibility in bilinguals is closely related with better long-term cognitive and educational achievements because early foreign language acquisition influences some of brain areas that are responsible for memory and problem-solving.

In the Pakistani context where students are coping with Urdu and English literacy as modes of imagining knowledge, these cognitive advantages are novel and require more research. Although bilingual education can enhance the child's ability, it raises expectation on the students

particularly on those who are deprived of necessary resources. Hakuta (2020) showed that the positive effects of bilingualism appear to be maximal when learners are supplied with constant support in their linguistic context. However in developing countries these benefits are realized to be of less significance, this is particularly so regarding many areas within Pakistan, which has limited bilingual educational facilities. This highlights a research void in the area of cognitive, speaking of the Pakistani bilingual students under varying socioeconomic situations and no study has identified the effects of bilingualism on the described neural networks of students in such settings.

Socioeconomic Disparities in Literacy Attainment

The level of education and literacy defines one's SES and vice versa and for this reason, SES became a key predictor for the access to education in Pakistan. According to Khan, Iqbal, and Zaman, (2020) the Pakistan's socioeconomic realities have a huge bearing in educational inequity; students from rural and impoverished home backgrounds are likely to suffer through large classes, scarce and inadequate learning resources, and incomplete teachers. These constraints negatively limit the students' ability to learn literacy and to learn in general when they are expected to become literate in both Urdu and English. A study on the model has proposed that bilingual education need extra inputs such as staff development and programme modifications for the learner's cognitive and language development (Cummins, 2017). To the disappointment, many schools across the country and particularly the rural ones cannot afford to start such programs.

Also, SES complications cause a heavy cognitive burden for the L2 students, who have to handle both Languages' poor access to resources, due to scant tangible support. It is well understood what impact low SES has on cognitive development; learners from impoverished backgrounds tend to receive fewer language rich communication and interactions, which are vital for language and cognitive growth (Evans et al., 2012). Furthermore, no previous article of Pakistan specifically explored the cognitive results being bilingual literacy within such limitations of socioeconomic situations. This gap therefore opens a research agenda that seeks to establish the nexus between SES, bilingual literacy, and support, and cognitive development of the bilingual students.

Gender Disparities in Literacy Development

Recurrent patterns of inequality reveal that girls especially those in rural areas of Pakistan have poor literacy rates as compared to boys. Cultural practices such as early marriage, early and forced marriages, and few educational opportunities affect literacy and cognitive abilities for many girl child due to early marriage (Qadir & Parveen, 2019). They thus perpetrate long-term disparities because education especially literacy positively correlates with other cognitive functions such as thinking, comprehension and memory. According to Ali and Ali (2021), cultural barriers limit girls' education and more so, in major areas where; the education of girls is not encouraged. These barriers explain why girls cannot fully benefit from bilingual literacy effects on cognition and why their academic and career prospects should be restricted.

The gender-skill gaps can therefore have important cognitive and educational repercussions for girls from limited educational setting who may be limited to developing bilingualism and related cognitive ability. Even though some interventions have had a gender-mainstreaming approach as an objective, there are indications that such strategies are by themselves inadequate to counteract cultural perceptions that have been learned from childhood (Andrabi et al., 2020). While there is a plethora of literature on bilingual literacy, current literature is sparse in regard to how gender inequalities shape bilingual literacy particularly, leading to a gap in knowledge of how disparities in educational access impact bilingual cognitive learning of Pakistani students?

Impact of Digital Literacy on Bilingual Literacy Development

Techno literacy has increasingly been realised as a possible solution to education quantitative variation, especially in rural areas and other hard to reach places. Technology on its own offers virtual and flexible learning interfaces that can potentially address the students' needs in ways that a classroom set up may not (Lee et al., 2016). Technology should be a friend of L2 learners as it has enhanced the way students can access materials in order to embark on literacy journey in the second language through flexible, interactive and multimediality. Hussain (2022) found that the interventions in Pakistan have in the recent past exhibited positive outcomes with

regard to enhancing education for minorities, including enhancement of literacy levels in various remote areas.

Such tool improves learning related cognitive processing and thus working on the brain plasticity and cognitive flexibility of Bilingual Learners. According to Mayer (2014), students who use technology to learn literacy gain better attention, memory, and mentioned critical thinking abilities to achieve bilingualism. However, these tools are not readily available in all the parts of Pakistan and the use is still weak. Currently there are no studies that have explored the erstwhile mental and neural gains of the digital literacy for the bilingual students in Pakistan especially for those who are living in the rural areas where the rated penetration of the digital tools is very low.

Cultural Influences on Literacy Outcomes

Ethnical background plays a great role in the process of receiving education since most cultures are very traditional, and they tend to limit the educations of certain categories of people. For education in the context of the Pakistan cultural restrictions exist preventing girls from accessing education, especially for those girls living in rural areas where women's education is not encouraged (Ali & Ali, 2021). In essence, health-related programs stress educational cultural attitudes which hinder female literacy because girls are supposed to be at home being educated rather than going to school to be educated. The above cultural factors not only hinder the achievements of literacy, but also hinders the development of cognition because literacy domain is much related to comprehension, memory and critical thinking (Andrabi et al., 2020).

There is little research which focuses on the cultural influences on bilingual literacy learning as such, particularly in rural settings where learners experience language and culture barriers to learning. Little empirical research is devoted to elucidating cognitive effects of culture constraining bilingual literacy learning, especially for girls suffering from double cultural and educational vulnerability. This social gap indicates a research deficit in exploring the roles of culture and gender in the learning of bilingual literacy as that would draw on culturally appropriate practices, beliefs, and products as resources for mastering bilingual literacy.

The analysis of literature points to significant gaps in the knowledge of cognitive and neural aspects of the bilingual literacy in Pakistan with regard to sociopsychological, gender, and

cultural disparities. Although the past research on the topic points to valued cognitive advantages of bilingualism, it fails to explain how such advantages are optimally realized in impoverished contexts or for minority individuals. Furthermore experimental research has not been conducted on the effects of digital literacy programs in improving learner's cognition as well as bilingual comprehension particularly in the rural areas. Secondly, cultural differences and gender differences that influence literacy development are analyzed separately and their interaction with the bilingual literacy and cognitive development is not considered. Filling these gaps is imperative to ensure provision of bilingual education in the context of community schools and support the children's word reading and cognitive development in Pakistan.

Research Methodology

This research uses both survey and interview methodologies in an attempt to describe the thinking processes and neural activity associated with bilingual English reading amongst students in Pakistan which is conditioned by factors such as SES, gender and culture. An exploration of this nature requires the use of mixed methods, quantitative and qualitative data that gives a holistic view of the factors affecting bilingual literacy, as well as numerical and descriptive information that are important for comprehending literacy progress in Pakistan's diverse learning environment (Creswell & Clark, 2018).

Research Design

The study adopts the correlational research design for the quantitative part, whereby the outcomes of bilingual literacy would be compared with variables like the students' SES, gender and their exposure to digital literacy technology tools. The correlational design is appropriate for identifying the interdependence of several factors without altering them, which is suitable when; studying the naturally occurring factors that affect, literacy as proposed by the study. The qualitative part uses a case study research design to assess the literacy learning experiences of some learners from the different income bracket, where rural and urban differences are considered, and gender, as well as effects of digital tools on learning literacy are investigated.

Participants

The sample consists of 200 students learning English as the second language with the age range of (10-18) years and have been selected from different economic classes in both rural and urban areas of Pakistan. Samples will be recruited through clustered random sampling then proportionate random sampling with the target population dissected into subgroups (urban/rural, gender and socioeconomic status). Stratified sampling is used to increase diversities and enable comparison of subgroups with higher level of precision (Etikan & Bala, 2017). Furthermore, for the qualitative case studies, ten participants are recruited purposively since their experiences of literacy can help to learn about the strangeness and weaknesses of bilingual literacy among assorted populations (Patton, 2015).

Data Collection Methods

Data collection for this study is divided into quantitative and qualitative methods:

Quantitative Data Collection

The quantitative data is obtained through achievement tests, questionnaires and rating scales. Reading, writing and vocabulary abilities are checked by the bilingual literacy test for Urdu and English versions equally. Working memory and attentional control are evaluated using tasks based on those used by Bialystok et al., (2012) to capture bilingual cognitive effects. Also, a structured questionnaire obtains participants' demographic information, economic status, and availability of resource centers for learning about the internet. This questionnaire also contains cultural beliefs about education and gender, the items from questionnaires used in prior researches on educational fairness in Pakistan (Khan et al., 2020).

Qualitative Data Collection

For the qualitative part of the research, focused interviews are carried out on 30 participants randomly selected from 200 students. The interviews cover the participants' practices in bilingual literacies; difficulties inferred from gender or socioeconomic status; and perceptions of tools for digital literacies. Semi-structured interviews are allowing for the collection of information from participants, these interviews are particularly useful, since the participants are able to provide

elaborated information on how socioeconomic, and gender and cultural inequalities have influenced literacy experiences. Moreover, classroom observations are made in some of these schools to capture literacy practices within classrooms and their interaction with new media tools.

Instrument

The items are constructed from the available questionnaires and modified to the context of Pakistan. Specifically, the Language and Social Background Questionnaire (Anderson et al., 2018) was used to adopted in the language proficiency and usage sections. The items of the digital literacy and technology use came from the Digital Literacy Framework (Lee et al., 2016). Based on source on educational barriers in Pakistan by Qadir and Parveen (2019) cultural attitudes and gender norms items are developed. This questionnaire will also help in determining impediments for bilingual literacy in Pakistan in L1 and L2 thereby depicting the requirements to aid Bilingual students in Pakistan since it will also propose a range of directives for policy consequents.

Section 1: Demographic Information

Age: _____

Gender: Male / Female / Other

Grade Level: _____

Primary Language(s) Spoken at Home: Urdu / English / Other (please specify): _____

Location: Urban / Rural

Socioeconomic Status Indicators:

Parental Education Level

Mother: No formal education / Primary / Secondary / Higher Secondary / Bachelor's / Master's / Doctorate

Father: No formal education / Primary / Secondary / Higher Secondary / Bachelor's / Master's / Doctorate

Household Income Range (monthly): Below PKR 20,000 / PKR 20,000–50,000 / PKR 50,000–100,000 / Above PKR 100,000

Section 2: Language Proficiency and Usage

Self-Rated Proficiency in Urdu:

Speaking: Poor / Fair / Good / Very Good / Excellent

Reading: Poor / Fair / Good / Very Good / Excellent

Writing: Poor / Fair / Good / Very Good / Excellent

Self-Rated Proficiency in English

Speaking: Poor / Fair / Good / Very Good / Excellent

Reading: Poor / Fair / Good / Very Good / Excellent

Writing: Poor / Fair / Good / Very Good / Excellent

Frequency of Language Use

Urdu

At Home: Never / Rarely / Sometimes / Often / Always

At School: Never / Rarely / Sometimes / Often / Always

With Friends: Never / Rarely / Sometimes / Often / Always

English

At Home: Never / Rarely / Sometimes / Often / Always

At School: Never / Rarely / Sometimes / Often / Always

With Friends: Never / Rarely / Sometimes / Often / Always

Section 3: Educational Resources and Support

Access to Educational Materials

Books at Home: None / 1–5 / 6–10 / 11–20 / More than 20

Access to Newspapers/Magazines: Yes / No

Parental Involvement in Education:

Frequency of Parental Help with Homework: Never / Rarely / Sometimes / Often / Always

Parental Attendance at School Meetings: Never / Rarely / Sometimes / Often / Always

School Infrastructure

Availability of Library: Yes / No

Availability of Computer Lab: Yes / No

Section 4: Digital Literacy and Technology Use

Access to Digital Devices

At Home: None / Smartphone / Tablet / Computer / Laptop

At School: None / Smartphone / Tablet / Computer / Laptop

Internet Access

At Home: Yes / No

At School: Yes / No

Frequency of Using Digital Devices for Learning

Daily Hours Spent on Educational Activities Using Digital Devices: None / Less than 1 hour / 1–2 hours / 2–3 hours / More than 3 hours

Self-Rated Digital Literacy Skills

Ability to Use Educational Software/Applications: Poor / Fair / Good / Very Good / Excellent

Section 5: Cultural Attitudes and Gender Norms

Attitudes toward Education

"Education is equally important for boys and girls." Strongly Disagree / Disagree / Neutral / Agree / Strongly Agree

"Girls should prioritize family responsibilities over education." Strongly Disagree / Disagree / Neutral / Agree / Strongly Agree

Perceived Barriers to Education for Girls

Cultural Norms: Not a Barrier / Minor Barrier / Moderate Barrier / Major Barrier

Economic Constraints: Not a Barrier / Minor Barrier / Moderate Barrier / Major Barrier

Safety Concerns: Not a Barrier / Minor Barrier / Moderate Barrier / Major Barrier

Community Support for Female Education

"The community supports girls attending higher education." Strongly Disagree / Disagree / Neutral / Agree / Strongly Agree

Section 6: Cognitive Engagement and Learning Strategies

Learning Preferences

Preferred Language for Learning New Concepts: Urdu / English / Both Equally

Engagement in Cognitive Activities

Frequency of Reading for Pleasure: Never / Rarely / Sometimes / Often / Always

Participation in Problem-Solving Games/Puzzles: Never / Rarely / Sometimes / Often / Always

Self-Efficacy in Learning

"I am confident in my ability to learn new things." Strongly Disagree / Disagree / Neutral / Agree / Strongly Agree

Data Analysis Techniques

Quantitative Analysis

Numerical data is on the other hand analyzed by use of descriptive and inferential statistics. Descriptive statistics give information about participants' basic demographics and literacy and inferential statistics in form of correlation and regression analyses are used to determine the relation between bilingual literacy and other independent factors such as SES, gender and access to technology (Field, 2018). The research uses the Statistical Package for the Social Sciences (SPSS) as the software for the analysis of the results because it introduces a package of effective statistical tools appropriate for analyzing big data sets (Pallant, 2020).

Qualitative Analysis

Interviews data are conducted to analyze the themes for bilingual literacy development based on the framework proposed by Braun and Clarke (2006). Key themes of the features are then described and are coded and analyzed in terms of the effectiveness of literacy practices: cultural attitudes, gender and socio-economic position. As for qualitative data, NVivo software is adopted for coding and categorization of data to facilitate thematically consistent systematic analysis of different patterns in qualitative data (QSR International, 2019).

Validity and Reliability

To test for internal validity and reliability, the study collect data from multiple sources such as tests, surveys and interviews, observations and recordings all of which increases the credibly of the findings. For the quantitative values, the internal consistency of the questionnaires is analyzed using Cronbach's alpha in order to test the internal consistency of the obtained values of the ''socioeconomic status", ''culture" and ''digital literacy" factors (Cronbach, 1951). For member check in the qualitative aspect, for example, the current study involves presenting the participants with the summarized interview transcripts to ensure they are correct and reliable (Lincoln & Guba, 1985).

Ethical Considerations

The ethical principles of this study were based on the standards of the APA (2017). Each individual and their legal guardian give informed consent; participants are also told their anonymity and the right to quit the study at any time will be preserved. All data is de-identified,

and digital data is kept in a secure Centre to ensure limited access by unauthorized persons. They also allow the participants to know the purpose of the study ad its findings through debriefing.

Data Analysis

The collected data of the study analyzed and how the four variables of socioeconomic status, gender, culture, and digital literacy interplay with the bilingual literacy learning for the Urdu-English bilingual learners in Pakistan. In capturing these interactions this current study uses both quantitative and qualitative information whereby the quantitative will give a measure of the interactions while the qualitative will offer a rich understanding of the interactions from the students. Quantitatively, correlation and regression analysis is used to examine the impact of socio-economic and demographic factors on students' literacy performance while a qualitative analysis of interviews and observations draws out the cultural as well as gendered complexities of textual mediated practices. In this synergistic manner, not only are the barriers to bilingual literacy in Pakistan revealed, but subsequently the subsequent possibilities for direct advocacy are recommended based on the examined concept of digital support within literacy in resource-constrained contexts. Here, information from these variables is integrated to convey a synthesized portrait of the reciprocal interactions contributing to literacy learning, as a basis for specific recommendations for educational policy and practice.

Table 1

Bilingual Literacy Scores by Socioeconomic Status and Gender

Socioeconomic Status	Gender	Sample Size (n)	Mean Literacy Score (Urdu)	Mean Literacy Score (English)	Standard Deviation (Urdu)	Standard Deviation (English)
High	Male	50	85.4	88.2	5.3	6.1
High	Female	50	83.7	87.5	6.0	5.7
Medium	Male	50	78.6	80.4	7.2	7.5

Socioeconomic Status	Gender	Sample Size (n)	Mean Literacy Score (Urdu)	Mean Literacy Score (English)	Standard Deviation (Urdu)	Standard Deviation (English)
Medium	Female	50	76.9	79.1	7.4	8.0
Low	Male	50	71.5	73.3	8.6	8.9
Low	Female	50	70.2	72.1	8.7	9.1

This table responds to the first research question of how the socioeconomic status and gender influence the bilingual literacy scores. Pupils from high socioeconomic level performed relatively better in both Urdu and English language skills, and this has very little difference between boys and girls within high SES bracket. However, as the socioeconomic status reduces the amount of money, literacy scores decrease drastically and the least scores are recorded in low socioeconomic status group. However, for each of the SES banding, female students on average performed slightly lower than their male counterparts implying that gender might be an influencing factor for literacy wherein its effects becomes more pronounced with diminishing SES. Both SES and gender emerge as key factors in Learning to Read, showing SES as highly significant and the lower SES disadvantage being the worst off.

Table 2

Distribution of Cultural Attitudes toward Education

Attitude Statement	Strongly Agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)
Education is equally important for boys and girls	30	40	15	10	5

Attitude Statement	Strongly Agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)
Girls should prioritize family over education	20	35	25	15	5
Literacy is essential for socioeconomic mobility	40	30	15	10	5
Digital literacy is crucial for success	50	30	10	5	5

This table assists in the analysis of the third research question on cultural expectations, and gender differences in perception of education. A slightly lower proportion agreed with the statement that education is as important for boys as for girls or strongly agreed, 70%; however, 55% agreed or strongly agreed that girls should drop out of school to get married. Such a mixed response imply that while cultural values of education may be seen in positive light in reference to the girl, traditional roles for girl are still encouraged. Also, 80% of participants confirmed the significance of literacy for improving one's social status, which indicates that though in this cultural context literacy is valued in general, girls are likely to be expected to be less educated and therefore to engage in fewer literacies than boys. These results cause to respond to the cultural factors that can restrain literacy and cognitive development for girls in particular.

Table 3

Digital Literacy Access and Usage among Participants by Socioeconomic Status

Socioeconomic Status	Access to Digital Devices (%)	Internet Access (%)	Frequency of Digital Tool Use (Hours/Week)	Mean Literacy Score (Digital Literacy)	Standard Deviation
High	95	90	10	85.7	5.2

Socioeconomic Status	Access to Digital Devices (%)	Internet Access (%)	Frequency of Digital Tool Use (Hours/Week)	Mean Literacy Score (Digital Literacy)	Standard Deviation
Medium	70	65	5	76.3	6.8
Low	40	30	2	65.4	8.3

This table concerns the second research question that is based on the presence of the digital skills' influence on the development of the bilingual skills with reference to the students who have limited access to resources. Students from higher SES own digital devices at higher percentage (95%) and use the internet also at a higher percentage (90%) using an average of 10 hours of digital tools per week. This access is positively associated with their digital literacy scores who in turn which likely improves their overall bilingual literacy and cognitive performance. However, lower SES students own fewer digital resources, spent 2 hours per week on digital tools, and have lower digital literacy. It is argued that because lower income households have limited internet access, their children will be less able to engage cognitively or develop their language abilities through digital media which will only exacerbate educational disadvantage. Given this, expanding more people's ability to be digital literates can definitely be a major strategy for reducing literacy levels that exist in the society.

Table 4

Cognitive Abilities Scores by Bilingual Proficiency Levels

Bilingual Proficiency Level	Sample Size (n)	Mean Working Memory Score	Mean Attentional Control Score	Standard Deviation (Working Memory)	Standard Deviation (Attentional Control)
High Proficiency	60	90.1	88.7	4.5	5.0
Moderate Proficiency	80	75.8	78.3	6.8	7.1
Low Proficiency	60	68.4	70.2	7.5	8.2

This table aims to answer the first research question by examining the impact that Bilingual Proficiency levels have on cognitive tasks which include; Working Memory and Attentional control. Better performance in both languages is related to better working memory and attentional control that proves the Theory of Bilingual Advantage given by Bialystok and colleagues (2012). The thinking ability of the moderately proficient students was moderate and the lowest result was from the low proficient students which implies that bilingual proficiency leads to improved cognitive ability. This highlights the importance of expanding the concept of bilingual education for enhancement of the cognitive achievements; nonetheless, the financial factors pose a question to the implementation of quality bilingual behavior in schools given the fact that the programme is expensive and may be disadvantageous to LS who require more cognitive help but cannot afford quality bilingual education.

Table 5

Gender-Based Literacy Disparities by Rural and Urban Location

Location	Gender	Sample Size (n)	Mean Literacy Score (Urdu)	Mean Literacy Score (English)	Standard Deviation (Urdu)	Standard Deviation (English)
Rural	Male	50	72.3	74.1	8.1	8.5
Rural	Female	50	69.5	71.3	8.6	8.9
Urban	Male	50	82.7	85.4	5.7	6.2
Urban	Female	50	80.2	83.3	6.1	6.5

This table elaborates the first and third research questions in consideration of the gender difference in literacy scores by rural-urban settlements. In both the languages, Urdu and English the male and female students of urban areas are more literacy than the rural areas students. Males scored slightly higher than females, particularly within the rural area this may be attributed to the fact that the number of school facilities is limited since girls are limited to many facilities due to traditional beliefs that restrict girl child access to school education. Urban females performed almost as well as urban males, indicating that where resources and especially education are available, gender gaps in literacy may be closed. Such evidence can be inferred as indicating that both location and gender are important predictors of literacy with rural girls of being most disadvantaged. This stresses the need for educational policies for enhancing education for the rural, female populace in enhancing bilingual literacy and cognitive abilities for every child.

Table 6

S*emi Structured Interviews Analysis*

Themes	Responses	Interpretation
Bilingual Literacy Practices	- "I use both languages in my daily reading but more in my native language."	Participants navigate between languages in literacy, often

Themes	Responses	Interpretation
		showing a preference for native language usage.
Difficulties Linked to Gender	- "As a female, I often feel my choices in language are restricted."	Gender impacts access to literacy resources, with females reporting limited autonomy in language use.
Difficulties Related to Socioeconomic Status	- "I can't afford digital resources to learn English effectively."	Socioeconomic status limits access to bilingual and digital resources, impacting literacy development.
Perceptions of Digital Literacy Tools	- "I think digital tools are useful, but many are in English, which is hard for me."	Participants recognize the benefits of digital tools but face language barriers in accessing or using them.
Cultural Influences on Literacy	- "My family prefers I read in my native language rather than English."	Cultural values influence literacy practices, especially language choice and preferred resources for literacy development.
Classroom Literacy Practices	- "In class, we mainly use textbooks, and digital tools are rarely used."	Classroom literacy practices rely heavily on traditional materials, with limited integration of digital tools.
Interaction with New Media Tools	- "I use social media in both languages, but I don't practice English writing on it."	New media offers bilingual exposure, but there is limited practice in developing formal literacy in English.

The data analysis table gives a complex picture of the style of cognitive and neural processes involved in building bilingual literacy in relation to the context of Pakistan and shows how articles of socio-economic class, gender, and culture bear a deep influence on literacy. The results reveal that there is always the tendency to prefer the use of the native language when the bilingual child has some control of the language, as influenced by culture and family norms. Another interesting factor that come out clearly is the gender dimension, and the Female participants especially complained of limited access to some literacy resources/ or freedom of language use due to gendered education. Education and income also play a part in decreasing participants' opportunities to use digital media, as they said they could not afford to use English-dominant media for English literacy learning. This paper examines the participants' views

regarding the various instruments of digital literacy resources highlighting the opportunities rising from the respective tools and the challenges they present; though many are in a position to embrace these tools, the issue of language translates into limitation of the resources. What has been observed in the classrooms is that the literacy practices have limited reliance on available technology with development of print-based material having a very less component in the new age technologies such as use of computers and Internet. The existing study reveals that while new media is strongly present throughout the daily lives of learners, it is not used to practice formal English; hence, casual digital interaction does not imply the development of systematic bilingual literacy. This synthesis accords with the study's goal because, as again we see, literacy is cognitive process coming under structural socio-cultural disparities and availability of modern tools especially in developing settings.

Collectively, this analysis respond to the research questions and given evidence on how socioeconomic status, gender, cultural attitudes, and digital literacy access co-constitute bilingual among the Pakistani students. Lack of digital literacy and restriction due to affordable socioeconomic status result in poor literacy level and cognitive function, more expressly among the rural and low income earners. Gender inequalities are seen, with girls in rural areas given limited chances in school by traditional culture norms on practices. Digital literacy seems to have positive cognition effects hence increasing digital option could rectify literacy deficits. These findings underpin policy efforts aimed at increasing and making Bilingual Education more accessible, strengthening or improving digital literacy assets, and raising cultural and gender literacy ones.

Discussion

This research work contributes a state of the art review of the factors affecting bilingual literacy in Urban-Urdu English learners in Pakistan with regard to socio-economic, gender, and culture aspects of the students. What the present research is able to identify are the multiple layers and interactions between these factors and how they influence literacy performance, cognitive skills and education.

Specifically, digital literacy emerged as a significant predictor of the available cognitive assets and bilingualism especially when the students grow in the urban setting or belong to higher

privileged backgrounds. The findings of the study reveal enhanced literacy outcomes for students who use digital tools in learning; their literacy scores are higher and their cognition engaged, via products, devices, and internet connectivity, insights that can be attributed to the multimedia affordances of the digital tools. On the other hand, students from low income and rural background spend a little time using technology density with compute time of less than 2 hours in a week, such restriction students' cognitive participation and the development of bilingual literacy skills.

The results imply that increasing the coverage and accessibility of people to the resources available in the digital space can be effective strategies for supporting the learning of marginalized learners. The use of technologies is advantageous in that it presents cognitive advantages of the bilingual mode of use including improved memory and attention thus useful in moderating between two languages. Hence, digital literacy access forms a part of the social justice strategy of an educational (model) to respond to literacy inadequacies in regards to SES.

In this study, it is found out that there is a strong relationship of socioeconomic factors, gender and culture in affecting the bilingual literacy of Urdu-English bilingual students. Students from high SES have better literacy scores in Urdu and English, pointing to the kind of resource availability enhancing the BIALS and affiliated executive function components including working memory and attention control. On the other hand, the children from the low income end of the scale will struggle since they lack the educational support they need, which would have seen them attain better literacy scores as well as better cognitive development.

Gender is also a very essential factor most of the time in the rural area since girl child is most of the time denied an education due to culture. The observation is made that female students overall receive lower marks in literacy and especially those from rural areas; this implies that stereotyped attitudes towards romantic roles hinder girl's learning and literacy development. These results also suggest that there is a limitation in socioeconomic status and cultural gender roles that impact student's literate abilities and overall cognitive growth that continues to perpetuate the educational disparities.

In this study, Low literacy and cognition of bilingual learners; Pakistani girls in rural areas are influenced more by cultural beliefs and gender differences. The analysis gives an implication that cultural practices suggest lower role for girls and therefore limited educational chances. This

cultural perception is evidenced by low literacy levels of rural girls as compared to those of rural boys as well as the urban boys. The results also indicate that with resources and opportunities accessibility, such as in urban areas, the gender disparity in literacy scores become narrower, hinting at a possibility of gaining education made gender divisive.

Such findings justify the need for changes on the cultural prejudice and the need for the formulation of Gender sensitive education policies especially for the girl child in the rural areas where they are most limited. Education OF female in these regions offers good literacy level and also assist in invoking the process of cognitive development by giving the girls an opportunity to enjoy the emergent cognitive advantages of receiving bilingual education. Consequently, for ALL the students in Pakistan to have a similar pattern and rate of cognitive and Literacy learning as recommended, culturally appropriate learning co-contexts must be designed.

Socio-economic status of students appears to be a strong determinant of performance in bilingual literacy as evidenced by higher percentages of scores for students from higher socio-economic status families than their counterparts in the lower socio-economic status families. This disparity is evident in both, reader abilities and working memory, attentional control to support bilingual processing. These findings support earlier studies that highlight the importance of resource quality such as qualified teachers; learning resources; and education-related support for literacy (Evans & Kim, 2012).

However, a key finding that emerges from the study is that though students from low SES have lower literacy scores, they also present variability in use of digital literacy and cognitive activities, depending on their experience with digital assets. The performance is also much higher in cases where even minimal digital resources are available, such as from lower income families. This implies that sizeable barriers exist regarding education mainly due to socioeconomic factors but small solutions like arising with digital equipment can make a difference. Such outcome implies that cost-efficient tech-based interventions might address negative impacts of socio-economic disparities on BI development.

Inequality by gender in literacy level is still evident and inequality by gender, region, age, and disability is still firmly embedded in most education systems especially in rural areas where the culture has remained nostalgic for the girl child. The results reveal that rural girls have the

lowest literacy achievement due to the combined influence of the restricted economic status and cultural gender type casting that assigns rural girl the responsibility of housewives rather than scholars. This ties up to other work done by other researchers regarding gender inequality in education state that when cultural norms limit female education they in equal measure limit female's education and subsequently reason, (Qadir and Parveen 2019).

Finally, the analysis conveys that these gender differences are much smaller in urban areas, with the actual literacy of girl students being nearly equivalent to boy students. This shows that if, one provides for such resource and educational chances, gender differences in literacy rates can in actuality reduce. Thus, these results imply the necessity for gender sensitive educational systems in the culture of the society that would help to reduce the gap between males and females in rural areas where the culture played a greatest role limiting the cognitive and literacy achievements of females.

Thus, the role of digital literacy appears to be the area where positive effects of technology could be harnessed in order to foster higher level of cognitive activity, as well as bilingual literacy. Incorporation of ICT in classrooms also bring out the fact that literacy and cognitive engagement of students in urban and higher socio-economic districts possesses, best-digitally tools. Interactive and multimodal resources, which are the resources of digital tools, enhance control of attention and memory that play an important role in the definition of bilingual skills (Mayer, 2014). Students from rural and low-income families who have little or no access to technology get behind in both cognitive activity and literacy skills.

This important discovery means that in scenarios where you cannot implement the conventional two-language system, digital literacy can be used as an added help. As compared to the overall scaled-up educational system changes, this approach seems quite affordable in terms of costs; as such, it may prove possible to address the current literacy gaps on comparatively short notice. But the study also reveals the gaps of current and ongoing promotion of digital literacy in particular that are frequently rolled out and seldom sustained in the rural context. Rectifying these losses could improve the role of digital literacy as a cognitive and educational intervention.

This research emphasizes the point that the SES, gender and cultural factors are intertwined in simultaneous bilingual literacy acquisition. For instance, the rural girls from poor background

experience a double jeopardy because culturally they are expected to remain in school with few resources and restricted education. These students show the lowest literacy and cognitive abilities affirmed how multiple disadvantages can hinder Cognitive and Literacy learning. Gender employment gap is also witnessed in the urban area, but the differences attributed to gender are compensated by better resource endowment, which establishes that even complementary, cultural factors can be partly compensated by improved socioeconomic conditions.

Through such intersectional analysis it becomes clear that in order to embark on improving bilingual literacy in Pakistan one must also incorporate the other social determinant of health that include economic, gender and cultural factors. Such as the policies for supporting girls in rural districts, improving information and communication technologies in the poor neighbourhoods, valuing cultural diversity regarding to literacy are crucial in order to develop equal opportunities in literacy.

Self-regulation that the conclusions of this work are similar to those of other studies that show that socioeconomic, gender and cultural differences play a huge role in influencing learning, especially in multilingual and impoverished contexts. Like Evans and Kim's (2012) research on socioeconomic disparities in literacy, the present study demonstrates that children from low SES homes experience significant literacy learning difficulties because of constrained access to education materials indicating how economic assistance helps in enhancing equity in learning. Furthermore, the gender differences identified specially for rural girls, correlate with the studies of Qadir and Parveen (2019) arguing that cultural barriers also keep girls away from education inhibiting their learning abilities and literacy. Discussed below are some implications of this study to Mayer's (2014) multimedia learning: From this study, therefore, we derive benefits of digital literacy to be a way of engaging the cognitive abilities that Mayer (2014) indicated to be helped by interactive multimedia in learning. Moreover, the study substantiates Bialystok et al. (2012) assertion of bilingual advantage, since bilingual increases cognitive flexibility, and attentional control, but the effect is conditioned by the accessibility of educational resources for a particular learner. Of course, the study provides a good support for the prior findings and the subsequent discussion, which demonstrates, how the concerned social, economic, gender and cultural factors enhance the complexity of Bilingual Literacy Development in Pakistan.

The implication of this study is encouraging because it supports the theoretical framework proposed for the study: Theory of Bilingual Advantage, Socioeconomic and Cultural Capital Theory, and the Digital Literacy Theory. Based on the Theory of Bilingual Advantage it was assumed that bilingualism leads to better cognitive performance especially for high-proficiency bilingual students in attentional control and cognitive flexibility (Bialystok et al., 2012). However, such privileges were limited to the students drawn from low SES status, thereby supporting Bourdieu's (1986) Socioeconomic and cultural capital theory proposing that poor SES and cultural resource limit learning and cognitive capability. Further, the poor literacy rates of the rural girls primarily owe to cultural capital on the grounds of gender which prevented the feminine gender from getting enlightened particularly in countries with conservative cultures (Ali & Ali, 2021). The improvement of cognitive activity by using tools of digital literacy accords with the Digital Literacy Theory asserting that computer-based interventions advance learning by providing adaptive and interactive conditions (Mayer, 2014). The results of this study therefore support the theoretical framework indicating how bilingual literacy is influenced by such considerations as cognition gains, socio-economic and cultural capital, and how digital literacy can improve learning achievement in contexts of constrained resources.

Implications of Findings

These findings imply that in order to close the gap in bilingual literacy in Pakistan there is a need to understand socioeconomic and cultural as well gender factors which play an important role in the process. Technology education programs offer an effective means of improving client stimulus and literacy levels whenever the conventional tools are unavailable. However, the level of success of such initiatives will depend on the extent that all the above mentioned products are made available for use by all the SES and gender across the predominantly rural settings of the region.

The critical notion to this study is whether education interventions can alter the experience of LEA students. It stated that there are bound cultural limitations which are still present and ideal and socioeconomic status alongside racism makes the learning environment uninviting, although offering things like the tools could make the difference. This approach seems likely to not only raise bilingual literacy accomplishment rates in Pakistan but also state that children from the

various ethnic backgrounds are provided equal opportunities for cognitive and educational development.

Limitations and Directions for Future Research

This research has some strengths, but they are also some of its weaknesses: self-report methodology employed in relation to culture and the use of digital resources. The studies that should be conducted in future include; In future research designs, measures should be taken in such a way that they as follow, measures of cognitive and literacy change following digital interventions, measures of the dynamic nature of cultural beliefs about education. There should also be future research to understand how bilingual literacy affects other cognition areas such as; critical thinking, problem solving which are crucial areas for learning. It has become significant in this study to find out, how and to what extent, these socio-economic, gender, and cultural factors determine bilingual literacy condition in Pakistan. It provides a way forward by adopting interventions, digital literacy, and sensitivity competent policies that will help reduce the disparity in students' performance.

Conclusion

This research investigates the patterns of bilingual literacy learning mediated by students' socioeconomic status, gender, and cultural context in Pakistan for Urdu-English bilingual learners. Analysis of results showed that learners with improved SES, better access to educational materials and enhanced IT skills perform better in literacy and cognitive tests. On the other hand, students from lower income and rural background have the worst literacy challenges, more the rural girls who are bound by culture. Digital literacy tools come out as a feasible medium intervention strategy, which could positively influence learners' cognitive learning and literacy learning when other learning resources are scarce.

The study proposes the Theory of Bilingual Advantage it proves how bilingualism enhances mental aspects like; attentional control and memory. However, these cognitive benefits are most easily obtained by students that already receive adequate education hence supporting the need for intervention that closes the gaps in the different SES. Lastly, the introduction of Socioeconomic and Cultural Capital Theory continues to explain how financial difficulties and

cultures that prevent women education', among other things, keep on perpetuating literate and cogitative differences. Looking at the Digital Literacy Theory the cognitive advantages promoted by digital resources are consistent, the use of technologies proves to be strategic for the construction of balanced literacy skills.

It is therefore incumbent on Pakistani policy makers to implement humanitarian policies that will enhance the economic status of the Pakistani society, gender sensitive education policies to enhance girl's education, and media/information literacy to increase the literacy standard of the society. Hence, educational policies that offer information in culturally diverse formats as well as resources that recognize and nurture bilingualism, may contribute to the nurturing of diverse and equal, as well as literacy and cognitive development, in all children. The present research aims at recommending specific programs that need to be initiated to help the underprivileged groups to improve the bilingual education, thus developing the appropriate strategies to support the availability of fair bilingual education for all Pakistan students. The directions for future research include examining the sustainability of the effects generated by the increased levels of digital literacy and analyzing how cultural perceptions continue to mediate bilingual education.

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Appendix A

Section 1: Demographic Information

Age: _____

Gender: Male / Female / Other

Grade Level: _____

Primary Language(s) Spoken at Home: Urdu / English / Other (please specify): _____

Location: Urban / Rural

Socioeconomic Status Indicators:

Parental Education Level:

Mother: No formal education / Primary / Secondary / Higher Secondary / Bachelor's / Master's / Doctorate

Father: No formal education / Primary / Secondary / Higher Secondary / Bachelor's / Master's / Doctorate

Household Income Range (monthly): Below PKR 20,000 / PKR 20,000–50,000 / PKR 50,000–100,000 / Above PKR 100,000

Section 2: Language Proficiency and Usage

Self-Rated Proficiency in Urdu:

Speaking: Poor / Fair / Good / Very Good / Excellent

Reading: Poor / Fair / Good / Very Good / Excellent

Writing: Poor / Fair / Good / Very Good / Excellent

Self-Rated Proficiency in English:

Speaking: Poor / Fair / Good / Very Good / Excellent

Reading: Poor / Fair / Good / Very Good / Excellent

Writing: Poor / Fair / Good / Very Good / Excellent

Frequency of Language Use:

Urdu:

At Home: Never / Rarely / Sometimes / Often / Always

At School: Never / Rarely / Sometimes / Often / Always

With Friends: Never / Rarely / Sometimes / Often / Always

English:

At Home: Never / Rarely / Sometimes / Often / Always

At School: Never / Rarely / Sometimes / Often / Always

With Friends: Never / Rarely / Sometimes / Often / Always

Section 3: Educational Resources and Support

Access to Educational Materials:

Books at Home: None / 1–5 / 6–10 / 11–20 / More than 20

Access to Newspapers/Magazines: Yes / No

Parental Involvement in Education:

Frequency of Parental Help with Homework: Never / Rarely / Sometimes / Often / Always

Parental Attendance at School Meetings: Never / Rarely / Sometimes / Often / Always

School Infrastructure:

Availability of Library: Yes / No

Availability of Computer Lab: Yes / No

Section 4: Digital Literacy and Technology Use

Access to Digital Devices:

At Home: None / Smartphone / Tablet / Computer / Laptop

At School: None / Smartphone / Tablet / Computer / Laptop

Internet Access:

At Home: Yes / No

At School: Yes / No

Frequency of Using Digital Devices for Learning:

Daily Hours Spent on Educational Activities Using Digital Devices: None / Less than 1 hour / 1–2 hours / 2–3 hours / More than 3 hours

Self-Rated Digital Literacy Skills:

Ability to Use Educational Software/Applications: Poor / Fair / Good / Very Good / Excellent

Section 5: Cultural Attitudes and Gender Norms

Attitudes Toward Education:

"Education is equally important for boys and girls." Strongly Disagree / Disagree / Neutral / Agree / Strongly Agree

"Girls should prioritize family responsibilities over education." Strongly Disagree / Disagree / Neutral / Agree / Strongly Agree

Perceived Barriers to Education for Girls:

Cultural Norms: Not a Barrier / Minor Barrier / Moderate Barrier / Major Barrier

Economic Constraints: Not a Barrier / Minor Barrier / Moderate Barrier / Major Barrier

Safety Concerns: Not a Barrier / Minor Barrier / Moderate Barrier / Major Barrier

Community Support for Female Education:

"The community supports girls attending higher education." Strongly Disagree / Disagree / Neutral / Agree / Strongly Agree

Section 6: Cognitive Engagement and Learning Strategies

Learning Preferences:

Preferred Language for Learning New Concepts: Urdu / English / Both Equally

Engagement in Cognitive Activities:

Frequency of Reading for Pleasure: Never / Rarely / Sometimes / Often / Always

Participation in Problem-Solving Games/Puzzles: Never / Rarely / Sometimes / Often / Always

Self-Efficacy in Learning:

"I am confident in my ability to learn new things." Strongly Disagree / Disagree / Neutral / Agree / Strongly Agree