

BEYOND THE BOOKSHELF: A JOURNEY INTO HOW AI ENABLED LIBRARIES SHAPE READING CULTURE

ALÉM DA ESTANTE: UMA JORNADA PARA VER COMO AS BIBLIOTECAS COM IA MOLDAM A CULTURA DA LEITURA

Article received on: 8/25/2025

Article accepted on: 10/24/2025

Shakir Khan*

*Imam Mohammad Ibn Saud Islamic University (IMSIU), Riyadh. Saudi Arabia and Chandigarh University, Chandigarh, India

Orcid: <https://orcid.org/0000-0002-7925-9191>
sgkhan@imamu.edu.sa

Saad Alzahrani**

**King Saud University, Riyadh, Saudi Arabia

Orcid: <https://orcid.org/0009-0005-3910-1081>
alzsaad@ksu.edu.sa

The authors declare that there is no conflict of interest

Abstract

This research primarily aims to analyse the impact of Parental Involvement (PI) on the improvement of reading activities and skills in primary school students using Artificial Intelligence (AI). In the field of education, it is imperative to acknowledge the significant influence of PI on the improvement of children's cognitive abilities in relation to reading attitudes, comprehensive skills, and academic achievement. This study examines the effects of PI through the utilization of a quasi-experimental design, employing a series of questionnaires that analyse reading habitat, demographic data, involvement, and involvement blockades. This research includes around 200 primary school children and their parents, who come from various schools and locations. The data are then provided to the designed dual modular architecture named ReadNet which composed of Natural Language Processing (NLP) and Machine Learning (ML) modules to explicitly enhance the reading comprehension and parental involvements respectively. The research demonstrates that there will be a disparity in the influence of student academic achievement between the control and experimental groups. The study's findings indicate that parental involvement in children's activities has significantly enhanced their reading habits and attitudes. This study made a valuable contribution to educational institutions and parental organizations by highlighting the potential of parental participation in enhancing

Resumo

Esta pesquisa tem como objetivo principal analisar o impacto do Envolvimento Parental (EP) na melhoria das atividades e habilidades de leitura em alunos do ensino fundamental, utilizando Inteligência Artificial (IA). No campo da educação, é imprescindível reconhecer a influência significativa do EP na melhoria das habilidades cognitivas das crianças em relação às atitudes em relação à leitura, habilidades de compreensão e desempenho acadêmico. Este estudo examina os efeitos do EP por meio da utilização de um delineamento quase-experimental, empregando uma série de questionários que analisam o ambiente de leitura, dados demográficos, envolvimento e bloqueios ao envolvimento. Esta pesquisa inclui cerca de 200 crianças do ensino fundamental e seus pais, provenientes de diversas escolas e localidades. Os dados são então fornecidos à arquitetura modular dupla projetada, denominada ReadNet, composta por módulos de Processamento de Linguagem Natural (PLN) e Aprendizado de Máquina (AM), para aprimorar explicitamente a compreensão leitora e o envolvimento parental, respectivamente. A pesquisa demonstra que haverá uma disparidade na influência do desempenho acadêmico dos alunos entre os grupos de controle e experimental. Os resultados do estudo indicam que o envolvimento parental nas atividades das crianças melhorou significativamente seus hábitos e atitudes em relação à leitura. Este estudo contribuiu significativamente para instituições de ensino e organizações de pais ao destacar o potencial da participação parental no aprimoramento das habilidades acadêmicas e de compreensão de



the academic and comprehensive abilities of primary school students.

Keywords: Parental Involvement (PI). Reading Attitude. Life Science. Library. Reading Comprehension. And Academics.

alunos do ensino fundamental.

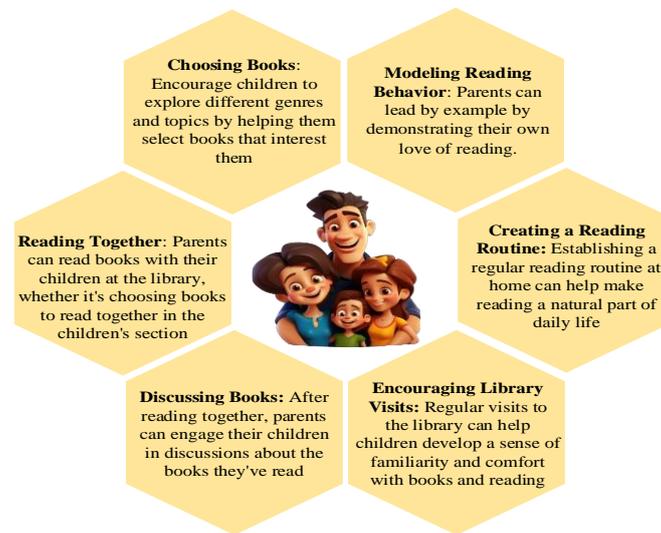
Palavras-chave: *Envolvimento dos Pais (EP). Atitude em Relação à Leitura. Ciências da Vida. Biblioteca. Compreensão Leitora e Desempenho Acadêmico.*

1 INTRODUCTION

Within the evolving landscape of academia and research, libraries remain vital as centres of knowledge transmission and intellectual inquiry, as noted by Lerner¹. Once primarily focused on printed literature, libraries have transformed into dynamic knowledge hubs that transcend traditional boundaries, significantly influencing the reading culture among students and scholars, according to Oranga² and Ribeiro³. This research investigates the multifaceted roles libraries play in shaping reading habits and examines how parental involvement contributes to this dynamic, as discussed by Zhu⁴. By exploring the extensive resources, services, and programs libraries offer, this study seeks to understand their broader impact on academic communication and interdisciplinary collaboration, as highlighted by Lawrence⁵. Using interviews, observations, and reading surveys, the study also highlights how libraries facilitate knowledge sharing and professional development, based on the findings of Panaoura⁶. Summarizing existing literature, it identifies patterns in library use and reading behaviour while offering recommendations for enhancing academic engagement and supporting reading culture, as outlined by Goudeau⁸. The strategic role of libraries in promoting intellectual inquiry, particularly in life sciences, is emphasized through a comprehensive review of academic communication practices by Jeynes⁹ and Bates¹⁰. Research also shows that students with developed reading skills outperform peers with weaker reading abilities, as indicated by Howard¹¹, and international benchmarks like EAIS and PIRLS have revealed reading literacy challenges in countries such as Turkey, as noted by Latipah¹². Interventions have focused on improving reading comprehension, recognized as critical to both social and cognitive development, as described by Nurhayati¹³. Reading practices are linked to mental and physical growth, influenced heavily by the home environment and family engagement, according to Hornby¹⁴. Notably, studies consistently confirm that active parental involvement significantly enhances children's reading and writing abilities, as concluded by Barger¹⁵.

2 THEORETICAL FRAMEWORK

This research is grounded in a theoretical framework that draws from library science, information science, and sociology to examine how libraries influence reading culture, particularly within the life sciences, as discussed by Evans¹⁶. The concept of Social Construction of Knowledge highlights the role of social interaction in shaping knowledge, positioning libraries as communal spaces where reading habits and academic collaboration emerge, according to Muller¹⁷. The Information Behaviour paradigm focuses on how users seek, evaluate, and utilize information, which is essential in understanding the role libraries play in academic engagement, as noted by Posey-Maddox¹⁸. User-Centered Design emphasizes tailoring library services to user preferences, thereby improving their effectiveness in fostering reading culture, as suggested by Meesad¹⁹. Innovation Diffusion Theory explains how new technologies and practices are adopted in libraries to match evolving reading trends in fields like life sciences, as described by Jeynes²⁰. The concept of Cultural Capital underscores how libraries build intellectual and professional capacity by offering resources, skills, and networks. In parallel, literature affirms the impact of parental involvement on children's reading development showing that practices such as reading together, encouragement, and active engagement enhance literacy in terms of fluency, speed, and independence. However, there is limited research linking motivation, attitude, and parental participation, as highlighted by Hajisoteriou²¹. Studies have explored how family culture, home literacy, and parental encouragement affect young and struggling readers, as examined by Tan²², while Li²³ investigates how immigrant families influence reading motivation and involvement.

Figure 1*Types of Parental Involvement for Reading Ability Enhancement*

As illustrated in **Figure 1**, the types of parental involvement contributing to reading ability enhancement include contact, learning support at home, decision-making participation, and community collaboration.

1.3 Research has been conducted on the correlation between motivation and attitude, which are two key elements that impact parenting. This entails creating a conducive domestic setting that fosters the educational and developmental growth of children.

Contact: Regular and effective communication is established between parents and teachers to facilitate the flow of information pertaining to children's growth, goals, and educational experiences, reading activities have always been seen as an important element in a person's culture and education. Salauddin²⁴.

Parental Engagement: Parents demonstrate active involvement in many school activities, including volunteering within classroom settings, attending school events, and helping in extracurricular pursuits.

Learning Support at Home: Families play a crucial role in facilitating children's learning beyond the confines of the school environment through the provision of educational resources, assistance with homework assignments, and active participation in collaborative learning endeavour Yulianti²⁵.

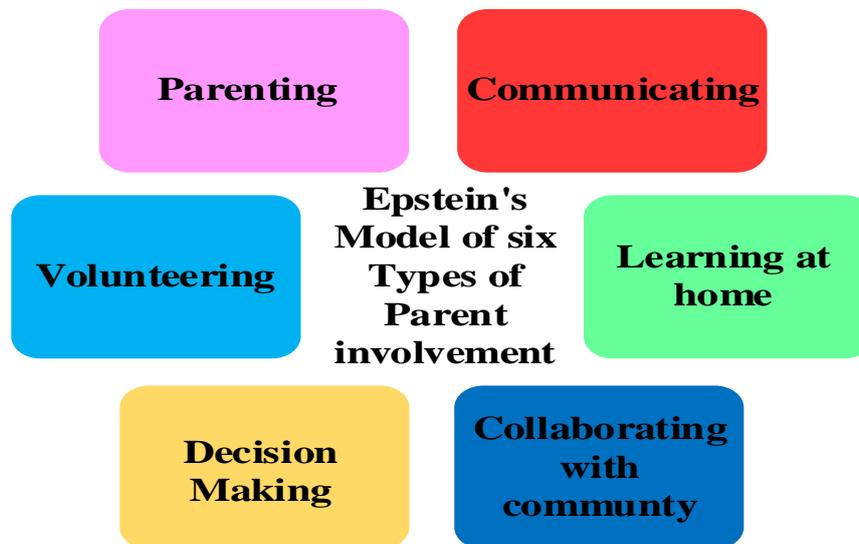
Decision-making Participation: Parental involvement in school decision-making processes can be facilitated through several means, including membership in

parent-teacher associations, serving on advisory boards, or engaging in school governance.

Engaging in Community Collaboration: Schools and families engage in partnerships with community organisations and resources to bolster children's education and overall welfare Yulianti²⁵.

Figure 2

Epstein's Model for Parental Involvement



According to Figure 2, Epstein's six types of involvement parenting, communication, volunteering, learning at home, decision-making, and collaborating with the community serve as the foundation for the study's questionnaire design.

3 LITERATURE REVIEW

This study is situated within a growing body of research emphasizing the significance of parental involvement, reading engagement, and the integration of technology particularly artificial intelligence (AI) in fostering literacy development.

3.1 Parental Involvement and Academic Performance

Numerous studies have established a strong correlation between parental engagement and children's academic success. Yulianti²⁶ analyzed data from over 2,500 parents, confirming that consistent involvement enhances literacy outcomes. Kim²⁶ extended these findings to science classrooms through the MORE model, demonstrating that collaborative home-school strategies effectively improve reading comprehension. Similarly, Berkowitz³¹ and Myende³² highlighted the importance of parental encouragement and teacher-parent collaboration in reducing academic barriers and improving learning environments. Ata-Aktürk³⁰ further emphasized that parental involvement in STEM education contributes to sustained academic growth over time.

3.2 Instructional Strategies and the Home Learning Environment

Research also explores how teaching strategies and home environments shape reading behavior. Rasulovala²⁸ identified effective pedagogical practices that cultivate a reading culture among students. Li²⁹ found that gamified educational platforms improved academic performance, particularly when supported by parental involvement. Kartel²⁹ reinforced this by showing that home-based activities such as digital engagement, observation, and note-taking positively influence academic outcomes.

3.3 Parental Support During the Pandemic

The COVID-19 pandemic underscored both challenges and innovations in literacy education. Nuryanti³³ found parental involvement to be essential for maintaining students' reading progress during school closures. Ewin³⁴ conducted a systematic review revealing that cognitive and technical parental engagement played a significant role in preserving academic continuity during remote learning.

3.4 Artificial Intelligence in Literacy Support

The integration of AI in education is opening new pathways to enhance reading skills. Zhang³⁵ combined AI systems with parental input and reported improved reading

performance. Liu³⁶ utilized chatbot-based reading programs and found significant gains in literacy skills. Xu³⁹ demonstrated that AI reading partners outperformed human readers in improving children's vocalization and engagement. These studies underscore the transformative potential of AI when paired with guided parental support.

3.5 Socio-Cultural Influences

Socio-cultural contexts play a critical role in literacy development. Ni³⁸, in a large-scale study involving immigrant families in China, confirmed that parental involvement boosted educational outcomes in under-resourced settings. Gay⁴⁰ discussed the challenges low-income families face, while Qualter⁴¹ advocated for inclusive digital literacy policies to reduce these disparities.

3.6 Innovations in Family Engagement

Emerging tools and strategies are reshaping how parents support children's learning. Devlieghere⁴² found that school–family collaboration improved educational planning and outcomes. Cagiltay⁴³ developed an in-home educational robot that significantly enhanced children's reading expression. Benedetto⁴⁴ highlighted the importance of adaptive digital parenting strategies, particularly during the pandemic.

In summary, literature clearly supports the role of parental involvement in enhancing reading performance, especially when combined with institutional support and digital innovations. However, existing studies rarely integrate AI technologies with parental engagement frameworks to predict or improve literacy outcomes a gap this study addresses through the development of the ReadNet framework.

4 RESEARCH DESIGN AND METHODOLOGY

This study employed a pretest-post test quasi-experimental quantitative research design with a matched control group to evaluate the impact of Parental Involvement (PI) on students' reading comprehension, motivation, and attitudes. The purpose was to assess changes in key literacy outcomes resulting from structured PI interventions, where random assignment was not feasible. Ensuring equality between groups, participants were

matched on pretest results to confirm no significant differences existed prior to intervention Erdener⁴⁵.

A total of 200 primary school students and their parents were selected using purposive sampling and divided equally into experimental (n = 100) and control (n = 100) groups. Ethical approval was obtained, informed consent was secured, and participant confidentiality was maintained throughout.

4.1 The study proceeded in three phases

4.1.1 Literature survey

The initial phase involved identifying factors contributing to students' reading culture. A comprehensive literature review was conducted through AIS e-library, SpringerLink, ScienceDirect, and Scopus. The TOPE framework was adopted to structure reading culture improvement constructs.

4.1.2 Expert review

The expert review ensured content validity of the research instrument. It followed two stages: (1) development of a structured questionnaire based on Epstein's Six Types of Involvement (parenting, communication, volunteering, learning at home, decision-making), and (2) feedback analysis. The 30-item instrument used a 4-point Likert scale ranging from "Always" to "Never." Six experts from education boards, academic institutions, and consultancies validated the questionnaire for clarity, relevance, and structure. Iterative feedback led to refinement, ensuring internal consistency with Cronbach's Alpha > 0.7.

4.1.3 Implementation and analysis

After administering the pretest, the intervention was delivered to the experimental group through structured PI activities. The post test was conducted after the intervention period. Quantitative analysis included paired and independent t-tests for comparing group

scores, Pearson correlation and regression for examining relationships between PI and reading outcomes, and Cohen's *d* for calculating effect sizes.

To enhance prediction and analysis, the study incorporated an AI-based ReadNet model consisting of two modules:

ReadNet-NLP: Utilized transformer-based NLP to assess reading comprehension responses.

ReadNet-ML: Applied supervised machine learning to structured PI data to forecast reading outcomes.

This comprehensive methodology enabled both outcome evaluation and predictive modeling, contributing valuable insights into how PI supported by AI can foster early reading skills. The iterative process of expert review reveals that the questionnaire was valid and reliable for examining the parental impact on school students to enhance the reading habit and academic performance. Table 1 shows the participating experts' profiles.

Table 1

Participating Expert Profiles

Experts ID	Organization	Designation	Experience
Proficient 1	NGRI	Research Data Officer	>4 years
Proficient 2	NGRI	Research Data Manager	>6 years
Proficient 3	GRI	Librarian	>6 years
Proficient 4	GRI	Research Data Manager	>14 years
Proficient 5	NGRI	Librarian	> 6 years
Proficient 6	NGRI	Research Data Officer	> 11 years
Proficient 7	GRI	Research Management Officer	>11 years
Proficient 8	NGRI	Library Manager	>16 years
Proficient 9	NGRI	Library Officer	>6 years
Proficient 10	GRI	Library Officer	>8 years

To ensure content validity of the research tools, ten domain experts were consulted from various educational institutions (see Table 1).

5 DATA ANALYSIS

In the data analysis stage, the responses from the participants were compiled, and inferences and statistics were drawn from the data to exemplify the understanding of the objectives of the research. The purpose of the study was to find out whether Parental Involvement had any impact on reading behaviours and abilities of elementary school students. There were three stages involved in the process:

5.1 Group comparisons and statistical tests

Participants are divided into a control group and an experimental group in a quasi-experimental design; it was through this method that the groups of participants were separated. Statistical techniques involving paired and independent sample t-tests were thus used in the assessment of possible differences across groups. Scores from the pre- and post-intervention treatment for the experimental group have been subjected to paired t-tests. Independent t-tests were used in assessing the efficiency of parental engagement post-treatment between experimental and control groups.

5.2 Measuring relationships and predictors

The correlation studies aimed to determine the relationship between pupils' reading outcomes and parental participation. Use of regression analysis was also carried out to determine which of the characteristics could predict the development of reading skills; and obstacles, type, and frequency of parental involvement were considered independent factors.

5.3 Item validation and reliability assessment

Cronbach's Alpha was used to determine the reliability of the questionnaire by ensuring that the responses on the set of items were consistent. For reliability, an appropriate threshold value was set to be 0.7. Things not fit for that description were studied and worked upon.

5.4 Results interpretation

The basis of the processed data drew the important inferences so that the following determinations could be made, important conclusions made are as follows:

Mean changes of the experimental group of pupils for their reading habit and ability were greater than that of the control group. Specific parental engagement activities that impact most significantly on enhancing results in reading.

5.6 Summary metrics

Effect Size: Cohens's d was used to calculate the magnitude of the difference in the intervention between the groups.

5.7 Participation rate

The parent and student response rate has been analysed to judge whether there is an adequate level of sample population representation in the study. This multi-step analytical approach by the researcher ensured that the conclusion drawn was robust, reliable, and meaningful to understand the role of parental involvement in the primary school students' reading development.

6 PROPOSED MODEL

Four major elements of the Parental Involvement Model for Enrichment of Reading and Literacy Activities and Skills among Primary Students are: Student Engagement, Institutional Support, Parental Participation, and Socio-Cultural Environment. We design a Machine Learning enabled Natural Language Processing (ML-NLP) module for effectively analyse both the parental comprehension and parental involvement named RadNet. Under each dimension, specific elements and indications are elaborated as follows along with mathematical modelling,

7.1 Parental participation

Above all three components include Parental participation in: monitoring and guiding, supporting the home environment, and engaging in learning activities. Parental participation involves monitoring learning, supporting the home environment, and engaging in reading activities. Parents who read or discuss stories with their children contribute significantly to learning, as noted by Vygotsky¹. A resourceful and welcoming home setup fosters literacy, according to Hornby¹⁴, while routine-setting and academic tracking further strengthen cognitive development, as emphasized by Jeynes²⁰.

7.2 Student engagement

Student engagement is reflected in reading habits, motivation, and cognitive skill growth. Motivation stems from a child's natural interest in reading, as described by Guthrie²⁶. Parental support helps build vocabulary and comprehension, as reported by the National Reading Panel²⁷, while regular reading routines form lasting habits, as outlined by Schiefele²⁸.

7.3 Institutional support

Institutional support includes resources, parent training, and teacher collaboration. Clear communication aligns home and school reading efforts, as highlighted by Jeynes²⁰. Workshops equip parents to support reading at home, as suggested by Desforjes²⁹, and access to libraries and tools enhances literacy, as recognized by OECD.

7.4 Socio-cultural environment

The socio-cultural environment reinforces institutional efforts through collaboration and access. Consistent parent–teacher communication ensures aligned goals, as stated by Jeynes²⁰, training supports long-term involvement, as described by Desforjes²⁹, and libraries and digital tools enable equitable literacy support, according to OECD.

Thus, institutional support plays the role of a mediator between home and school in favour of reading activities.

8 FINDINGS

All the differences reveal measurable changes in the reading behaviour, attitudes, and performance of the treatment group, as revealed by the study. Where this engagement is also fostered by institutional and environmental factors, parental involvement determines children's reading capacities to a great extent. This strategy thus provides valuable insights into how elementary school children can be educated to enhance the schooling and cognitive skills of such children through focused parental engagement for educational organizations and parent organizations. Presented below are the proposed tables for your research regarding parent involvement and how it impacts the reading activities and capabilities of elementary school students. The elements have been identified along with the indicators and the relevant dimensions included in a model as shown in the following tables 2 - 4:

Table 2

Demographic Indicator

Dimension	Factor	Indicator
Parental Participation	Involvement with Education	Hours spent reading, hours spent reading to children in education
	Home Environment Support	Books, digital material, and specific room for reading
	Monitoring and Support	Creating a reading routine, tracking progress of reading, and homework support
Student Engagement	Reading motivation	Love for reading and readiness to try new literature.
	Cognitive Skills Development	Enhancement of critical thinking, vocabulary, and comprehension
	Reading habit	Frequency and duration spent reading independently
Institutional Support	Teacher collaboration	Encompasses coordinated reading techniques as well as the number of parent-teacher conferences.
	Parents' Education	Holding seminars as well as utilization of resources for enhancement of literacy

	Provision of Educational Materials	School's libraries, online resources, and extracurricular activities
Socio-Cultural Environment	Community Support	Local groups, reading clubs and libraries support literacy.
	Cultural values in education	Literacy at home, and what parents want achieved in schools
	Economic factors	It involves the cost of books and educational material.
Table 2b. Experimental Details Component		Details
Research Methodology		Quasi-Experiment Design.
Sample Size		200 elementary school going children with their parents.
Groups		Control Group (100), Experimental Group (100).
Data Collection Tools		Experiments, observations and questionnaire tests.
Questionnaire Sections		Challenges, PI level, demographics and reading habits.
Data Analysis Method		Comparing reading habits and abilities.

The proposed model includes multiple dimensions for evaluating reading skills enhancement. Table 2a shows demographic and contextual indicators across four core areas: parental participation, student engagement, institutional support, and socio-cultural environment.

Table 3

Questionnaire Indicators

Factor	Questionnaire Indicators
Participation in Learning	Group reading sessions, storytelling and story-talking frequency.
Home Environment Support	Books, reading nook, digital access.
Monitoring and Guidance	Sets daily objectives in reading, monitors the child's growth and development in school, and helps with homework.
Reading motivation	Includes a love for reading as well as willingness to borrow books from the library.
Cognitive Development	Critical thinking, vocabulary, and comprehension.
Building a Reading Habit	Number of books read monthly, and number of hours spent reading daily.

The proposed model includes multiple dimensions for evaluating reading skills enhancement. Table 2a shows demographic and contextual indicators across four core areas: parental participation, student engagement, institutional support, and socio-cultural environment.

Experimental details such as methodology, sample size, and tools are presented in Table 2b, while Table 2c defines the key questionnaire indicators.

Finally, Table 2d lists specific skills and outcome indicators such as comprehension, fluency, and academic improvement.

Table 4

Skill Indicator

Skill/Attitude	Indicator
Reading Comprehension	Ability to respond to questions about a text or story.
Vocabulary Development	Weekly growth in the number of words learned.
Reading Fluency	The expression, clarity, and words read per minute.
Reading Habits	The enthusiasm for reading and the number of books read on her own.
Attitude Toward Reading	Likes to hear positive remarks about reading and would love to know new stories.
Outcome	Indicator
Academic Performance Improvement	Higher grades in the language-based subjects and readings.
Reading Skills Development	Richer vocabulary, broader understanding, and more fluent.
Positive Reading Attitudes	Their sense of excitement and involvement in readings-related activities increased.
Improved Parent Child Interaction	The relationship between the parent and the child is much closer because of the co-operative learning exercises.

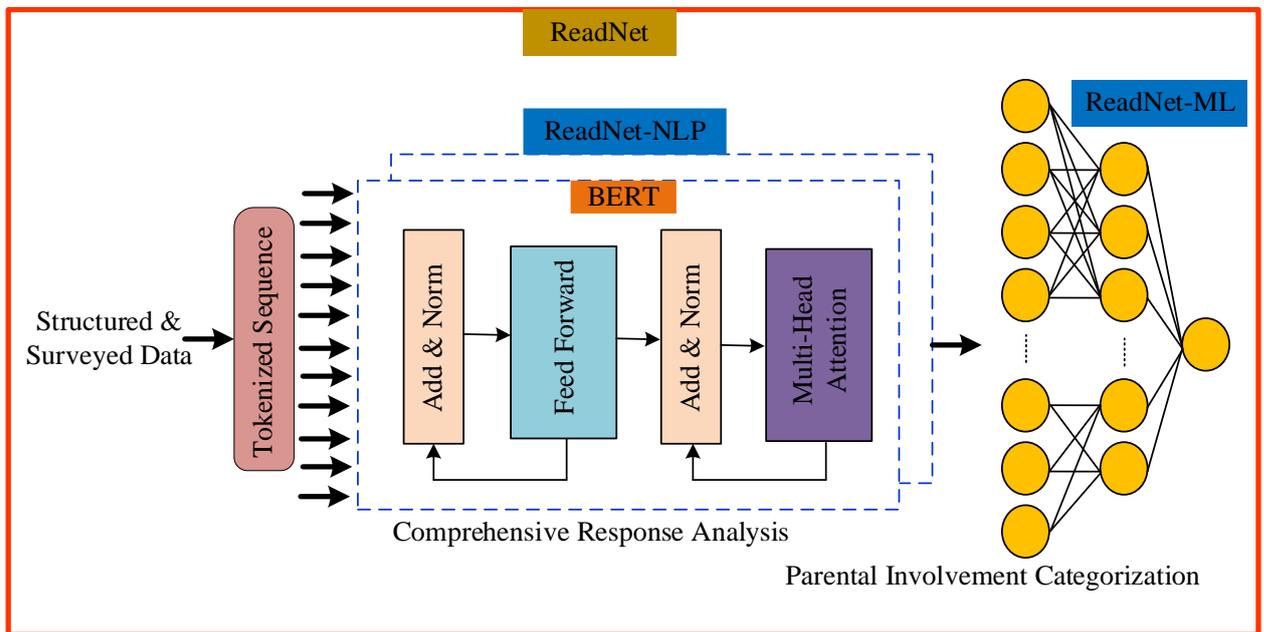
Figure 3*Architecture of ReadNet Model*

Figure 3 demonstrates the architecture of the ReadNet model, integrating both the NLP and ML modules to predict and enhance reading comprehension and parental involvement.

8.1 ReadNet model

The designed ReadNet composed of dual interconnected modules named ReadNet-NLP and ReadNet-ML modules respectively shown in figure 3 The ReadNet-NLP module employs transformer-based NLP module for analysing students reading comprehension response, detecting coherence, fluency, and lexical richness, and enabling feedback and automated scoring for reading assignments. The ReadNet-ML module employs supervised learning algorithm to effectively train the features in comprehensive outcomes, student reading improvement likelihood, parental engagement, questionnaires scores, and demographic data.

Initially, a data was collected that can be denoted as $D = \{(x_j, y_j)\}_{j=1}^N$ in which the inputs features is denoted by x_j which represents both the text and structured survey data, the outcome variables is denoted by y_j which represents the academic performance and reading comprehension score, and the number of samples is denoted by N . Every x_j

composed to two parts named textual and numerical inputs respectively which are mathematical formulated as:

$$x_j^{\text{text}} \in \mathbb{T}, \mathbb{T} \rightarrow \text{Space of NLP texts} \quad (1)$$

$$x_j^{\text{num}} \in \mathbb{R}^d, d \rightarrow \text{Number of structured features} \quad (2)$$

So that, its defined as:

$$x_j = (x_j^{\text{text}}, x_j^{\text{num}}) \quad (3)$$

The transformer-based encoder is denoted by $T(\cdot)$ which effectively maps the textual input to dense vector representation as:

$$h_j = T(x_j^{\text{text}}) \in \mathbb{R}^k \quad (4)$$

From the above equation, the embedding dimension is denoted by k . Furthermore, the output is employed for predicting the comprehension score and categorization. The regression function is also designed to predict the reading comprehension. The regression function is defined as,:

$$\hat{y}_j^{\text{comp}} = f_{\theta}(h_j) \quad (5)$$

From the above equation, the regression head is denoted by $f_{\theta}: \mathbb{R}^k \rightarrow \mathbb{R}$, and the forecasted comprehension score is denoted by \hat{y}_j^{comp} . The major objective of regression function is to diminish the Mean Squared Error (MSE) as:

$$L_{\text{comp}} = \frac{1}{N} \sum_{j=1}^N \left(\hat{y}_j^{\text{comp}} - \hat{y}_j^{\text{comp}} \right)^2 \quad (6)$$

The output is provided to the ReadNet-ML module which forecast the parental involvement impact by employing structured data x_j^{num} with NLP embeddings h_j . Both the data types are combined as:

$$z_j = \text{Con}(h_j, x_j^{\text{num}}) \in \mathbb{R}^{k+d} \quad (7)$$

For the above equation, the regression is applied as:

$$\hat{y}_j^{\text{PI}} = g_{\theta}(z_j) \quad (8)$$

From the above equation, the function mapping regression is denoted as $g_{\theta} : \mathbb{R}^{k+d} \rightarrow \mathbb{R}$, and the predicted reading impact score is denoted by \hat{y}_j^{PI} . The regression loss function is denoted by:

$$L_{\text{PI}} = - \sum_{j=1}^N \sum_{c=1}^C y_{j,c} \log \hat{y}_{j,c} \quad (9)$$

To ensure optimization objective, the joint loss function for the ReadNet is denoted by:

$$L_{\text{total}} = \alpha L_{\text{comp}} + \beta L_{\text{PI}} \quad (10)$$

From the above equation, the task importance hyperparameters are denoted by $\alpha, \beta \in \mathbb{R}$.

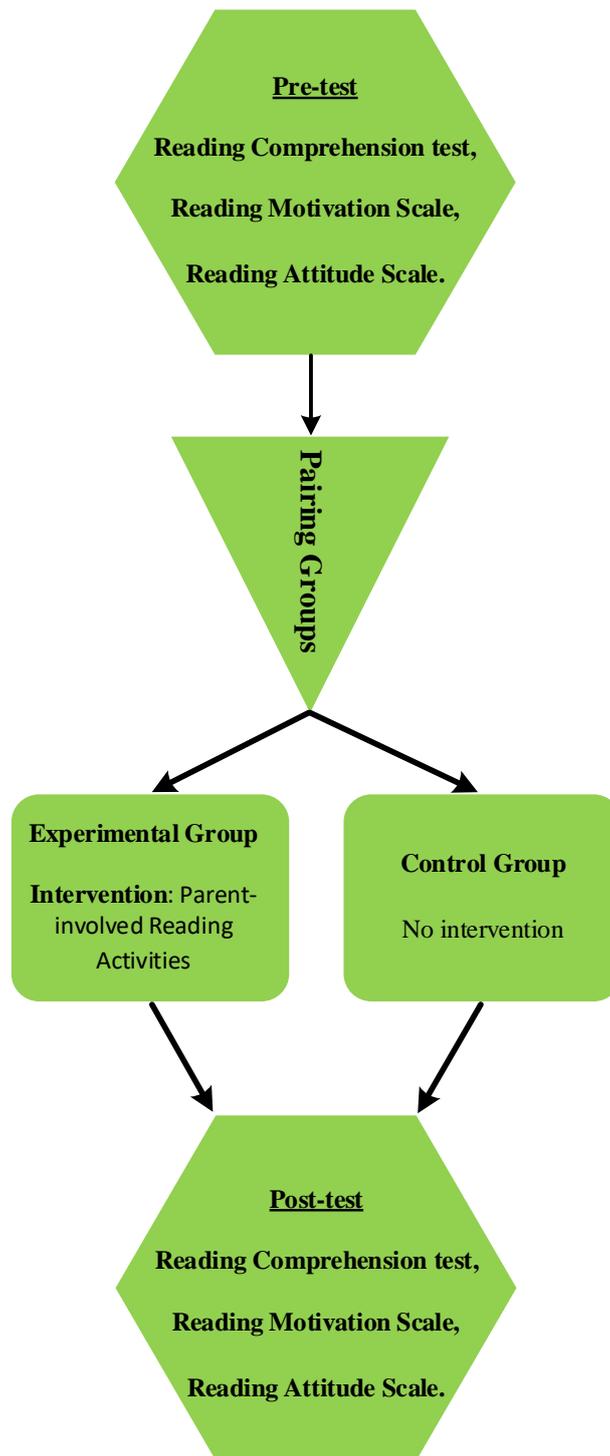
8.2 Results

The primary aim of this study is to investigate the influence of libraries on the development of reading culture in relation to parental engagement. The objective of the survey is to collect data regarding participants' viewpoints on library books reading habits. The final purpose is to get vision into the impact of libraries on scholarly engagement and reading practices, considering the interactions between teachers and parents.

Followed by, we conduct questionnaires on parental involvement for reading practice improvement. Figure 3 presents the pre and post-test analysis of the propounded research. The questionnaires are provided as follows,

8.2.1 Parental Involvement Analysis

- Engage in proactive efforts to locate reading resources that align with your child's individual interests?
- Together did you visit library with your children?
- Do you offer occasions for your child to engage in oral reading with you?
- Are you have been associating with your children regarding the unknown word /vocabularies?
- Are you ask any question regarding your children reading materials?
- Did you and your children read any books in library together?

Figure 4*Pretest and Post-test Analysis*

As seen in **Figure 4**, the pre-test and post-test comparisons show a marked improvement in the reading abilities of students whose parents were more actively involved.

8.3 Children's reading habits

Parents were asked whether they observed changes in their children's reading habits over time, their confidence while supporting them, and whether the children preferred reading independently or with others. They also shared insights into the types of books their children enjoyed, highlighting personal preferences and reading engagement patterns.

8.4 Demographic data

The demographic section gathered information on the parents' income range, occupation, and highest level of education. It also included questions about the age of the child and the total number of children in the household to understand the family context influencing reading support.

8.5 Parental involvement barriers

Parents discussed their confidence in helping their children improve reading comprehension, as well as the challenges they faced in doing so. These included limited time, resource availability, and obstacles during reading sessions, especially when trying to read aloud or provide learning materials at home.

Table 5

Glimpse of Demographic Data

Variable	Glimpse	Female	%
# of Children	6+	8	16
	5-6	16	30
	3-4	28	55
	2	5	8
Income Status	4600+	14	25
	3702-4600	15	28
	2703-3701	10	18
	5-2700	20	38
Education Level	Master's Graduate	8	14
	Faculty Graduate	11	20
	High School Graduate	10	18

	Secondary School Graduate	8	14
	Primary School Graduate	23	44
Work	Public Services	16	30
	Small Business	11	21
	Private Employee	9	16
	House Maker	23	43
Relationship with children	Other	3	6
	Brother/Sister	2	3
	Mother	25	50
Age	45+	9	18
	35-45	35	68
	25-34	11	20

From the above table, the parent demographic information is provided in which the age group of 35-45 parents are among 70%, the parents with age of 25-34 are in the range of 20%, while the parents with 45+ age are in 18%. There were about 25 mothers, 2 brothers/sisters, and 3 guardians were involved in this study. The examination of the parents' occupations also analysed in which 18%, 20%, 30%, and 45% are employed in other works, small business owners, public service jobs, and house makers respectively. The income status of the parents also examined in which about 37% are in income range above 2700, about 30% are in income range of 4600, about 25% are in income range of 3701, and 13% are in income range of above 4600. The education level of the parents includes primary school graduate, secondary school graduate, high school graduate, and faculty graduate respectively includes 46%, 40%, 10%, and 4% respectively. There are about 8% of families composed of 4 children, 16% of the families composed of 6 children, 30% of the families composed of 5-6 children, and 54% families composed of 3-4 children.

In addition to that, we have also analysed the control group among the children in similar classroom. In the control group analysis, the average scores among the students are analysed. Table 4 denotes the distribution of gender among the students in both control and experimental group respectively.

Table 4*Control Group Distribution*

Group	N	%	Gender
Control Group	Female	30	60
	Male	30	40
Experimental Group	Female	40	50
	Male	30	50

The gender distribution across both control and experimental groups is outlined in **Table 6**, ensuring gender-balanced representation.

From the below mentioned, data collection tools, we conduct normality distribution analysis which are provided in the table 5 below,

Table 7*Normality Distribution Analysis Comprehensive Analysis*

Table 5. Normality Distribution Analysis Comprehensive Analysis	Standard Deviation (SD)	Kurtosis	Skewness	Average
Informative Analysis	3.97	-0.448	0.784	6.99
Narrative Analysis	3.55	0.252	0.188	8.73
Attitude Scale for Reading	0.35	0.635	-0.855	3.37
Comprehensive Examination	0.389	0.863	-0.816	3.32
Incentive Reading Scale	0.357	0.157	-0.882	3.25
Extrinsic Enthusiasm	0.412	0.287	0.312	3.24
Intrinsic Enthusiasm	0.467	-0.384	0.261	3.27

The normality analysis of questionnaire metrics is summarized in **Table 5**, confirming the data's suitability for statistical testing.

8.6 ReadNet analysis

This sub-section emphasizes the qualitative and quantitative analysis of the proposed ReadNet on reading comprehension and parental involvement respectively. Below we clearly explain the ReadNet with four conventional ML models named Logistic Regression (LR), Decision Tress (DT), Random Forest (RF) and Support Vector Machine (SVM) also shows numerical and graphical analysis in table 6 and figure 5(a)-(c), & 6(a)-(b) respectively.

8.7 Qualitative analysis

The proposed ReadNet enables noteworthy improvement than conventional ML models which are already mentioned above in both functional and design terms. The conventional models are completely relying on structured numerical data, the ReadNet combined NLP for extracting high semantic representation from the reading responses of the students where the existing model lacks. In addition to that, the dual module in the ReadNet architecture allows us to combinedly examine both the survey and text data which extracts the reading comprehension and nuanced patterns of the parental involvement where the conventional classifiers tend to lose. The proposed model is also well suited for real time dynamic learning feedback which employs deep contextual language understanding which improves the educational settings interpretability. With these properties, ReadNet shows its value in the environment where linguistic and behavioral cues are crucial for examining the cognitive growth of children.

Table 8

Comparative Analysis of Proposed ReadNet Vs Existing Models

Model	Reading Comprehension			Parental Involvement	
	R ² score	MAE	RMSE	Accuracy	Precision
Logistic Regression (LR)	0.50	0.62	0.81	72.8%	75%
Decision Tree (DT)	0.55	0.60	0.78	76.3%	77%
Support Vector Machine (SVM)	0.59	0.56	0.73	79.1%	80%
Random Forest (RF)	0.61	0.53	0.70	82.4%	84%
ReadNet	0.78	0.42	0.57	89.3%	91%

Table 8 highlights the performance of ReadNet against existing machine learning models, where it outperforms in accuracy and error metrics.

8.7.1 Quantitative analysis

Figure 5

(a)-(c) Reading Comprehension Analysis among Proposed and Existing Works

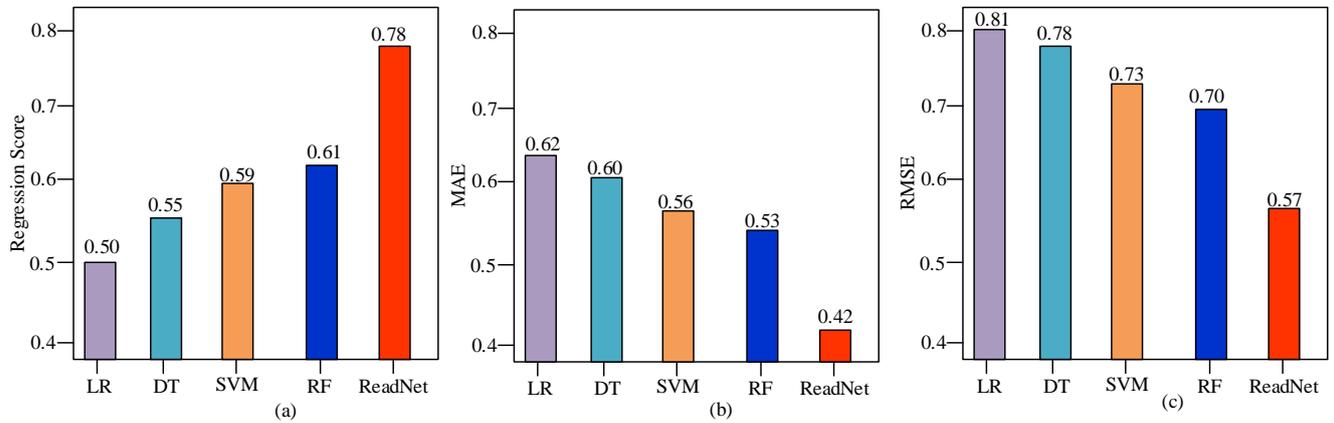
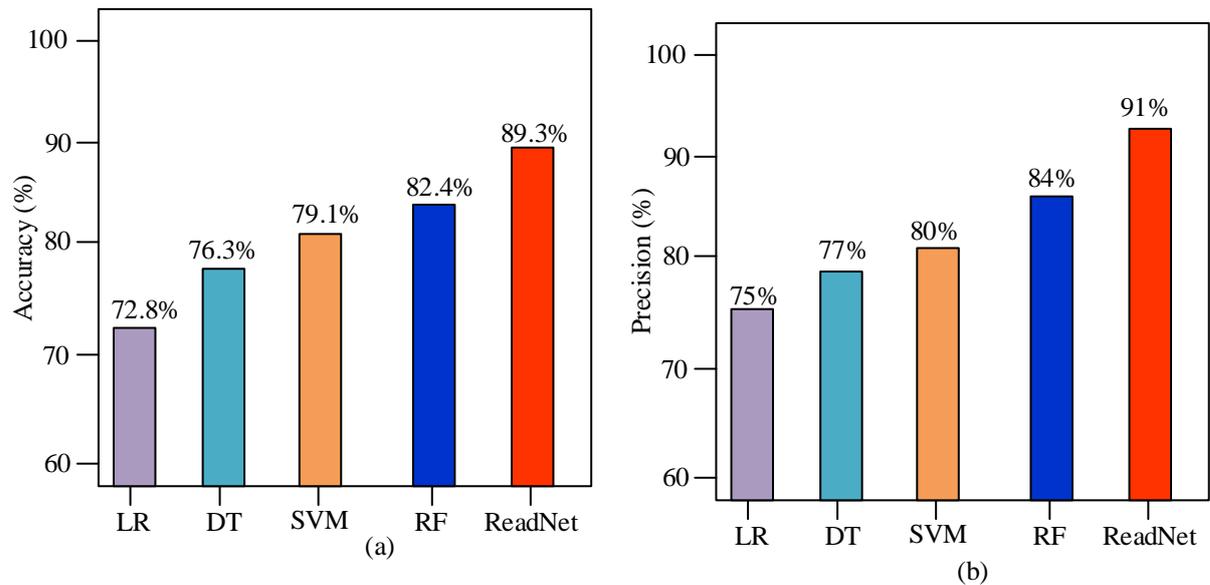


Figure 6

(a)-(b) Parental Involvement Analysis among Proposed and Existing Works



The performance of the ReadNet model on both reading comprehension and parental involvement is visually depicted in Figures 5(a)–(c) and Figures 6(a)–(b), clearly demonstrating its effectiveness over traditional models.

From the empirical evaluation on primary school students' surveys and their parents, the proposed ReadNet superiors the existing machine learning model performance among multiple metrics. In terms of reading comprehension prediction, the ReadNet gains R^2 score of 0.78 when compared to LR of 0.50, DT of 0.55, SVM of 0.59,

and RF of 0.61. In terms of parental involvement classification tasks, the accuracy achieved by ReadNet is 89.3% whereas LR, DT, SVM, and RF gains accuracy of 72.8%, 76.3%, 79.1%, and 82.4% respectively. Other minor metrics include F1-score, recall, and precision are superior to the proposed model which shows its robustness and generalization capability. Furthermore, ReadNet also diminishes the Mean Absolute Error (MAE) by 18%-25% in reading comprehension when compared to the state-of-the-art models. Those results state that the hybrid utilization of NLP and ML with feature entrenched learning enables highly reliable predictions in educational outcomes.

9 CONCLUSION

In summary, this study examined the significant impact of Parental Involvement (PI) on the development of reading activities and skills in elementary school students. Testa⁷ explains employing a quasi-experimental methodology and administering extensive questionnaires that assessed multiple dimensions of engagement, we were able to notice a measurable influence on the cognitive development, reading attitudes, comprehension abilities, and academic achievements of youngsters. A comprehensive investigation of PI dynamics was made possible by the involvement of more than 200 primary school children and their parents from various schools and locations. The results of our study emphasise the notable disparity in academic achievement between the control and experimental groups, emphasising the substantial impact of parental involvement on student results. The study revealed a positive association between parental participation and enhanced reading habits and attitudes among students. This study acts as a compelling appeal to educational institutions and parental organisations, highlighting the crucial significance of parental involvement in augmenting the academic and holistic abilities of elementary school pupils. Through the acknowledgment and proactive encouragement of parental engagement, various parties involved can collectively cultivate a setting that fosters comprehensive child growth and scholastic achievement. To fully harness the educational journey of our children, it is imperative to prioritise ongoing endeavours aimed at cultivating robust collaborations between educational institutions and families.

INFORMED CONSENT STATEMENT

Not applicable.

DATA AVAILABILITY STATEMENT

Not applicable.

ACKNOWLEDGMENTS

The authors extend their appreciation to Libraries Commission for funding this work through the Library Research Support Program.

CONFLICTS OF INTEREST

The authors declare that they have no conflict of interest.

REFERENCES

1. Lerner RE, Grolnick WS, Caruso AJ, Levitt MR. Parental involvement and children's academics: The roles of autonomy support and parents' motivation for involvement. *Contemp Educ Psychol.* 2022;68:102039. <https://doi.org/10.1016/j.cedpsych.2021.102039>
2. Oranga J, Obuba E, Sore I, Boinett F. Parental involvement in the education of learners with intellectual disabilities in Kenya. *Open Access Lib J.* 2022;9(4):1–18. <https://doi.org/10.4236/oalib.1108322>
3. Ribeiro LM, Cunha RS, Silva MCAE, Carvalho M, Vital ML. Parental involvement during pandemic times: Challenges and opportunities. *Educ Sci.* 2021;11(6):302. <https://doi.org/10.3390/educsci11060302>
4. Zhu Q, Cheong Y, Wang C, Tong J. The impact of maternal and paternal parenting styles and parental involvement on Chinese adolescents' academic engagement and burnout. *Curr Psychol.* 2023;42(4):2827–2840. <https://doi.org/10.1007/s12144-020-01328-0>
5. Lawrence KC, Fakuade OV. Parental involvement, learning participation and online learning commitment of adolescent learners during the COVID-19 lockdown. *Res Learn Technol.* 2021;29. <https://doi.org/10.25304/rlt.v29.2425>

6. Panaoura R. Parental involvement in children's mathematics learning before and during the period of the COVID-19. *Soc Educ Res.* 2021;65–74.
7. Testa A, Jackson DB. Parental incarceration and school readiness: Findings from the 2016 to 2018 National Survey of Children's Health. *Acad Pediatr.* 2021;21(3):534–541. <https://doi.org/10.1016/j.acap.2020.10.004>
8. Goudeau S, Sanrey C, Stanczak A, Manstead A, Darnon C. Why lockdown and distance learning during the COVID-19 pandemic are likely to increase the social class achievement gap. *Nat Hum Behav.* 2021;5(10):1273–1281. <https://doi.org/10.1038/s41562-021-01104-9>
9. Jeynes W. Parent involvement for urban students and youth of color. In: Milner HR, Lomotey K, editors. *Handbook of Urban Education.* 2nd ed. New York: Routledge; 2021. p. 418–433.
10. Bates J, Finlay J, O'Connor Bones U. “Education cannot cease”: The experiences of parents of primary age children (age 4–11) in Northern Ireland during school closures due to COVID-19. *Educ Rev.* 2023;75(4):657–679. <https://doi.org/10.1080/00131911.2021.2009390>
11. Howard AL, Alexander SM, Dunn LC. Helicopter parenting is unrelated to student success and well-being: A latent profile analysis of perceived parenting and academic motivation during the transition to university. *Emerg Adulthood.* 2022;10(1):197–211. <https://doi.org/10.1177/2167696820944435>
12. Latipah E, Kistoro HCA, Putranta H. How are the parents' involvement, peers and agreeableness personality of lecturers related to self-regulated learning? *Eur J Educ Res.* 2021;10(1):413–425.
13. Nurhayati S. Parental involvement in early childhood education for family empowerment in the digital age. *Empowerment.* 2021;10(1):54–62.
14. Hornby G, Blackwell I. Barriers to parental involvement in education: An update. *Educ Rev.* 2018;70(1):109–119. <https://doi.org/10.1080/00131911.2017.1281222>
15. Barger MM, Kim EM, Kuncel NR, Pomerantz EM. The relation between parents' involvement in children's schooling and children's adjustment: A meta-analysis. *Psychol Bull.* 2019;145(9):855. <https://doi.org/10.1037/bul0000201>
16. Evans MP. Educating preservice teachers for family, school, and community engagement. *Fam Sch Community Engagem Partnersh.* 2018;9–19.
17. Muller C, Kerbow D. Parent involvement in the home, school, and community. In: *Parents, Their Children, and Schools.* New York: Routledge; 2018. p. 13–42.
18. Posey-Maddox L, Haley-Lock A. One size does not fit all: Understanding parent engagement in the contexts of work, family, and public schooling. *Urban Educ.* 2020;55(5):671–698. <https://doi.org/10.1177/0042085916661374>

19. Meesad P, Mingkhwan A. User experience and engagement in smart digital libraries. In: *Libraries in Transformation. Studies in Big Data*. Vol. 157. Cham: Springer; 2024. https://doi.org/10.1007/978-3-031-69216-1_8
20. Jeynes WH. A practical model for school leaders to encourage parental involvement and parental engagement. *Sch Leadersh Manag*. 2018;38(2):147–163. <https://doi.org/10.1080/13632434.2018.1439462>
21. Hajisoteriou C, Karousiou C, Angelides P. Successful components of school improvement in culturally diverse schools. *Sch Eff Sch Improv*. 2018;29(1):91–112. <https://doi.org/10.1080/09243453.2017.1382541>
22. Tan CY, Lyu M, Peng B. Academic benefits from parental involvement are stratified by parental socioeconomic status: A meta-analysis. *Parenting*. 2020;20(4):241–287. <https://doi.org/10.1080/15295192.2020.1755007>
23. Li X, Yang H, Wang H, Jia J. Family socioeconomic status and home-based parental involvement: A mediation analysis of parental attitudes and expectations. *Child Youth Serv Rev*. 2020;116:105111. <https://doi.org/10.1016/j.chilyouth.2020.105111>
24. Salauddin N. Reading habits of newspaper among the engineering students and academic staff: A survey of Jahangirabad Institute of Technology, Barabanki. *Int Res J Libr Inf Sci*. 2017;7(3).
25. Yulianti K, Denessen E, Droop M, Veerman GM. School efforts to promote parental involvement: The contributions of school leaders and teachers. *Educ Stud*. 2022;48:98–113.
26. Kim JS, Burkhauser MA, Mesite L, Asher CA, Relyea JE, Fitzgerald J, et al. Improving reading comprehension, science domain knowledge, and reading engagement through a first-grade content literacy intervention. *J Educ Psychol*. 2020. <https://doi.org/10.1037/edu0000396>
27. Rasulova A, Karimov U. Socio-pedagogical aspects of the formation of reading culture and skills. *Asian J Multidimens Res*. 2022;11(4):114–118.
28. Li X, Chu SK. Exploring the effects of gamification pedagogy on children's reading: A mixed-method study on academic performance, reading-related mentality and behaviors, and sustainability. *Br J Educ Technol*. 2020;52:160–178. <https://doi.org/10.1111/bjet.13021>
29. Kartel A, Charles M, Xiao H, Sundi D. Strategies for parent involvement during distance learning in Arabic lessons in elementary schools. *J Int Lingua Technol*. 2022.
30. Ata-Aktürk A, Demircan HÖ. Supporting preschool children's STEM learning with parent-involved early engineering education. *Early Child Educ J*. 2020;49:607–621. <https://doi.org/10.1007/s10643-020-01073-0>

31. Berkowitz R, Astor RA, Pineda D, DePedro KT, Weiss EL, Benbenishty R. Parental involvement and perceptions of school climate in California. *Urban Educ.* 2017;56:393–423. <https://doi.org/10.1177/0042085915623330>
32. Myende PE, Nhlumayo BS. Enhancing parent–teacher collaboration in rural schools: Parents’ voices and implications for schools. *Int J Leadersh Educ.* 2022;25(3):490–514. <https://doi.org/10.1080/13603124.2020.1731792>
33. Nuryanti N, Iswara PD. Home literacy environment: The solution to improve early reading skills of students in primary school during COVID-19. *Int Conf Elem Educ.* 2021;3(1):219–228.
34. Ewin CA, Reupert AE, McLean LA, Ewin CJ. The impact of joint media engagement on parent–child interactions: A systematic review. *Hum Behav Emerg Technol.* 2020.
35. Zhang Z, Xu Y, Wang Y, Yao B, Ritchie DE, Wu TS, et al. StoryBuddy: A human-AI collaborative chatbot for parent-child interactive storytelling with flexible parental involvement. In: *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems.* New York: ACM; 2022.
36. Liu C, Liao M, Chang C, Lin H. An analysis of children's interaction with an AI chatbot and its impact on their interest in reading. *Comput Educ.* 2022;189:104576. <https://doi.org/10.1016/j.compedu.2022.104576>
37. Yulianti K, Denessen E, Droop M, Veerman GM. Transformational leadership for parental involvement: How teachers perceive the school leadership practices to promote parental involvement in children’s education. *Leadersh Policy Sch.* 2019;20:277–292.
38. Ni S, Lu S, Lu K, Tan H. The effects of parental involvement in parent–child reading for migrant and urban families: A comparative mixed-methods study. *Child Youth Serv Rev.* 2021;123:105941. <https://doi.org/10.1016/j.chilyouth.2021.105941>
39. Xu Y, Aubele J, Vigil V, Bustamante AS, Kim YG, Warschauer M. Dialogue with a conversational agent promotes children’s story comprehension via enhancing engagement. *Child Dev.* 2021;93:e149–e167. <https://doi.org/10.1111/cdev.13712>
40. Gay B, Sonnenschein SF, Sun S, Baker LM. Poverty, parent involvement, and children’s reading skills: Testing the compensatory effect of the amount of classroom reading instruction. *Early Educ Dev.* 2020;32:981–993. <https://doi.org/10.1080/10409289.2020.1762294>
41. Qualter D. From digital exclusion to digital inclusion: Shaping the role of parental involvement in home-based digital learning – A narrative literature review. *Comput Sch.* 2024.
42. Devlieghere J, Li Y, Vandebroek M. Beyond the veil of parents: Deconstructing the concept of parental involvement in early childhood education and care. *Early Years.* 2020;42:587–598. <https://doi.org/10.1080/09575146.2020.1744913>

43. Cagiltay B, White NT, Ibtasar R, Mutlu B, Michaelis JE. Understanding factors that shape children's long-term engagement with an in-home learning companion robot. In: Proceedings of the 21st ACM Interaction Design and Children Conference. New York: ACM; 2022.
44. Benedetto L, Ingrassia M. Digital parenting: Raising and protecting children in media world. In: Parenting – Studies by an Ecocultural and Transactional Perspective. 2020.
45. Erdener MA, Knoepfel RC. Parents' perceptions of their involvement in schooling. *Int J Res Educ Sci.* 2018;4(1):1–13. <https://doi.org/10.21890/ijres.369746>
46. Coleman JS. *Parents, Their Children, and Schools.* New York: Routledge; 2018.
47. Alzahrani S, Shakir K, Yazeed A, Salauddin N, Ahmed S. Navigating the technological frontier: Tracing the journey from Library 2.0 to Library 5.0 and its impact on knowledge repositories. *Inf Dev.* 2025;0(0). <https://doi.org/10.1177/02666669251348907>
48. Kiyama JM, Harper CE. Beyond hovering: A conceptual argument for an inclusive model of family engagement in higher education. *Rev High Educ.* 2018;41(3):365–385. <https://doi.org/10.1353/rhe.2018.0015>
49. Timms C, Fishman T, Godineau A, Granger J, Sibanda T. Psychological engagement of university students: Learning communities and family relationships. *J Appl Res High Educ.* 2018;10(3):243–255. <https://doi.org/10.1108/JARHE-05-2017-0060>

Authors' Contribution

Both authors contributed equally to the development of this article.

Data availability

All datasets relevant to this study's findings are fully available within the article.

How to cite this article (APA)

Khan, S., & Alzahrani, S. BEYOND THE BOOKSHELF: A JOURNEY INTO HOW AI ENABLED LIBRARIES SHAPE READING CULTURE. *Veredas Do Direito*, e223421. <https://doi.org/10.18623/rvd.v22.n5.3421>