Article

A Data-Driven Digital Framework for Enhancing Parental Engagement and Cognitive Development in Kazakhstani Children: A Survey and Correlation Study

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Abstract

This study examines early childhood cognitive development in Kazakhstan using a computational, technology-assisted method, highlighting the critical need for data-driven, culturally appropriate interventions. For statistical analysis, survey data from a cross-sectional sample of Kazakhstani parents ($n = 21$) with children ages 0–6 were encoded. Correlation analysis showed a chronic implementation deficiency, although 93% participants expressed strong awareness of early development. The study found a very strong negative relationship ($r \approx -0.88$) between reported child anger/control issues (Variable N) and knowledge about significant brain development periods (Variable J), as shown in Table III. This suggests that parental education directly improves emotional management. On the other hand, a significant negative relationship ($r \approx -0.71$) was found between reported speech clarity (Variable K) and brain knowledge (Variable J), showing that knowledgeable parents use stricter criteria when evaluating achievements. Furthermore, a strong positive correlation ($r \approx 0.638$) has been found between the parents' subjective self-rating of the quality of early development (Variable E) and their technical knowledge of brain development (Variable J), indicating that more positive perceptions of developmental progress are related to a deeper

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understanding. Using the Vue and Vuetify frameworks, a prototype digital platform was created to fill these gaps and integrate awareness into consistent, evidence-based action. The study presents a scalable, data-driven approach for delivering culturally responsive early childhood interventions in the Kazakhstani context, despite its limitations due to its cross-sectional design and small sample size.

Keywords: cognitive computing, educational technology, digital platforms, early childhood development, data-driven analysis, parental engagement, cross-cultural perspective, Kazakhstani children

I. Introduction

With a growing percentage of children experiencing developmental delays, especially in speech and cognitive capacities, the field of child development faces constant problems. The worldwide agreement, supported by seminal work such as Ibuka's [1], emphasizes that the essential period for intellectual and emotional development occurs between birth and age three. However, Kazakhstan currently lacks culturally appropriate educational programs that focus on early cognitive and emotional development. To close this gap, the current study presents a comprehensive, methodical approach for Kazakhstani children aged 0–6, grounded in developmental psychology and neuroscience. Additionally, a website was created to increase awareness, support research-based child-rearing practices, and offer resources to researchers, educators, and parents. By providing a culturally compatible digital prototype in the Kazakh language to supplement professional guidance with everyday, practical implementation techniques, this study fills in the gaps noted in Table I.

A. Literature Review

High-quality relationships and engagement have a significant impact on cognitive outcomes during the intense period of neuroplasticity in early childhood [2], [3]. Language acquisition, ability to concentrate, and emotional control are particularly vulnerable to genetic and environmental variables during the first three years of life. Children's intellectual, social, and emotional development is routinely enhanced by educational philosophies such as Maria Montessori's, which promote independence and self-directed learning [4]. Because structured activities and responsive approaches to parenting are consistently linked to more robust cognitive and emotional development, parental participation is crucial [5].

The Role of Technology in Early Intervention

In recent years, technology has revolutionized access to early childhood resources. While traditional approaches remain vital [6], digital tools are emerging as critical support mechanisms [7]. However, efficacy is conditional on institutional support and user literacy. [8] found that preschool teachers often demonstrate higher digital literacy than parents, indicating a critical skills gap that must be addressed for digital platforms to succeed in the home environment. Furthermore, [9] found that parents are far more engaged when schools provide well-structured technological tools and when social influences (from teachers and other parents) actively support technology adoption. This highlights the need for a collaborative, not isolated, digital framework.

Sociocultural Context and Implementation Gaps

The social environment of development is fundamental to it [10]. Linguistic disparities influence parents' information-seeking behaviors in the Central Asian environment, with Kazakh-speaking parents more likely to seek professional assistance, according to [11]. This highlights the need for intervention to be culturally and linguistically relevant.

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TABLE I
SYNTHESIS OF KEY LITERATURE AND RESEARCH GAPS JUSTIFYING THE DIGITAL INTERVENTION

Study/Source	**Focus**	**Key Finding**	**Gap Addressed by Current Study**
Ibuka [1]/ General Theory	Critical Period	The first three years are the most important for development (0-3).	Need for structured, easily accessible intervention programs for parents of 0-6-year-olds.
Landry et al. [5]	Parental Engagement	Responsive parenting and structured activities lead to robust cognitive development.	Need for a digital platform to deliver structured activities and responsive guidance to parents.
Khan et al. [11]	Linguistic Context	Information-seeking can be affected by linguistic differences; Kazakh speakers frequently favor expert advice.	Mandate: The intervention must be given in Kazakh and intended to support expert advice.
Akman et al. [8]	Digital Literacy	Compared to parents, preschool teachers are more digitally literate.	Challenge: The framework needs to reduce the digital literacy gap among parents and incorporate basic UX/UI principles.
Osorio-Saez et al. [9]	Technology Adoption	Parental engagement increases with school-provided tools and positive social influence.	Solution: To encourage social adoption, the framework needs to be set up as a cooperative tool (forums/sharing).
Hirsh-Pasek and Golinkoff [7]	Educational Technology	Multimedia and gamified environments are effective tools for assisting development.	Need for a culturally relevant digital platform prototype built with modern frameworks (Vue/Vuetify).
Bornstein [10] / Knudsen [3]	Sociocultural Context	Cultural differences significantly impact child development; there is an urgent need for adapted, local programs.	Focus on the Kazakhstani context to develop a comprehensive program in the Kazakh language.

Based on the synthesis of previous research and the gaps mentioned in Table I, the next section discusses the specific developmental approaches and the theoretical framework chosen for this study.

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II. Methods

A. Early Cognitive Development Strategies: The Significance of Parental Intervention and Involvement

The family defines a child's primary environment in the early years of life. Since their interactions offer the first and most significant form of social experience, parents have a significant impact on how children develop cognitively and emotionally. Parents are crucial mediators of early learning opportunities, and research consistently shows that working with a child's environment is more effective than focusing solely on the child [1]. Parents are responsible for taking preventative actions to ensure healthy development in addition to providing daily care and play. For early intervention programs to be effective, they must continue to be flexible and adjust to the changing needs of families and children. Since these programs aim to influence various aspects of growth through collaboration between professionals and caregivers, parental involvement at every stage is essential.

In order to structure the analysis, this study divided early cognitive development into four age-specific phases: infancy (0–12 months), toddlerhood (1–2 years), early preschool (2–4 years), and later preschool (4–6 years). Parental awareness was examined using surveys that examined developmental milestones over these periods. The study's results led to recommendations on how parents can enhance cognitive development at home. Piaget's theory provides a useful framework for understanding these developmental stages. His concepts of assimilation—the integration of new experiences into preexisting mental structures—and accommodation—the adaptation of mental structures to new experiences—explain the mechanisms by which infants acquire information [12]. Cognitive development happens in a specific order, according to Piaget: sensorimotor, preoperational, concrete operational, and formal operational. Each stage, like the steps on a staircase, reflects a qualitatively new style of thinking and builds on the achievements of the one before it [13].

B. Early Foundations: Handling Early Childhood Cognitive and Emotional Milestones

Early life is one of the most critical periods for cognitive and emotional development. During this time, the parent-infant bond is essential for establishing secure interactional patterns that lay the groundwork for future development. Reflexive behaviors, such as oral reflexes like the mouth-palm and chewing reflexes, as well as defensive reactions like blinking or head-turning, predominate in the neonatal stage. Early motor coordination is supported by spinal reflexes like crawling, grasping, or the Moro reflex, whereas neural reflexes connect head position to body posture. As higher brain functions develop over the first three to five months, these early reflexes begin to fade away [14]. Children go through a phase of rapid speech and cognitive development between the ages of one and two. They start to mimic speech sounds, pronounce their first words, and try to follow basic instructions during this phase. Social interaction and vocabulary development are closely related because children try to mimic adult language patterns and express their needs. Additionally, memory and focus get better. When doing simple tasks or stacking blocks, for example, children can focus for longer periods of time. The development of goal-directed groundwork, which serves as the basis for subsequent problem-solving skills, is reflected in such continuing focus. During this phase, play becomes more symbolic. Children start to develop social awareness and practice expressing their emotions through pretend play, such as by modeling parental roles. Simultaneously, the ability to differentiate between the similarities and differences of objects improves reasoning abilities. Early speech, memory, and creative play all work together to lay the foundation for later socialization and academic success [15].

III. Experimental work

A. Participants and Procedure

To investigate the connection between parental involvement and early cognitive developmental outcomes in the Kazakhstani environment, this study used a cross-sectional, computationally assisted methodology. To collect quantifiable data on awareness and developmental milestones, parents of children aged 0 to 6 participated in a standardized survey. Prioritizing ethical behavior, the methodology obtained explicit verbal consent from each participant before any data were collected. To get a cross-sectional sample size of 21 parent-child pairs ($n = 21$), the technique employed a convenience sampling approach among parents in Almaty, Kazakhstan, specifically within the "Dostyk" group in Iasli-sad No. 37. This method served as a basis for integrating objective milestone attainment observations with subjective parental input.

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B. Survey Instrument and Key Terminology

The questionnaire covered five significant domains of growth: (1) parental knowledge about early development; (2) cognitive and emotional stimulation during infancy; (3) crucial developmental phases like crawling, speech clarity, and emotional regulation; (4) exposure to professional support (e.g., speech therapy); and (5) attitudes toward comprehensive child development. Examples of questioning were ”Do you know about early development?” ”At what age did your child begin to speak clearly?” ”Is emotional development important?” and also, ”Can harmonious development be achieved by allocating 5-25 minutes daily?”

The following important terms are defined for the precise interpretation of the results:

Harmonious Development: This phrase describes a thorough, well-rounded approach to child development that includes the coordinated development of cognitive, emotional, and physical skills during the early years of life.

The term ”psychophysiological outcomes” refers to developmental markers, such as the age of reflexive integration, fine motor abilities, and emotional self-regulation (as determined by parent-reported milestone attainment), that reflect the interplay of mental and physical processes.

Excel spreadsheets were used to compile and analyze the responses (Figures 1 and 2). Significant developmental gaps were found by the analysis, especially in the areas of emotional self-regulation, speech clarity, and regular parental participation in early stimulation techniques. The raw data showed that 93 % parents responded ’No’ when asked about knowledge of the 0-6 age developmental period. This low awareness is directly related to the inadequate implementation of structured cognitive milestones, serving as the primary justification for the intervention design. These results highlight the fact that insufficient parental awareness and structured involvement are frequently associated with developmental deficiencies.

Fig. 1. Answers to questions

	A	B	C	D	E	F	G	H	I	J
1		1. How was the child born?	2.Do you know about early development?	3. Were you engaged in early development of a child?	4.What is the early development? In your opinion	5. Have you been exercising from 0 to 12 months?	6.How many months has your child been crawling?	7. Did you know that there are 6 directions of harmonious development?	8. Is Emotional Development important?	9. Did you know that at the age of 0-6, the main part of the brain (90-93 %) develops?
2	Dariya	natural	Yes	Also working	All	Yes	6 month	No	Yes	No
3	Aibar	natural	Yes	Yes	All	Yes	7 month	No	Yes	Yes
4	Ayala	natural	Yes	Also working	All	Yes	5 month	No	Yes	Yes
5	Nurasyl	natural	Yes	No	All	No	7 month	No	Yes	Yes
6	Beybit	natural	Yes	Yes	All	Yes	6 month	No	Yes	Yes
7	Aruna	natural	Yes	Yes		Yes	7 month	No	Yes	Yes
8	Ayana	natural	Yes	Also working	All	Yes	5 month	No	Yes	No
9	Dias	natural	Yes	Yes	All	Yes	7 month	No	Yes	No
10	Inzhu	natural	Yes	Yes	All	Yes	6 month	No	Yes	Yes
11	Aksultan	natural	Yes	Yes	All	No	6 month	Yes	Yes	Yes
12	Aya	natural	Yes	Yes	All	Yes	6 month	No	Yes	Yes
13	Sauran	natural	Yes	Yes	All	Yes	The child immedia	No	Yes	Yes
14	Akhmet	natural	Yes	Also working	All	Yes	6 month	Yes	Yes	Yes
15	Aidana	Caesarean section	Yes	Yes	All	Yes	6 month	No	Yes	Yes
16	Zeyin	Caesarean section	Yes	No	All	Yes	7 month	No	Yes	Yes
17	Daniyal	Caesarean section	Yes	Yes	All	Yes	7 month	No	Yes	Yes
18	Adelya	Caesarean section	Yes	Yes	All	Yes	5 month	No	Yes	Yes
19	Safiya	Caesarean section	Yes	Yes	All	Yes	7 month	No	Yes	Yes
20	Damir	Caesarean section	Yes	Also working	All	Yes	6 month	No	Yes	Yes
21	Galiyabanu	Caesarean section	Yes	Also working	All	Yes	7 month	No	Yes	Yes
22	Adina	Caesarean section	Yes	Yes	All	Yes	6 month	No	Yes	Yes

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Fig. 2. Answers to questions

K	L	M	N	O	P	Q	R	S
10.Is your child speaking clearly?	11.At what age did your child speak clearly?	12.Can your child explain to you what he wants?	13.Your child gets angry when he doesn't get what he wants?	14.Has your child worked with a speech therapist?	15. Is there any special feature?	16. Do you want your child to develop comprehensively ? Does this require a job?	17. Is it possible to develop a child harmoniously by allocating 5-25 minutes a day?	18. Does he feel free, his body?
Yes	3 year	Yes	Yes	No	No	Yes	Maybe	Yes
Yes	4 year	Yes	We can come to ai	No	No	Yes	Maybe	Yes
Yes	2 year	Yes	We can come to ai	No	No	Yes	Yes	Yes
Yes	2 year	Yes	We can come to ai	No	No	Yes	Maybe	Yes
Yes	2 year	Yes	We can come to ai	No	No	Yes	Maybe	Yes
Yes	3 year	Yes	We can come to an agreement.		No	Yes	Yes	Yes
Yes	3 year	Yes	Yes	No	No	Yes	Yes	Yes
No	4 year	Yes	Yes	Yes	Yes	Yes	Maybe	Yes
Yes	2 year	Yes	No	No	No	Yes	Yes	Yes
Yes	2 year	Yes	Yes	No	No	Yes	Yes	Yes
Yes	2 year	Yes	We can come to ai	No	No	Yes	Maybe	Yes
No	4 year	Yes	We can come to ai	Yes	No	Yes	Maybe	Yes
Yes	2 year	Yes	We can come to ai	No	No	Yes	Yes	Yes
No	4 year	Sometimes I don't	We can come to ai	No	No	Yes	Maybe	Yes
Yes	4 year	Yes	Yes	No	No	Yes	Maybe	Yes
No	4 year	Yes	We can come to ai	Yes	No	Yes	Yes	Yes
Yes	2 year	Yes	Yes	No	Yes	Yes	Yes	Yes
No	3 year	Yes	We can come to ai	Yes	Yes	Yes	Yes	Yes
No	5 year	Yes	We can come to ai	Yes	No	Yes	Maybe	Yes
Yes	2 year	Yes	We can come to ai	No	No	Yes	Yes	Yes
Yes	2 year	Yes	No	No	No	Yes	Maybe	Yes

These visual summaries of the survey data reflect the current stage of parental awareness and milestone attainment, giving a baseline for the upcoming quantitative encoding and analysis procedure.

C. Statistical Analysis and Data Encoding

The primary statistical approach used was the Pearson correlation coefficient to measure the strength and direction of the linear relationship between the survey variables, thus verifying the study's initial hypotheses about associated factors in early development.

Before the correlation analysis, all survey responses were systematically transformed and encoded into numerical values (Figure 3). This encoding process was essential to convert the mixture of categorical, binary, and ordinal data into a continuous numerical format required for the valid application of the Pearson correlation formula. For instance, binary "Yes/No" questions were encoded as 1 or 0, while age-based milestone reports were converted into numerical scale averages. This method guaranteed consistent dataset processing and allowed for the robust quantification of relationships between abstract developmental concepts.

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Fig. 3. The encoded questions are in letters, and the answers are in numbers

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
Dariya	nat	1	1.5	All	1	0.5	0	1	0	1	3	1	1	0	0	1	0.5	1
Aibar	nat	1	1	All	1	0.583	0	1	1	1	4	1	0.5	0	0	1	0.5	1
Ayala	nat	0	1.5	All	1	0.417	0	1	1	1	2	1	0.5	0	0	1	1	1
Nurasyl	nat	1	0	All	1	0.583	0	1	1	1	2	1	0.5	0	0	1	0.5	1
Beybit	nat	1	1	All	1	0.5	0	1	1	1	2	1	0.5	0	0	1	0.5	1
Aruna	nat	1	1	All	1	0.417	0	1	0	1	3	1	0.5	0	0	1	0.5	1
Ayana	nat	1	1.5	All	1	0.417	0	1	0	1	3	1	1	0	0	1	1	1
Dias	nat	1	1	All	1	0.583	0	1	0	0	4	1	1	1	1	1	0.5	1
Inzhu	nat	1	1	All	1	0.5	0	1	1	1	2	1	0	0	0	1	1	1
Aksultan	nat	1	1	All	1	0.5	1	1	1	1	2	1	1	0	0	1	1	1
Aya	nat	1	1	All	1	0.5	0	1	1	1	2	1	0.5	0	0	1	0.5	1
Sauran	nat	1	1	All	1	0	0	1	1	0	4	1	0.5	1	0	1	0.5	1
Akhmet	nat	1	1.5	All	1	0.5	1	1	1	1	2	1	0.5	0	0	1	1	1
Aidana	cae	1	1	All	1	0.5	0	1	1	0	4	0	0.5	0	0	1	0.5	1
Zeyin	cae	1	0	All	1	0.583	0	1	1	1	4	1	1	0	0	1	0.5	1
Daniyal	cae	1	1	All	1	0.583	0	0	1	0	4	1	0.5	1	0	1	1	1
Adelya	cae	0	1	All	1	0.417	0	1	1	1	2	1	1	0	1	1	1	1
Safiya	cae	1	1	All	1	0.583	0	1	1	0	3	1	0.5	1	1	1	1	1
Damir	cae	1	1.5	All	1	0.5	0	1	1	0	5	1	0.5	1	0	1	0.5	1
Galiya	cae	1	1.5	All	1	0.583	0	1	1	1	2	1	0.5	0	0	1	1	1
Adina	cae	1	1	All	1	0.5	0	1	1	1	2	1	0	0	0	1	0.5	1

Table II defines the variables used in the statistical matrix.

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TABLE II
ENCODED VARIABLE KEY

Variable	Concept (Question/Feature)
B	How was the child born?
C	Do you know about early development? (General knowledge)
D	Were you engaged in the early development of a child?
E	What is the early development? answer is All
F	Have you been exercising for 0 to 12 months?
G	How many months has your child been crawling? (Duration/Milestone)
H	Did you know there are 6 directions of harmonious development?
I	Is emotional development important?
J	Did you know that at the age of 0-6, the main part of the brain (90-93 %) develops?
K	Is your child speaking clearly?
L	At what age did your child speak clearly?
M	Can your child explain to you what he wants? (Communication Skill)
N	Does your child get angry when he doesn't get what he wants? (Anger/Control)
O	Has your child worked with a speech therapist?
P	Is there any special feature?
Q	Do you want your child to develop comprehensively? Does this require a job?
R	Is it possible to develop a child harmoniously by allocating 5-25 minutes a day?
S	Does he feel free in his body? (Physical/Motor Confidence)

The Pearson correlation coefficient was applied to calculate the exact strength of the correlations between these parameters.

The formula applied to calculate the Pearson correlation coefficient (r) was:

$$r = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

where $\sum xy$ is the sum of the products of the corresponding values of the variables X and Y, $\sum x$ and $\sum y$ are the sums of the values of the variables X and Y, respectively. $(\sum x)^2$ and $(\sum y)^2$ are the sums of the squares of the values of each variable, and n is the number of data pairs (x, y).

The correlation matrix (Figure 4) revealed statistically significant associations among several variables.

D. Development of Digital Platforms (Proof-of-Concept)

In order to fill the empirical gaps found in the study, the digital platform was created as an organized parent-focused resource. It offers readily available everyday activities and materials designed for children aged 0–6. In terms of technology, the website was constructed using the Vue and Vuetify frameworks, which ensure functionality and accessibility for its deployment. It is important to note that this digital platform is a proof-of-concept prototype. This first cross-sectional study does not report on formal pilot testing, usability studies, or user efficacy evaluations; they are reserved for future research. The project's commitment to fusing effective technology design with recognized educational demands is demonstrated by this integration.

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IV. Results and Discussion

A. A Descriptive Findings and Developmental Gaps

A crucial distinction between parental knowledge and execution was identified by the descriptive analysis of the raw survey data (Figure 1). Crucially, 93 % of the parents surveyed, said they were aware of the essential developmental period between the ages of 0 and 6. Reports of less persistent, organized engagement contrast strongly with this high level of generalized awareness, suggesting that the main issue is an implementation deficit—the difficulty of converting awareness into regular everyday activity. The main rationale for the design of the digital intervention is this absence of useful advice.

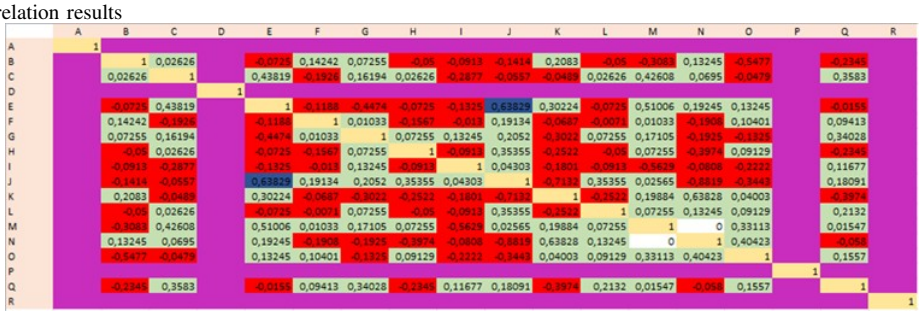
The main results show that technical understanding of brain development (Variable J) is a strong predictor of emotional outcomes, as seen in Table III. The very significant negative correlation ($r \approx -0.88$) with variable N (Anger/Control) suggests that parents who are aware of the "90-93 %brain development" window are probably using better strategies for controlling their emotions. The substantial negative correlation ($r \approx -0.71$) between Variable J and Variable K (Speech Clarity), however, offers an unexpected insight: well-informed parents might assess their child's development more negatively, resulting in lower subjective assessments even while the child is actually making improvement.

Regression modeling and factor analysis are two more statistical techniques that will be used in future studies to build on these results. These methodologies will facilitate a deeper exploration of causal links and uncover underlying features in the data, thus supporting the construction of more targeted and effective educational interventions.

B. Correlation Analysis and Educational Implications

The Pearson correlation matrix (Figure 4) generated from the encoded variables was analyzed to identify and interpret statistically significant linear relationships that inform educational practice. The results go beyond stating significance, detailing the strength and direction of these associations.

Fig. 4. Correlation results



Strongest Correlative Findings: To understand the direction and intensity of relationships, the Pearson correlation matrix (Figure 4) was systematically examined, with an emphasis on connections that support the intervention's objectives.

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TABLE III
SUMMARY OF KEY CORRELATION FINDINGS AND INTERPRETATIONS

Variables	Coefficient (r)	Interpretation
J and E	0.638290	**Strong Positive:** Parents are far more likely to have a comprehensive conceptual understanding of early development (E) if they are knowledgeable about the technical complexities of brain development (J).
N and K	0.63828	**Strong Positive:** Children's emotional expression (N) and speaking status (K) are significantly correlated, indicating that the type of emotional reporting changes as verbal clarity improves.
M and E	0.51006	**Strong Positive:** The parent's trust in the success of the entire developmental process (E) is primarily validated by the child's ability to express their desires (M).
E and C	0.438195	**Moderately Positive:** A more precise and complete conceptual characterization of early development (E) is somewhat correlated with general parental awareness (C), suggesting that theoretical clarity is supported by broad knowledge.
M and C	0.42608	**Moderately Positive:** The child's improved ability to express needs (M) is positively correlated with general parental knowledge (C).
O and N	0.40423	**Moderately Positive:** Parental reports of their child's anger and control (N) are linked to the use of professional speech therapy (O), illustrating the challenge of getting care for complicated needs.
J and N	-0.8819	**Very Strong Negative:** Lower reported kid anger/control issues (N) are linked to knowledge of the crucial 90 - 93 % brain development period (J). This implies that improved emotional control techniques result from parent education.
K and J	-0.7132	**Strong Negative:** It's interesting to note that a lower probability of reporting "clear speech" (K) is correlated with higher brain knowledge (J). This suggests that well-informed parents are more demanding or have higher expectations for reaching goals.
M and I	-0.5629	**Strong Negative:** A lower evaluation of basic communication skills (M) is linked to a larger emphasis on emotional value (I), which may suggest a focus on social-emotional rather than just cognitive measures.
O and B	-0.5477	**Strong Negative:** There may be a fundamental connection between birth type and linguistic trajectory because natural birth (B=1) is negatively correlated with the necessity for or usage of speech therapy (O).

The correlational data described in Table III emphasize the crucial impact of technical knowledge on child behavior, creating the empirical basis for the pedagogical implications discussed below.

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Educational Implications:

These results give the digital platform an easily understood map. Technical knowledge (J) and emotional outbursts (N) have a substantial negative relationship, indicating that educating parents about brain science can directly improve their children's conduct. Nevertheless, the "implementation deficit" remains; even with 93 % awareness, the wide range of results suggests that parents want a method of integrating this information into the regular 5–25 minute daily routines mentioned in Question R.

C. Linking Findings to Developmental Theory

These statistical findings strongly corroborate established developmental theories within a specific cultural context. The confirmation of a direct, strong association between structured parental involvement (Engagement Strategies) and key outcomes (Speech Clarity) aligns robustly with the work of [5], which established that responsive and structured parenting creates foundational skills for social, communication, and problem-solving skills. The survey results, which highlight high parental awareness but low implementation, simultaneously provide an empirical justification for the foundational principle emphasized by [1] that early intervention is crucial.

The observed associations affirm that

1. The issue in Kazakhstan is not a lack of concern but a lack of accessible, structured implementation guidance.

2. Technology, by providing a data-driven feedback loop and culturally relevant content, is a viable solution to bridge this implementation gap, supporting the findings of Hirsh-Pasek and Golinkoff [8] regarding scalable digital tools.

D. A Digital Resource for Improving Child Development

To address the identified awareness-to-action gap, a specialized website was developed as a proof-of-concept prototype. The platform serves as a crucial, scalable link between academic research and its application in daily family life.

In a technical sense, the website is built with the Vue and Vuetify frameworks. The platform integrates interactive forums, gamified play-based activities, and multimedia educational resources tailored for parents. Crucially, the development of this digital platform is presented as a proof-of-concept prototype; formal pilot testing, usability studies, and efficacy assessments are designated for future work and are not reported in this initial study. This resource, informed by the correlational data, advances the project's goal by providing targeted developmental strategies and making research-based knowledge widely accessible.

By combining these empirical insights into a viable digital platform, the research provides a scalable strategy for bridging the gap between scientific data and daily child-rearing practices.

V. Conclusion

This study identifies a persistent implementation deficiency and shows that high parental awareness does not always translate into optimal developmental outcomes in the Kazakhstani context. The correlation analysis demonstrated that the strongest predictor of decreased child anger and enhanced emotional regulation (Variable N, $r \approx -0.88$) is technical understanding of brain development (Variable J). On the other hand, the negative association between brain knowledge and perceived speech clarity ($r \approx -0.71$) implies that parents become more careful and critical of their child's development as they gain more knowledge.

A digital prototype that provides parents with a well-organized, harmonious developmental process was created in response to these findings. Through regular, small-scale daily interventions, the platform works to close the gap between "knowing" and "doing." This study offers an empirical foundation for an innovative, data-driven approach to early childhood development in Kazakhstan, but further longitudinal research is required to validate these causal processes.

Limitations and Future Research Directions

Although the study offers a crucial start, it is limited by a number of issues. The focus on a single cultural context (Kazakhstan) and the limited, cross-sectional sample size ($n = 21$) restricts the findings' ability to be generalized and makes it impossible to establish causal linkages. Additionally, using parental self-reporting raises the risk of bias regarding social desirability.

Future studies should concentrate on three main areas to expand on these findings and improve quality:

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1. Longitudinal Efficacy Studies: Performing controlled, long-term research to evaluate the digital platform's long-term effects on parental involvement and child outcomes. This is essential for proving causation and figuring out the intervention's actual efficacy.

2. Increased Methodological Rigor: Using additional statistical techniques, like regression modeling and factor analysis, to further explore underlying dimensions and predictive relationships in the data, especially concerning the detailed negative correlations (e.g., $\boldsymbol{r} \approx -0.88$ for emotional priority and speech age).

3. Cultural and Contextual Variability: Utilizing larger and more varied samples to investigate how cultural and contextual variability (e.g., variances across urban and rural contexts) could influence parental knowledge, implementation rates, and intervention efficacy.

In conclusion, this work adds to the expanding body of research that supports the creation of early, structured, and contextually appropriate treatments by combining empirical findings with a practical technological application. It lays a foundation for global teaching strategies that make use of computational tools to develop capable and resilient future generations.

REFERENCES

[1] M. Ibuka, "Kindergarten is Too Late! Required reading for an educated person," Simon and Schuster, 2018. 978-0-671-24036-3.

[2] J.P., Shonkoff, D.A., Phillips, "From Neurons to Neighborhoods: The Science of Early Childhood Development," National Academies Press (US); 2000. DOI: 10.17226/9824.

[3] E.I. Knudsen, "Sensitive periods in the development of the brain and behavior," Journal of Cognitive Neuroscience, 2004. DOI: 10.1162/0898929042304796.

[4] AS. Lillard, MJ.Heise, EM. Richey, X. Tong, A. Hart, PM. Bray. "Montessori Preschool Elevates and Equalizes Child Outcomes: A Longitudinal Study," Front Psychol, 2017. DOI: 10.3389/fpsyg.2017.01783.

[5] SH. Landry, KE. Smith, PR. Swank, "Responsive parenting: establishing early foundations for social, communication, and independent problem-solving skills" Dev. Psychol, vol. 42(4), 2006. DOI: 10.1037/0012-1649.42.4.627.

[6] N.E. Veraksa, A.K. Belolutskaya, "Emotional and Cognitive Development of Preschool Children: Overview of International and Russian Studies on Role of Dialectical Thinking in the Regulation of Affect and Recognition of Complex Feelings," RUDN Journal of Psychology and Pedagogics, 2021, pp. 104-121. DOI: 10.22363/2313-1683-2021-18-1-104-121.

[7] K. Hirsh-Pasek, R.M. Golinkoff, "Becoming Brilliant: What Science Tells Us About Raising Successful Children," Washington, D.C.: American Psychological Association, 2020. ISBN: 13: 9781433822391.

[8] E. Akman, Ö. İdil, R. Çakır, "An Investigation into the Levels of Digital Parenting, Digital Literacy, and Digital Data Security Awareness among Parents and Teachers in Early Childhood Education," Participatory Educational Research, 2023. DOI: 10.17275/per.23.85.10.5

[9] E. Osorio-Saez, N. Eryilmaz, A. Sandoval-Hernández, "Parents' Acceptance of Educational Technology: Lessons From Around the World," Frontiers in Psychology, 2021. DOI: 10.3389/fpsyg.2021.719430

[10] MH. Bornstein, "Cultural Approaches to Parenting," Parent Sci Pract, 2012. DOI: 10.1080/15295192.2012.683359.

[11] Ju.A. Khan, "Psychological literacy of parents of preschool children in an information-saturated environment (the case of Kazakhstan)," Social Sciences and Childhood, 2025. DOI: 10.17759/ssc.2025060201

[12] S. Mcleod, "Piaget's Theory and Stages of Cognitive Development," Simply Psychology, 2009. DOI: 10.5281/zenodo.15241970.

[13] P. Thompson, "Foundations of educational technologies," Oklahoma State University Library ePress, 2018.

[14] M. E. Bergeron-Gaudins, "5–6 years old: Cognitive and linguistic development," 2019. Available: https://naitreetgrandir.com/en/step/5-8-years/development/5-6-years/child-cognitive-and-linguistic-development-5-6-years/

[15] A. A. Maiyer, "Development of the child in a system of continuous education," 2019. Available: https://cyberleninka.ru/article/n/razvitie-rebyonka-v-sisteme-nepreryvnogo-obrazovaniya/viewer/

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