The Impact of Interactive Multimedia Technologies on the Development of Emotional Intelligence in Primary School Students in Kazakhstan

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***Abstract*—Emotional Intelligence (EI) is a crucial component of personal and social development, particularly during the school years. However, the effects of interactive multimedia tools specifically designed to help primary school pupils develop their emotional intelligence remain largely unexplored. The purpose of this study was to develop emotional intelligence in primary school pupils through interactive multimedia technologies and to evaluate the effectiveness of this intervention. The study involved 140 fourth-grade primary school pupils at Secondary Comprehensive School No. 69 in Shymkent, Kazakhstan. A quasi-experimental pre-test/post-test design with parallel groups was employed, with participants assigned to experimental and control conditions. The study initially revealed a low level of emotional intelligence among learners, particularly in the areas of self-regulation, empathy, and emotional awareness. Following the eight-week intervention, the experimental group's emotional intelligence scores increased significantly ($t(69) = 9.15$, $p < 0.001$, $d = 1.01$, large effect), whereas the control group showed no significant change, and a post-test comparison confirmed a significant difference between groups ($t(138) = 6.43$, $p < 0.001$, $d = 1.09$, large effect). The implementation of adapted multimedia materials contributed substantially to the enhancement of children's self-regulation, empathy, and awareness of their own emotions. The program proved highly effective within Kazakhstani schools characterized by a bilingual educational environment, underscoring the importance of localization and cultural adaptation of educational resources. This research confirms the critical role of multimedia technologies in fostering emotional intelligence and highlights the necessity of integrating such programs into students' learning experiences. These findings align with the research objectives and provide practical insights for educators seeking to develop emotional intelligence in younger schoolchildren in Kazakhstan and beyond, thereby promoting more effective, research-based strategies for multimedia educational technology.**

***Keywords*—digital learning tools, development, emotional Intelligence, multimedia technologies, primary education, young learners**

I. Introduction

In the context of rapid social and technological changes, the development of EI has become a critical factor in the successful socialization and personal growth of schoolchildren [1, 2]. The acquisition of emotional and social skills is particularly important during the primary school years, as this period is characterized by the formation of fundamental mechanisms of self-regulation, the ability to recognize and understand one's own emotions, and the development of empathic interactions with others [3].

Modern research highlights the strong relationship between the level of emotional intelligence and academic success, psycho-emotional well-being, and the reduction of conflicts within the school environment [4]. Primary school years represent a critical period for the active development of social-emotional skills. The quality of this process affects not only a child's current emotional state but also their long-term ability to engage constructively with the external world [5].

The development of emotional intelligence at this stage of education has become a priority pedagogical task, significantly influencing the holistic development of a student's personality [6]. However, existing theoretical concepts vary considerably. Most researchers argue that emotional intelligence can be acquired and taught to others, effectively developing in the process of socialization [7, 8]. In contrast, others believe that this trait is transmitted exclusively at the genetic level, similar to other cognitive abilities, and is therefore difficult to develop [9].

For an extended period, Kazakhstani pedagogy assumed that modern schools were unable to fully develop students' emotional skills [10]. To date, practical recommendations and well-defined methodologies for fostering emotional intelligence in students have not been systematically implemented [11]. In recent years, only a few programs addressing specific components of emotional intelligence have been developed, but these have not gained widespread adoption in schools [12].

In recent years, the development of EI has increasingly been examined within the context of the digitalization of education [13–16]. The growing integration of information, communication, and multimedia technologies into the educational process creates new opportunities for implementing social-emotional learning [17–19]. The combined use of visual, auditory, and interactive resources enables the simulation of real-life situations, the enactment of social scenarios, and, consequently, the development of emotional responsiveness and empathy in children [20].

Plass and Kaplan [21], Kaddouri *et al.* [22] indicated that digital tools, when properly integrated into the educational process, can not only enhance students' motivation but also positively influence the emotional sphere by fostering creativity, critical thinking, and the ability to collaborate

within a group. In this context, the practice of incorporating digital solutions into the Social-Emotional Learning (SEL) system warrants special attention. Demirdis [23] highlights that the digital environment can serve as an effective platform for developing emotional competencies, provided that it is supported by appropriate pedagogical strategies. Interactive and gamified educational platforms demonstrate significant potential for shaping sustainable models of social behavior among Primary School Pupils (PSP), increasing emotional engagement, and enhancing the immersive experience of the learning process [24].

However, previous research indicates that, despite the growing use of digital technologies in education, most solutions continue to primarily target cognitive and subject-specific skills, with social and emotional development often receiving less attention [25–29]. Social and emotional aspects of learning often remain at the periphery of both scholarly attention and educational policy. This issue is particularly evident in Central Asian countries, including Kazakhstan, where the digitalization of education is rapidly advancing but continues to prioritize academic knowledge acquisition [30]. The integration of students' social and emotional development into the digital educational environment is still insufficient.

While previous studies have mostly focused on middle and high school students [31–34], this research investigates the impact of multimedia-based interventions on the emotional intelligence of primary school pupils. The study also considers how these interventions can support social and academic development, taking into account the national context, educational infrastructure, pedagogical practices, and cultural characteristics.

A. Theoretical and Conceptual Framework

The core characteristic of EI lies in the intelligent use of emotions, encompassing a range of competencies and abilities that determine how effectively an individual understands and regulates both their own emotions and those of others, as well as how they manage interpersonal relationships [35]. The diversity of EI models—differing in definitions, areas of application, and methods of measurement—has led to the necessity of their classification [36]. A comparative overview of the most influential EI frameworks is presented in Table 1.

Table 1. Classification of EI models

Model	Key Authors	Focus
Ability Model	Peter Salovey, John D. Mayer (1990s)	Treats emotional intelligence as a set of cognitive abilities related to emotion processing
Mixed Model (Goleman)	Daniel Goleman (1995)	Combines emotional abilities with personality traits and competencies
Trait Emotional Intelligence Model	K. V. Petrides (2000s)	Emphasizes subjective experience and personality integration
Bar-On Model of Emotional-Social Intelligence	Reuven Bar-On (1997)	Focuses on emotional and social functioning for well-being
Genos Emotional Intelligence Model	Ben Palmer, Con Stough (2001)	Designed for organizational and leadership contexts

In this study, the intervention is explicitly anchored in the Ability Model of EI developed by Salovey and Mayer, which conceptualizes emotional intelligence as a set of cognitive abilities for perceiving, understanding, and managing emotions. This model was selected because its components (emotion perception, understanding, and regulation) align closely with the design of the multimedia activities, such as interactive storytelling and emotion recognition tasks integrated into the program.

The adaptation of the Ability Model of EI for this study also considered the cultural and pedagogical context of Kazakhstan. The country's educational policy, including the State Program for the Development of Education and Science (2020–2025) and initiatives promoting school digitalization, emphasizes integrating innovative technologies, fostering soft skills, and supporting bilingual and multicultural learning environments. These priorities informed the design of the multimedia intervention, ensuring alignment with local curricula, pedagogical norms, and the communicative approaches recommended by the Ministry of Education of the Republic of Kazakhstan.

Herut *et al.* [37] note that a high level of EI contributes significantly to the effective development of key competencies in schoolchildren. The formation and enhancement of EI are critical factors for both the social and academic success of students in comprehensive schools, serving as essential mechanisms for the successful socialization of young learners [38]. Taibolatov *et al*. [39] have demonstrated a direct correlation between components of students' EI and their learning motivation, which in turn contributes to the development of qualities associated with a successful personality from the senior preschool and primary school age. Arias *et al*. [40] emphasize the necessity of an integrated approach to EI development and the creation of an emotionally and intellectually stimulating educational environment. Moreover, the development of EI is influenced not only by the training itself but also by the broader educational environment in which this training is implemented [41].

An important consideration involves identifying the challenges and risks associated with developing EI within a digital educational context [42]. Shafait *et al*. [43] argue that EI development in schoolchildren must be comprehensive, as the isolated formation of individual components neither enhances overall success nor yields cumulative benefits.

Cultural differences significantly influence the traditions and approaches used to develop EI components in different countries [44]. In the context of Kazakhstan, primary school students typically learn in a bilingual (Kazakh and Russian) environment, where educational interactions are shaped by collectivist cultural values, strong emphasis on respect for elders, and collaborative learning practices. These factors differ from Western contexts, where EI interventions often assume a predominantly individualistic orientation and a single-language setting. To account for these differences, the multimedia intervention in this study was culturally adapted: the content included characters and storylines reflecting Kazakhstani daily life, proverbs, and moral lessons familiar

to students; all activities were available in both Kazakh and Russian; and interactive exercises encouraged group discussions and cooperative problem-solving, aligning with the collectivist pedagogical tradition. These adaptations ensured cultural and pedagogical relevance, thereby increasing the effectiveness and acceptability of the intervention among the target population. In this regard, it is feasible to adopt selective methods and techniques, which can be partially integrated and require further refinement and empirical validation.

The literature review confirms that fostering EI is a key objective of contemporary education and that multimedia technology can substantially enhance the effectiveness of educational programs in this domain. However, a comparative analysis reveals that in Central Asian countries, particularly in Kazakhstan, teachers' awareness of EI—especially among primary school educators—remains underdeveloped, and empirical research addressing EI-related issues within education is extremely limited [45, 46].

B. Related Research

In recent years, global research has increasingly focused on the effects of interactive multimedia technologies on the development of EI in primary school pupils [47]. Drigas *et al.* [48] assert that well-designed media and multimedia interventions can enhance children's emotional awareness, empathy, and emotion regulation skills, as well as increase learning motivation and academic engagement. These findings are supported by both meta-analyses on interactive technologies in education and studies of emotional learning programs [49]. Yang *et al.* [50] explored how digital game-based learning is influenced by children's trait emotional intelligence. Zarifsanaiey *et al.* [51] examined the effects of digital storytelling and group discussions on the social and emotional intelligence of female primary school pupils. Similarly, So *et al.* [52] conducted a study on primary school students' perceptions and experiences of self-regulated science learning in a multimedia-supported e-learning environment.

Herrera *et al.* [53] analyzed the emotional intelligence of Colombian primary school students in relation to gender and geographic location (rural versus urban). Karagianni and Drigas [54] investigated the use of innovative technologies for children with special educational needs, while Stalmach *et al.* [55] found that interactive activities and multimedia modules can enhance these students' emotional competence and self-regulation. Nevertheless, the authors emphasized the importance of teacher training and instructional customization for effective implementation. These findings are particularly relevant for inclusive education practices.

Based on the reviewed studies, the existing body of literature demonstrates substantial research on the relationship between multimedia technologies and emotional intelligence. However, no prior study has specifically examined the impact of interactive multimedia technologies on the development of EI among Kazakhstani primary school pupils. In this regard, the present research is of particular significance. Accordingly, the purpose of this study is to develop emotional intelligence in primary school pupils through interactive multimedia technologies and to evaluate the effectiveness of this intervention.

C. Research Questions

Q1: Does the use of interactive multimedia technologies have a statistically significant effect on the overall EI scores of primary school pupils?

Q2: Are there significant differences in post-intervention EI scores between the Experimental Group (EG) and the Control Group (CG)?

Q3: What is the effect size of the multimedia-based intervention on EI development among primary school pupils?

II. Materials and Methods

A. Data Collection and Sample

This study employed a quasi-experimental pre-test/post-test design with parallel groups [56] to collect and analyze data on the impact of interactive multimedia technologies on the development of EI among Kazakhstani primary school pupils. Two parallel fourth-grade classes in an urban school were randomly assigned to experimental and control conditions. This design was selected for the following reasons: (a) full randomization of students across groups was not feasible due to administrative and ethical constraints (students are assigned to permanent classes); (b) this approach enables the assessment of causal relationships between the use of a specially adapted multimedia complex—comprising various digital formats—and the development of EI in a natural school setting.

The research was conducted at Secondary Comprehensive School No. 69 in Shymkent, Kazakhstan. A total of 140 fourth-grade students participated in the study: 70 students in the EG and 70 in the CG. Participants' ages ranged from 9 to 10 years (M = 9.8 years), with a balanced gender distribution (69 boys and 71 girls). The sample should be considered a convenience sample drawn from a single urban school, which limits the representativeness of the findings. The assignment of intact classes rather than individual pupils ensured ecological validity but restricted full randomization, a feature inherent to quasi-experimental school-based research. The demographic characteristics of the study participants are presented in Table 2.

Table 2. Demographic characteristics of study participants

Characteristic	EG	CG	Total
Age (mean ± SD)	9.5±0.3	9.6±0.4	9.55±0.35
Gender (boys/girls)	35/35	34/36	69/71
Language of instruction (Kazakh / Russian)	60/10	58/12	118/22

B. Procedure

The entire research process was conducted between January and May 2024. The eight-week intervention (March–May 2024) was based on recent research on emotional learning and digital teaching resources. The intervention was implemented as part of literary reading classes, with the primary objective of fostering emotional development [57]. Prior to the intervention, specialized teacher training was organized to ensure that participating teachers were adequately prepared to implement the program. Prior to the study, written informed consent was obtained

from the parents of all participants, along with verbal assent from the ESP, presented in an age-appropriate and comprehensible manner. The information provided included a description of the study's objectives, the nature of the sessions, their duration, and the voluntary nature of participation.

Data confidentiality was ensured through the coding of questionnaires, separate storage of personal information from test results, and restricted access to the data, limited to the research team. A pilot stage was conducted in advance, involving 20 students from grades 3–4. Based on the pilot results, the wording of the questionnaire items and the test instructions were refined. To ensure the reliability and reproducibility of the obtained results, the study was organized in stages, maintaining procedural rigor and incorporating preliminary adaptation of the instruments to the cultural and linguistic context. The main stages of the study are presented in Table 3.

Table 3. Main stages of the research procedure

Stage	Description	Duration
Translation and adaptation	Translation of questionnaire into Kazakh, back-translation, and expert review	January 2024 (3 weeks)
Pilot testing	Testing the instrument on a small group and refining the wording	February 2024 (2 weeks)
Teacher training	Training teachers in the methodology of using multimedia technologies	March 2024 (1 week)
Intervention	Implementation of interactive sessions and EI assessment in the EG	March–May 2024 (8 weeks)
Final assessment	Re-measurement of EI in all participants immediately following the intervention	May 2024 (1 week)

C. Teacher Training

To ensure the successful implementation of the experimental program, specialized training was organized for primary school teachers involved in the EG. A total of six teachers participated in the training and subsequently conducted lessons in the experimental classes. The training was held at M. Auezov South Kazakhstan University and comprised theoretical, methodological, and technological components. It was delivered by experts in educational psychology and educational technologies.

During the training, teachers were introduced to the fundamentals of EI, methods for its development in the school environment, and the practical application of interactive multimedia materials developed within the framework of the project. These materials included animated videos, educational videos, and game-based tasks on digital platforms. The training also addressed strategies for supporting students in situations of emotional stress and conflict.

To evaluate the effectiveness of the training, an anonymous feedback questionnaire was administered, along with a short test assessing participants' understanding of EI concepts and their ability to work with the digital platforms. The content and structure of the training are presented in Table 4.

Table 4. Content of teacher training

Module	Topics and Objectives	Duration (hours)
Theoretical preparation	Concept of emotional intelligence, its components, and relevance in primary education	4
Working with multimedia	Practical training in using video materials, interactive games, and digital tasks	6
Pedagogical methods	Techniques for emotional support, engaging students, and modeling real-life situations	4

D. Intervention

To implement the EI development program for the EG, a specially adapted multimedia complex was designed and introduced, incorporating various digital formats. The CG students continued to follow the traditional curriculum.

The intervention was explicitly grounded in the ability model of emotional intelligence proposed by Mayer and Salovey [58], which distinguishes four branches: (1) perceiving emotions, (2) using emotions to facilitate thinking, (3) understanding emotions, and (4) managing emotions. Each multimedia activity was systematically designed to develop one or more of these branches. For example:

Animated clips and recognition tasks focused on Perceiving emotions by helping students identify facial expressions and tone.

Group discussions and story-based analysis promoted Understanding emotions by exploring causes, consequences, and emotional dynamics in social situations.

Interactive games requiring decision-making under emotional conditions fostered Managing emotions, as students practiced self-regulation and selecting appropriate responses.

Table 5. Content for "literary reading"

Week	Lesson theme	Multimedia component	EI development goal
1	Simple emotions in everyday life (short humorous stories)	Animated clips showing clear facial expressions	Recognize basic emotions (happiness, sadness, anger)
2	Friendship and helping others (short fables)	Interactive game: match emotions to characters	Identify others' emotions; link feelings to actions
3	Overcoming fear (adapted fairy tale)	Animation with pauses for emotional analysis	Distinguish fear from other emotions; identify triggers
4	Understanding different perspectives (comic stories)	Video lesson showing multiple viewpoints	Recognize that people feel differently in the same situation
5	Dealing with mistakes (school story)	Interactive decision-making game	Develop emotional regulation after making a mistake
6	Managing disappointment (contemporary short story)	Animated story with branching choices	Learn strategies to manage negative emotions
7	Conflicting emotions (classic children's novel excerpt)	Video + guided discussion pauses	Recognize mixed feelings; choose constructive actions
8	Empathy and moral choice (fairy tale or modern parable)	Interactive moral dilemma animation	Practice empathy; predict emotional consequences of actions

Reflective activities and scenario-based videos targeted Using emotions to facilitate thinking, enabling students to incorporate emotional information into reasoning and problem-solving.

To ensure clarity and replicability, Table 5 includes an additional column specifying the targeted EI component(s) according to Mayer and Salovey's model.

E. Data Collection Tools

To quantitatively assess the level of EI among primary school pupils, the study employed an established instrument: the Emotional Intelligence Questionnaire for Children (EIQ-C) [59–61]. In this research, the questionnaire was adapted to the cultural and linguistic context of Kazakhstan in accordance with the International Test Commission Guidelines for Translating and Adapting Tests. The adaptation process included forward translation into Kazakh and Russian, back-translation into English by independent bilingual translators, and subsequent reconciliation by a panel consisting of child psychologists and education specialists.

Linguistic and content validation of the adapted versions was conducted by a group of experts comprising faculty members from the Department of Pedagogy and practicing school psychologists. Particular attention was paid to ensuring the relevance of the wording to the developmental characteristics of 9–10-year-old students, as well as the content validity of the test items. A pilot study involving 32 students who were not part of the main sample confirmed acceptable internal consistency of the scales, with a Cronbach's alpha coefficient of 0.84 for the EIQ-C questionnaire.

The instrument was administered before and after the intervention (pre-test and post-test), enabling the identification of changes in emotional intelligence indicators resulting from the implementation of multimedia technologies.

F. Data Analysis

Table 6 presents the main data analysis methods used at various stages of the study.

Table 6. Data analysis methods used

Type of analysis	Purpose of analysis
Descriptive statistics (DS)	Characterization of the sample, baseline differences
Independent t-test	Testing equality of mean age between groups; comparison of post-test EI scores between EG and CG
Chi-square test	Testing equality of gender and language distribution
Paired-samples t-test	Assessing changes in EI indicators within groups (pre/post); evaluating improvement in individual EI components
Shapiro–Wilk test	Testing normality of distribution
Levene's test	Testing homogeneity of variances

Table 6 summarizes the statistical procedures applied to examine both the baseline equivalence of groups and the effectiveness of the intervention. Descriptive statistics provided a general overview of the sample and allowed us to identify any initial differences between groups. Inferential tests, such as the independent t-test and chi-square test, ensured that the EG and CG were comparable in terms of age, gender, and language distribution. The paired-samples t-test was crucial for detecting changes in EI indicators within groups across pre- and post-test phases, thereby highlighting the dynamics of intervention effects. Assumptions of parametric testing were systematically checked using the Shapiro–Wilk test (normality) and Levene's test (homogeneity of variance), which strengthened the reliability and validity of the results.

III. Result and Discussion

Table 7 presents a comparative overview of the demographic characteristics of participants in the EG and the CG at the baseline stage.

Referring to Table 7, statistical analysis indicated no significant differences between the EG and the CG in terms of age, gender, or language of instruction. This finding confirms the initial comparability of the samples and supports the conclusion that the groups were equivalent with respect to critical demographic variables. Therefore, any differences identified in subsequent analyses can be confidently attributed to the effects of the experimental intervention. They are not the result of pre-existing characteristics of the participants.

Table 7. Group equivalence test results

Characteristic	EG	CG	Test statistic	*p*-value
Age (mean ± SD), years	9.8 ± 0.4	9.9 ± 0.5	$t(138) = -1.05$	0.296
Gender (% girls)	50.0%	51.4%	$\chi^2(1) = 0.06$	0.81
Language of instruction (Kazakh / Russian)	85.7% / 14.3%	82.9% / 17.1%	$\chi^2(1) = 0.20$	0.65

To further verify group equivalence, additional analyses were conducted for age, gender distribution, and baseline levels of emotional intelligence prior to the intervention. The results of DS and equality tests are summarized in Table 8.

Table 8. DS and comparison of demographic indicators

Characteristic	EG	CG	Test statistic	*p*-value
Age, years (mean ± SD)	9.8 ± 0.4	9.9 ± 0.5	$t(138) = -1.05$	0.296
Gender (% girls)	50.0%	51.4%	$\chi^2(1) = 0.06$	0.81
EI score before intervention (mean ± SD)	65.3 ± 7.8	64.9 ± 8.1	$t(138) = 0.31$	0.757

Note: t — independent t-test; χ^2 — chi-square test.

The absence of significant differences in baseline indicators allows us to confidently attribute subsequent changes in EI to the intervention. Prior to applying parametric methods, the Shapiro–Wilk test was conducted to assess the normality of EI score distributions in both groups at different stages of the study. The results indicated that the distributions were approximately normal ($p > 0.05$). This finding justified the use of parametric tests. The test statistics and corresponding p-values demonstrated no significant deviations from normality. This confirms the appropriateness of parametric analysis for further data processing. The results are summarized in Table 9.

Table 9. The results of EI scores

Group	Time	W	*p*-value
EG	Pre-test	0.976	0.122
	Post-test	0.965	0.146
CG	Pre-test	0.978	0.134
	Post-test	0.969	0.098

Levene's test revealed no statistically significant differences in variances between the groups for either the pre-intervention or post-intervention EI scores ($p > 0.05$). This finding confirms the assumption of homogeneity of variances. Homogeneity is a prerequisite for applying subsequent parametric analyses. The detailed results are presented in Table 10.

A paired-samples t-test was performed to examine the within-group changes in EI from pre-test to post-test. In the EG, the analysis revealed a statistically significant increase in mean EI scores following the intervention ($p < 0.001$), accompanied by a large effect size (Cohen's $d = 1.01$). This indicates a strong impact of the multimedia-based program. Conversely, the CG demonstrated only minimal, statistically non-significant changes ($p > 0.05$). This confirms the absence of meaningful improvement without the intervention. The detailed results of the paired-samples t-tests are presented in Table 11.

Table 10. Results for equality of variances

Measure	F	*df*1	*df*2	*p*-value
EI scores (pre)	0.89	1	138	0.347
EI scores (post)	1.15	1	138	0.285

Table 11. Results for changes in EI scores within groups

Group	Pre M ± SD	Post M ± SD	*t* (df)	*p*-value	Cohen's *d*
EG	65.3 ± 7.8	73.8 ± 6.5	9.15 (69)	<0.001	1.01
CG	64.9 ± 8.1	65.7 ± 8.3	1.24 (69)	0.215	0.10

Note: *d* = Cohen's d (effect size).

A paired-samples t-test revealed a significant increase in EI scores within the EG from pre-test to post-test ($t(69) = 9.15$, $p < 0.001$, $d = 1.01$, large effect), whereas no significant change was observed in the CG ($t(69) = 1.24$, $p = 0.215$, $d = 0.10$, small effect). According to Cohen [62], values of $d \geq 0.80$ indicate a large effect.

To assess whether the observed post-intervention differences between the EG and CG were statistically significant, an independent samples t-test was conducted on post-test EI scores. The results, presented in Table 12, indicate a statistically significant difference between the two groups, with a large effect size (Cohen's d), confirming the strong impact of the multimedia-based program.

An independent-samples t-test comparing post-test EI scores between the EG and CG revealed a statistically significant difference ($t(138) = 6.43$, $p < 0.001$, $d = 1.09$, large effect). This confirms once again the strong impact of the multimedia-based intervention.

Table 12. Independent t-test for post-test scores

Group	Post-test M ± SD
EG	73.8 ± 6.5
CG	65.7 ± 8.3

To address the question of which EI components (emotion perception, understanding, and regulation) showed the greatest improvement after the intervention, component-level analyses were performed within the EG. Paired-samples t-tests indicated statistically significant gains across all three components, with the most substantial improvement observed in emotion perception. The detailed results are presented in Table 13.

Table 13. Improvement in EI components (EG)

Component	Pre-test (M ± SD)	Post-test (M ± SD)	Mean D	*t*(69)	*p*-value	Cohen's *d*
Emotion perception	21.5 ± 3.2	25.4 ± 2.9	+3.9	8.12	<0.001	0.97
Emotion understanding	22.0 ± 3.0	24.5 ± 2.8	+2.5	6.21	<0.001	0.74
Emotion regulation	21.8 ± 3.1	23.9 ± 2.7	+2.1	5.83	<0.001	0.70

The results indicate that all three EI components demonstrated statistically significant improvement following the intervention ($p < 0.001$ for all comparisons). Among these, emotion perception exhibited the largest mean difference (+3.9) and the strongest effect size (Cohen's $d = 0.97$). This suggests that the multimedia program was particularly effective in enhancing students' ability to accurately recognize and interpret emotional cues.

All EI components showed statistically significant improvement within the EG (all $p < 0.001$). The largest effect size was observed in emotion perception ($d = 0.97$, large effect). Emotion understanding and emotion regulation also showed substantial gains, with medium-to-large effect sizes ($d = 0.74$ and $d = 0.70$, respectively). These findings align with the design of the intervention, which emphasized interactive activities such as emotion recognition games and scenario-based storytelling. These activities fostered both awareness and management of emotions.

Overall, these results highlight the program's capacity to address multiple dimensions of EI. The most pronounced impact was found in perception skills, which are an essential foundation for higher-order emotional competencies.

Fig. 1 illustrates the comparison of mean EI scores in the EG and CG at both pre-test and post-test stages. The EG exhibited a substantial increase in EI scores after the intervention. By contrast, the CG demonstrated only a marginal and statistically non-significant change. This graphical representation reinforces the statistical findings. It confirms that the observed improvement in the EG can be attributed to the multimedia-based program implemented during the intervention period.

Comparison of mean EI scores between EG and CG before and after the eight-week intervention. The EG exhibited a substantial increase in EI scores from 65.3 to 73.8, while the CG showed minimal change (64.9 to 65.7).

This study provides empirical evidence that multimedia-based educational technologies constitute an effective tool for enhancing EI among primary school pupils. The findings revealed a significant improvement in EI levels within the EG following the eight-week intervention based

on the author's methodology. The large effect size underscores the statistical significance of the program. It also highlights its pedagogical relevance.

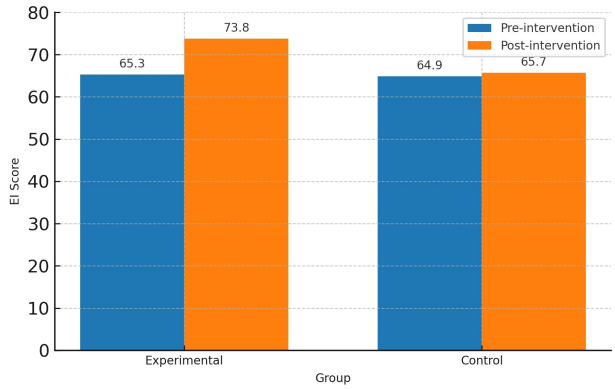

Fig. 1. Comparison of mean EI scores between EG and CG before and after the intervention.

A. Theoretical Explanation

The effectiveness of this multimedia-based approach can be explained by theories of emotional intelligence and learning. According to Mayer and Salovey's model, EI involves perceiving, understanding, and managing emotions [63]. Multimedia resources offer interactive and multisensory experiences that facilitate the recognition and regulation of emotional content. Additionally, Cognitive Load Theory suggests that well-designed multimedia reduces extraneous cognitive load, allowing pupils to focus more effectively on emotional learning [64]. In line with this, Social Learning Theory emphasizes that observing modeled emotional behaviors in multimedia can further enhance children's emotional competence [65].

B. Comparison with Previous Research

The integration of multimedia resources was found to increase learners' engagement and motivation. These are factors recognized as critical for successful learning outcomes. This result aligns with previously reported findings in the literature [66].

These findings are consistent with prior studies showing that interactive digital programs can enhance emotional and social skills in primary school children. However, effect sizes vary depending on program design and cultural context [67]. Differences between studies may be due to the level of interactivity, the use of culturally relevant content, or the combination of multimedia with other pedagogical strategies.

These findings offer valuable implications for educators and curriculum developers in designing evidence-based programs aimed at fostering emotional competence in early schooling. Furthermore, the results corroborate conclusions drawn by other scholars in similar contexts [68].

The present findings demonstrate significant improvements in students' emotional intelligence as a result of implementing interactive multimedia technologies. They are consistent with prior research in this domain [69–71].

Thus, the present study contributes to the growing body of knowledge on the application of multimedia technologies in primary education and their role in fostering children's emotional development. The findings provide empirical support for the potential of an integrated approach that combines modern technological tools with the specific characteristics of the local educational context. This creates opportunities for both theoretical advancement and practical implementation.

C. Limitations

Several limitations should be acknowledged, as they may influence the interpretation of results. These include the relatively narrow age range and limited sample size, as well as the short duration of the intervention. Additionally, the program focused exclusively on multimedia technologies. It did not integrate other pedagogical strategies. Future research should consider evaluating comprehensive approaches that combine multimedia tools with traditional teaching methods. Such integration may lead to more sustainable and profound outcomes.

It is also essential to situate these findings within the broader cultural, institutional, and policy context of Kazakhstan. The absence of a systematic framework, methodological foundation, and evidence-based practices currently constrains the effective integration of digital tools into emotional learning. This highlights the urgent need for scholarly inquiry into the potential of multimedia technologies as a means of developing emotional intelligence among elementary school pupils. By providing empirical evidence from Kazakhstani educational institutions, the present study expands scientific understanding of the possibilities offered by digital technologies for fostering emotional competence. It also suggests practical directions aligned with ongoing educational reforms.

D. Recommendations

For teachers, the findings underscore the importance of systematically incorporating interactive multimedia resources into classroom instruction to facilitate students' emotional development. This includes integrating EI elements into existing curriculum content rather than treating them as isolated activities. Teachers are encouraged to utilize digital tools that combine visual, auditory, and interactive components to create emotionally enriched learning environments that foster empathy, self-regulation, and social interaction skills.

For Educational Technology developers (EdTech), the results highlight the necessity of ensuring cultural and linguistic adaptation of digital content to local educational contexts. Additionally, priority should be given to designing user-friendly, intuitive interfaces and incorporating gamified elements that maintain learner engagement and motivation. Interactive scenarios, animated narratives, and adaptive feedback mechanisms are recommended as effective strategies to promote active participation and deeper emotional learning among elementary school students.

IV. Conclusion

This study addressed a critical and underexplored dimension of primary education by examining the impact of interactive multimedia technologies on the development of EI among primary school pupils in Kazakhstan. The findings provide empirical evidence that curriculum integration of multimedia resources significantly enhances students' emotional competencies, confirming the pedagogical value

of digital interventions in fostering self-awareness, emotion regulation, and social skills.

The results underscore the necessity of embedding modern digital tools into instructional practices and systematically preparing teachers for their effective application. These innovations not only promote academic engagement but also support the formation of essential socio-emotional skills, which are increasingly recognized as critical for holistic child development in the context of 21st-century education.

While the present research demonstrates promising outcomes, several limitations must be acknowledged, including the relatively narrow demographic scope, limited sample size, and short intervention duration. In addition, the study was conducted in a single urban school in Shymkent, which constrains the generalizability of the findings to the broader Kazakhstani context. The reliance on a self-report instrument (EIQ-C), even after adaptation and validation, may introduce subjective bias in assessing emotional competencies. Moreover, possible variations in teacher implementation could have influenced the effectiveness of the intervention.

Future studies should expand the geographic and cultural diversity of participants, adopt longitudinal designs to assess sustained effects, and explore the integration of multimedia tools with other pedagogical strategies to maximize learning outcomes.

Overall, this study contributes to the theoretical and practical discourse on emotional education by providing a robust foundation for curriculum transformation through technology-driven approaches. Its implications extend beyond Kazakhstan, offering valuable insights for global educational systems seeking to leverage interactive multimedia technologies to cultivate emotionally competent, resilient, and adaptive learners.

Ethical Considerations

Approval for this research was obtained from the Ethical Committee of the Academic Council at Abai Kazakh National Pedagogical University, Kazakhstan, on 14 October 2024 (Ref. No. 4). Since the participants were fourth-grade students, written informed consent was obtained from their parents or legal guardians prior to participation. All participants and their parents were provided with an informed consent form outlining the purpose of the study, the voluntary nature of participation, the right to withdraw at any time, and assurances of confidentiality and anonymity. Only those whose parents or guardians signed the consent form were included in the study. To ensure participant privacy, alphanumeric identifiers were used instead of names for all surveys and assessments, in compliance with data protection guidelines. These measures were implemented to guarantee full adherence to ethical research standards.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Conceptualization, GZ and GU; methodology, AZ; software, SZ; validation, OB, AK and UK; formal analysis, GZ; investigation, GU; resources, AZ; data curation, SZ; writing—original draft preparation, OB; writing—review and editing, AK; visualization, UK; supervision, GZ; project administration, GU; funding acquisition, AZ. All authors have read and agreed to the published version of the manuscript.

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