The Impact of Computer-supported Collaborative Learning on the Development of Communication Skills in Primary School Students

Zhuldyzay Amanzholova [1], Aziya Zhumabayeva [1], Meirgul Ospanbekova [2,*], Sakhipzhamal Uzakbayeva [3], Kamolakhon Abrorkhonova [4], and Askarbek Kussainov [1]

[1] Department of Primary Education, Abai Kazakh National Pedagogical University, Almaty, Kazakhstan
[2] Departament of the Educational Program of Pedagogy and Methods of Primary Education, Arkalyk Pedagogical University named after Ybyray Altynsarin, Arkalyk, Kazakhstan
[3] Department of Pedagogy and Psychology, Kazakh Ablai Khan University of International Relations and World Languages, Almaty, Kazakhstan
[4] Department of "Primary Education Pedagogy", Nizami Tashkent State Pedagogical University, Tashkent, Uzbekistan
Email: zhuli.pedagog@mail.ru (Z.A.); aziya_e@mail.ru (A.Z.); Meirgul1976@mail.ru (M.O.); sahipzhamal.a@mail.ru (S.U.); kabrorxonova@mail.ru (K.A.); kusainov_apnk@mail.ru (A.K.)
*Corresponding author
Manuscript received December 30, 2025; revised February 2, 2026; accepted February 26, 2026; published September 15, 2026

***Abstract*—The modernization of primary education in Kazakhstan, driven by digital transformation, requires the effective development of Primary School Learners' (PSLs) Communication Skills (CS). Traditional teaching methods and the limited use of Interactive Digital Instructional Strategies (IDIS) constrain opportunities to foster CS, and empirical evidence on the impact of Computer-Supported Collaborative Learning (CSCL) remains scarce. This study evaluated the effectiveness of CSCL in developing PSLs' CS using a quasi-experimental design with 124 Grade 4 students at Y. Altynsarin School-Gymnasium No. 65 in Shymkent. Over eight weeks, the Experimental Group (EG) engaged in CSCL-based learning, while the Control Group (CG) followed traditional instruction. The results showed that CSCL significantly enhanced overall CS, including structured collaboration, dialogic communication, and shared knowledge construction. These findings highlight the value of CSCL for primary teacher education and support the integration of digital collaborative technologies in multilingual classroom contexts.**

***Keywords*—communication skills, computer-supported collaborative learning, digital instructional strategies, primary education**

I. Introduction

The incorporation of Interactive Digital Instructional Strategies (IDIS) into primary education is transforming educational practices worldwide [1]. IDIS not only facilitates subject-matter knowledge acquisition but also supports the development of key competencies, with Communication Skills (CS) being particularly important [2]. Consequently, IDIS can help Primary School Learners (PSLs) improve their CS. Researchers in developed countries have proposed various strategies to foster students' CS [3].

Lev Vygotsky's work provides a foundational perspective, conceptualizing communication as a primary condition for children's personal development [4, 5]. Based on this framework, developing children's CS is a key priority in primary education, as effective communication strongly influences learning and social interaction [6, 7]. Effective communication is a complex, multifaceted activity that requires specific knowledge and skills acquired through social experience. Successful social adaptation depends on high-level CS, which also underpins the differentiation and development of mental activity in early ontogenesis. Children's interactions with adults and peers shape personal, cognitive, and regulatory behaviors, highlighting the practical importance of fostering CS from an early age.

The development of CS is a holistic and gradual process that engages PSLs in communicative activities and creates motivating environments that support self-realization. In technology-mediated educational settings, effective interaction among PSLs is increasingly recognized as a critical outcome. A meta-analysis indicates that effective communication involves not only the exchange of information but also understanding the interlocutor's emotions and intentions, expressing ideas clearly, and listening actively [8]. Key structural components of CS include empathy, activity, and evaluation [9].

Recent studies emphasize the role of interactive learning platforms, including computer-mediated communication, multimedia environments, digital collaboration tools, and online technologies [10]. These approaches make learning more engaging, flexible, and personalized, thereby fostering the development of PSLs' CS. Interactive digital classrooms enable immediate feedback, access to diverse resources, and inclusive learning, preparing PSLs for participation in the digital age.

A. Statement of the Problem

In Kazakhstan, a multi-ethnic state with over 130 ethnic groups, developing stable interethnic relations is crucial. Successful interethnic harmonization increases societal demands for effective communication and tolerance, making PSLs' CS particularly important. These skills include collaboration, active listening, clear expression of ideas, and tolerance toward diverse opinions [11].

The digital educational environment in primary schools has the potential to improve learning quality and foster students' personal growth. However, low levels of CS can hinder constructive dialogue, self-realization, and socialization in a multicultural society [12]. Despite the potential of IDIS, primary schools in Kazakhstan still rely predominantly on traditional methods [13, 14], with limited use of digital tools for meaningful peer interaction.

Systematic approaches to monitoring PSLs' CS are also

lacking, as clear diagnostic indicators and validated assessment tools have not yet been established. This gap highlights the need for empirical research on the implementation of IDIS to foster CS among PSLs using reliable instruments and controlled designs. Reviews of Kazakhstani studies (2018–2024) show few comprehensive investigations; most publications are utilitarian and applied in nature [15–19]. Therefore, modeling and testing interactive digital instructional approaches for CS development remain highly relevant.

One promising approach is Computer-Supported Collaborative Learning (CSCL) and its potential to enhance PSLs' CS. A key unresolved question is how CSCL contributes to CS development and improves learner interaction. While CSCL is known to enhance engagement in communication, its role in developing CS in primary education—especially in Kazakhstan—remains underexplored.

B. Study Purpose and Research Questions

In response to these gaps, this study examines the effectiveness of CSCL in developing PSLs' CS, focusing on learning outcomes, communicative culture, and practical application. Specifically, it aims to evaluate how CSCL fosters structured collaboration, dialogic communication, and shared knowledge construction. The study is guided by the following research questions:

Q1: What is the level of CS among PSLs before and after the intervention?

Q2: What level of CS is achieved as a result of participation in the CSCL intervention among PSLs?

Q3: What impact does CSCL have on the development and mastery of CS among PSLs?

It is hypothesized that the intervention will result in statistically significant improvements in overall CS, as measured by pre- and post-test assessments, while promoting mastery of collaboration and dialogic communication. Supplementary classroom observations and fidelity monitoring were conducted to assess instructional processes and adherence to the CSCL model.

C. Significance of the Study

This study addresses the pressing need to enhance PSLs' CS through CSCL. It responds to the gap between the recognized importance of fostering CS in digital educational environments and the limited availability of valid, reliable, and statistically robust research tools.

The study contributes to a deeper understanding of how CSCL can effectively foster CS and provides empirical evidence from Kazakhstan. Practically, the findings may inform instructional strategies that leverage CSCL to promote structured collaboration, dialogic communication, and shared knowledge construction in multilingual primary classrooms.

II. Literature Review

IDIS diversify students' CS and increase their motivation for academic achievement, social interaction, and collaborative learning. According to Garzon and Inga [20], IDIS not only improve the learning process in primary education but are also recognized as a foundational component of contemporary primary schooling. Siddiq, Scherer, and Tondeur [21] emphasize the importance of using digital educational materials, tools, and services that support CS; however, they do not fully address the potential and necessity of these tools for fostering meaningful interaction and peer collaboration.

Research by Chung *et al.* [22] indicates that developing students' CS is a complex yet essential instructional challenge that educators must address. Yi, Dong, and Qiao [23] argue that IDIS offer a promising approach to organizing communicative processes by employing active methods to support listening comprehension, oral expression, dialogic interaction, and the clear conveyance of meaning in both individual and group contexts. Consequently, the use of IDIS to organize interactive communicative activities contributes to the improvement of students' CS.

Ramirez [24] examined the impact of technology-enhanced interactive instruction, including CSCL, multimedia-based speaking activities, online discussion platforms, and digital role-playing tasks, on the development of PSLs' CS. Dhamija and Dhamija [25] explored the affordances of IDIS, highlighting features such as multimodal input, real-time feedback, flexible participation, and opportunities for repeated practice—elements that are difficult to achieve through traditional instructional methods alone. Ahmad *et al.* [26] report that IDIS enhance student engagement and classroom participation, particularly when learners collaborate on communicative tasks. Chusna, Khasanah, and Najikhah [27] similarly argue that such communicative tasks are essential for effective CS development.

Recent international studies highlight the global relevance of digital strategies for fostering PSLs' CS. For example, Álvarez, Zurita, and Carvallo [28] found that CSCL-supported multimedia tasks significantly improved oral communication and peer collaboration in multilingual classrooms. Adeshina [29] reported that platform-based role-playing and guided digital scenarios enhanced engagement and dialogic skills across diverse socio-cultural settings. Similarly, Chen, Preston, and Li [30] demonstrated that text-based CSCL and shared digital concept maps strengthened students' ability to plan, negotiate meaning, and co-construct knowledge in small-group interactions.

While these studies confirm the potential of IDIS and CSCL for CS development, several limitations remain. Most interventions are short-term, often lack standardized and validated assessment tools, and examine only limited communicative dimensions. Furthermore, few studies systematically integrate CSCL into the primary school curriculum, particularly in multilingual or multicultural classrooms [31]. These gaps limit the generalizability of findings and leave unanswered questions about which instructional features most effectively support sustained CS development.

Collectively, these limitations highlight the need for research that (i) implements structured, curriculum-aligned CSCL interventions, (ii) employs validated instruments to measure multiple dimensions of CS, and (iii) examines longer-term effects in authentic classroom settings, as addressed in the present study.

III. Materials and Methods

This study employed a quasi-experimental, non-equivalent control group design [32, 33], selected to examine the effects of CSCL on the development of CS among PSLs in an authentic classroom setting. This design allowed for the application of appropriate statistical analyses while maintaining ecological validity within the constraints of the school environment.

A. Participants

The study was conducted at Y. Altynsarin School-Gymnasium No. 65 in Shymkent, Kazakhstan. The sample included 124 Grade 4 students (aged 9–10 years) from two intact classes (see Table 1). Class 4A (n = 62) was assigned to the Experimental Group (EG), while Class 4B (n = 62) served as the Control Group (CG). Intact classes were used to preserve the natural instructional setting and minimize disruption.

Written informed consent was obtained from parents or legal guardians. Participant characteristics are presented in Table 1.

Table 1. Participant characteristics

Characteristic		EG (n = 62)	CG (n = 62)	Total (n = 124)
Age	(years, Mean ± SD)	9.48 ± 0.51	9.52 ± 0.49	9.50 ± 0.50
Gender	Male	31 (50.0%)	30 (48.4%)	61 (49.2%)
	Female	31 (50.0%)	32 (51.6%)	63 (50.8%)
Previous academic achievement	High	18 (29.0%)	17 (27.4%)	35 (28.2%)
	Medium	34 (54.8%)	36 (58.1%)	70 (56.5%)
	Low	10 (16.2%)	9 (14.5%)	19 (15.3%)

To control for baseline academic differences between the groups, students' prior academic achievement was categorized based on their end-of-term grades in the Kazakh language from the semester preceding the intervention. These grades were obtained from official school records and reflected students' overall performance in language-related competencies, including speaking, listening, reading, and writing.

In accordance with school assessment guidelines, students were classified as high-, medium-, or low-achieving based on established grade thresholds. This procedure ensured that the EG and CG were comparable in terms of prior language achievement before the intervention. The distribution of achievement levels did not differ significantly between the groups, supporting baseline equivalence.

B. Experimental Manipulation and Research Procedures

The study was conducted over an eight-week period at the beginning of the 2025 academic year. The intervention was implemented during 32 Kazakh language lessons (four lessons per week). The experimental manipulation was fully integrated into the regular instructional process and conducted during scheduled classroom hours, thereby ensuring ecological validity.

Both the EG and the CG followed the same institutional curriculum, timetable, and assessment requirements. The key distinction between the groups was the instructional approach. The intervention implemented in the EG replaced traditional instructional practices, allowing the observed effects to be attributed to the specific features of the CSCL-based intervention rather than to differences in instructional time, content coverage, or curricular objectives.

C. Teacher Training Program

CSCL instruction was implemented in Kazakh language lessons, and a targeted pre-intervention teacher training program was conducted prior to the start of the study. The training consisted of two sessions (totaling 3 hours) and included detailed instructional guidelines, lesson templates for Kazakh language instruction, and sample tasks aligned with CSCL principles.

The primary objective of the training was to ensure consistent and methodologically sound implementation of CSCL in the EG. Teachers completed structured training modules focusing on (i) the theoretical foundations of CSCL and (ii) the use of digital platforms to facilitate collaborative interaction, as well as (iii) the design and implementation of technology-mediated communicative tasks in Kazakh language lessons and (iv) strategies for providing formative feedback through digital tools.

Throughout the training period, regular meetings were held to address implementation-related issues and to ensure fidelity to the instructional design.

D. Intervention

The instructional intervention was implemented within the Kazakh language curriculum. CS occupy a central position among the key competencies defining the educational profile of PSLs. They are particularly significant, as they form the foundation of learners' overall educational activity. A distinctive feature of the CSCL-based approach in Kazakh language lessons is its dual role: it explicitly supports the development of CS while also serving as a learning tool that fosters speech skills and communicative abilities in conditions that closely approximate authentic communication.

The EG and the CG differed with respect to instructional format, interaction structure, and the use of learning tools. In the EG, instruction was organized using a technology-enhanced CSCL approach. Students worked in small heterogeneous groups of four, formed based on prior academic achievement and communicative ability. Collaborative activities were supported through digital tools, including tablet-based collaborative workspaces and shared multimedia resources. Group interaction was primarily synchronous and face-to-face, while technology was used to structure tasks, support joint attention, and document group outcomes.

CSCL tasks required students to jointly plan, discuss, and produce oral responses, including collaborative role-plays, picture-based discussions, and problem-solving dialogues. The teacher acted as a facilitator, providing structured prompts, guiding questions, and scaffolding strategies to support productive peer interaction. Group outputs consisted

of jointly constructed oral performances, which were either presented to the class or recorded for subsequent reflection. In contrast, the CG received traditional instruction consistent with regular classroom practice (see Fig. 1).

Fig. 1 presents the main components and instructional logic of the CSCL-based intervention.

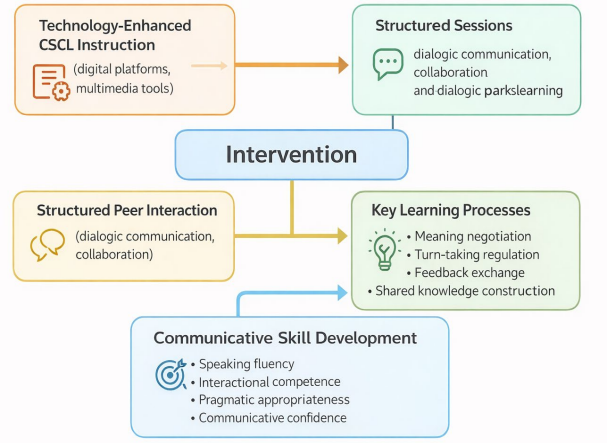

Fig. 1. Main components and instructional logic of the CSCL-based intervention.

Table 2 presents the CSCL activities implemented within the Kazakh language subject.

Table 2. Weekly CSCL intervention plan for the EG

Week	CSCL activities and digital affordances
1	Pair interaction supported by digital task cards containing scripted prompts and visual cues; prompts required alternating speaker roles and joint completion of short oral exchanges.
2	Text-based collaboration using shared digital documents and concept-mapping tools, enabling simultaneous input, visual linking of ideas, and peer discussion around jointly constructed content.
3	Platform-supported role-play with guided digital scenarios, where students followed role-specific instructions displayed on shared screens and provided structured peer feedback using embedded comment functions.
4	Digitally mediated problem-based group tasks, requiring groups to negotiate solutions and record collective oral responses using shared multimedia workspaces.
5	Multimedia speaking and listening tasks combining short audio/video stimuli with peer-response prompts that required explanation, clarification, and follow-up questions.
6	CSCL roundtable speaking via shared digital whiteboards, where each student contributed sequentially to a jointly constructed oral text supported by visual planning cues.
7	Integrated CSCL activities using online quizzes with collaborative discussion modes, prompting groups to justify answers orally before submitting a shared response.
8	Digital group projects culminating in platform-based oral presentations supported by shared slides and structured reflective peer feedback forms.

Across all CSCL activities, digital tools were selected not merely as delivery media but as interaction-structuring mechanisms. Shared digital workspaces required students to co-construct a single group product, thereby necessitating negotiation, turn-taking, and mutual clarification. Task interfaces provided role-based prompts and visual scaffolds that guided participation and reduced the likelihood of individual dominance. In several activities, sequential contribution formats and shared editing spaces implicitly regulated turn-taking, while peer feedback functions encouraged reflective dialogue.

These affordances transformed technology into an active mediator of collaboration rather than a passive instructional tool, making the CSCL instructional logic transparent and replicable.

E. Instruments and Measures

All instruments were developed by the authors and adapted to the developmental characteristics of PSLs and the educational context of Kazakhstan (see Table 3).

Table 3. Research instruments and groups involved

Instrument	Group
Oral communication assessment (analytic rubric)	EG, CG
Classroom observation checklists	EG, CG
Digital interaction records	EG
Fidelity checklists	EG, CG

All communicative assessment tasks were administered within the Kazakh language curriculum and aligned with its stated communicative objectives (see Tables A1 and A2 in Appendix).

F. Validity and Reliability of the Analytic Rubric

The analytic rubric used to assess students' CS was developed based on established theoretical models of communicative competence and aligned with the objectives of the Kazakh language curriculum.

To ensure content validity, the rubric was reviewed by a panel of five experts, including specialists in primary education, educational technology, CSCL research, and an experienced primary school teacher. Minor revisions were made based on their feedback.

Prior to the main study, the rubric and associated assessment tasks were pilot tested with a comparable group of 28 Grade 4 students from the same school who did not participate in the intervention. The pilot study confirmed the feasibility of the tasks and the clarity of rubric descriptors for classroom implementation.

To establish inter-rater reliability, two trained raters independently scored a randomly selected subset of 30% of pre- and post-test oral performances. The raters participated in structured training and calibration sessions, during which the rubric, scoring criteria, and benchmark samples from pilot recordings were discussed to ensure consistency in interpretation. All performance samples were anonymized, and raters were blinded to students' group assignment (EG/CG) and assessment phase (pre-test/post-test).

Reliability analysis was conducted using the Intraclass Correlation Coefficient (ICC; two-way random-effects model, absolute agreement), yielding values ranging from 0.82 to 0.89, indicating good to excellent inter-rater reliability. Minor discrepancies were resolved by averaging the two ratings, which is a standard procedure in analytic performance assessment.

G. Rater Training and Scoring Procedures

Students' oral performances were assessed by two independent raters with professional backgrounds in primary language education. Prior to the main scoring phase, both raters participated in a structured training and calibration session, during which the analytic rubric, scoring criteria, and benchmark samples from pilot recordings were reviewed to ensure a shared understanding of performance levels.

Practice scoring was conducted using sample recordings not included in the study dataset, and discrepancies were discussed until consensus on rubric interpretation was

reached.

To reduce potential bias, all oral performance samples were anonymized, and raters were blinded to students' group assignment (experimental or control) and assessment phase (pre-test or post-test).

Each student completed four representative speaking tasks aligned with the communicative objectives of the Kazakh language curriculum: guided pair dialogue, picture-based oral description, role-play, and collaborative problem-solving talk. All performances were evaluated using the analytic rubric.

For reliability analysis, a randomly selected subset of 30% of the performances was independently scored by both raters. In cases of minor scoring discrepancies, final scores were obtained by averaging the two ratings, a commonly accepted procedure in analytic performance assessment.

H. Data Analysis Methods

Table 4 summarizes the data analysis procedures. Given the quasi-experimental design with intact classes, the equivalence of the EG and CG was examined prior to the intervention. Independent-samples t-tests on pre-test CS measures revealed no statistically significant differences between the groups ($p > 0.05$ across all dimensions), confirming initial group comparability.

Table 4. Data analysis methods

RQ	Statistical analysis
RQ1	Paired-samples t-test (within-group pre–post)
RQ2	Independent-samples t-test
RQ3	ANCOVA; effect sizes; between-group comparisons
Supplementary	Descriptive and comparative analysis
Fidelity	Fidelity analysis

IV. Result

Table 5 presents pre-test descriptive statistics for CS. The EG and CG demonstrated comparable levels across all dimensions, confirming initial group equivalence.

Table 5. Pre-test descriptive statistics for CS

CS Dimension	EG Mean ± SD	CG Mean ± SD
Speaking fluency	2.81 ± 0.54	2.78 ± 0.57
Interactional competence	2.74 ± 0.56	2.71 ± 0.55
Pragmatic appropriateness	2.69 ± 0.52	2.66 ± 0.50
Communicative confidence	2.77 ± 0.58	2.75 ± 0.56
Overall CS	2.75 ± 0.47	2.73 ± 0.48

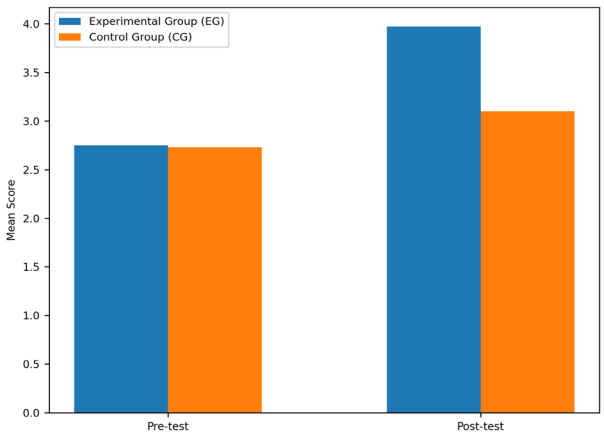

Fig. 2. Mean CS scores (pre- and post-test).

Post-test analysis revealed that the EG outperformed the CG across all CS dimensions. Tables 6–8 and Fig. 2 summarize these results.

Table 6. Post-test descriptive statistics for CS

CS Dimension	EG Mean ± SD	CG Mean ± SD
Speaking fluency	4.01 ± 0.49	3.12 ± 0.55
Interactional competence	3.94 ± 0.52	3.08 ± 0.53
Pragmatic appropriateness	3.88 ± 0.50	3.05 ± 0.51
Communicative confidence	4.06 ± 0.47	3.15 ± 0.54
Overall CS	3.97 ± 0.44	3.10 ± 0.49

Mean CS scores for the EG and CG before and after the intervention indicate that the EG exhibited substantially greater improvements in CS compared to the CG.

Analysis of gain scores (see Table 7) further confirmed that the EG achieved significantly higher improvements in CS than the CG across all dimensions.

Table 7. Pre- to post-test gain scores in CS

Dimension	EG Mean Gain	CG Mean Gain
Speaking fluency	+1.20	+0.34
Interactional competence	+1.20	+0.37
Pragmatic appropriateness	+1.19	+0.39
Communicative confidence	+1.29	+0.40
Overall gain	+1.22	+0.37

Table 8. Post-test inferential analysis

Measure	Test statistic	*p*-value
Overall CS	$t = 9.87$	<0.001
Speaking fluency	$t = 8.94$	<0.001
Interactional competence	$t = 8.61$	<0.001
Pragmatic appropriateness	$t = 8.27$	<0.001
Communicative confidence	$t = 9.12$	<0.001

The post-test inferential analysis revealed statistically significant differences ($p < 0.001$) across all CS dimensions, favoring the EG. Between-group effect sizes were large (Cohen's $d = 1.87$; $\eta^2 = 0.44$), indicating strong practical significance.

Classroom observation and fidelity data (see Table 9) indicated higher levels of active peer interaction, dialogic communication, student turn-taking, and formative feedback in the EG compared to the CG. Fidelity indicators confirmed consistent implementation of both instructional approaches.

Table 9. Summary of descriptive observation and fidelity data

Indicator	EG (%)	CG (%)
Active peer interaction	86%	42%
Dialogic communication	82%	39%
Student turn-taking	79%	44%
Ongoing formative feedback	88%	46%
Adherence to instructional model	91%	93%

The EG demonstrated consistently higher CS scores, greater pre–post improvements, and more active engagement in classroom communication compared to the CG. These findings support the effectiveness of the CSCL-based intervention in fostering CS among PSLs.

V. Discussion

The present study examined the development of PSLs CS and evaluated the impact of a CSCL intervention within Kazakh language instruction. The findings provide robust evidence that structured, technology-enhanced collaborative activities can significantly enhance multiple dimensions of CS, including speaking fluency, interactional competence, pragmatic appropriateness, and communicative confidence [34, 35].

While both groups demonstrated improvement, the modest

gains observed in the CG warrant closer examination. Traditional instruction, although aligned with curricular objectives, relied primarily on teacher-led explanations, whole-class questioning, and individual student responses. Such instructional formats typically provide limited opportunities for sustained peer interaction, uneven participation, and minimal scaffolding for collaborative dialogue. As a result, learners—particularly less confident speakers—may remain passive participants, receiving fewer opportunities to rehearse language, negotiate meaning, and obtain immediate formative feedback during communicative tasks.

In contrast, the CSCL-based approach addressed these pedagogical limitations by embedding communication within structured collaborative activities supported by digital tools. Visual and multimedia scaffolding, shared digital workspaces, and guided prompts helped externalize thinking, reduce cognitive load, and support planning and turn-taking during interaction [36, 37]. Importantly, technology-mediated collaboration created more equitable participation conditions, ensuring that all learners actively contributed to group tasks rather than relying on a small number of dominant speakers. These features help explain the substantially greater gains observed in the EG across all CS dimensions.

Consistent with socio-constructivist learning theories, the findings indicate that CSCL promotes active engagement, dialogic interaction, and joint knowledge construction [38, 39]. Learners in the EG not only achieved higher post-test scores but also demonstrated stronger pre–post development, suggesting that communication skills are best fostered when learners are positioned as active co-constructors of meaning rather than passive recipients of instruction. Classroom observations further revealed increased learner confidence, autonomy, and willingness to engage in peer dialogue—outcomes that were far less evident under traditional instructional conditions.

These results align with international research emphasizing the pedagogical affordances of CSCL. For example, Shamsi and Bozorgian [40] reported that multimedia-supported collaborative tasks enhanced oral interaction by providing visual cues and shared reference points. Van Hoe *et al.* [41] demonstrated that platform-based role-playing and guided digital scenarios increased dialogic competence by structuring interaction and feedback. Similarly, Nielsen *et al.* [42] found that shared digital concept maps supported planning, negotiation, and collective meaning-making among primary learners. Collectively, these studies reinforce the argument that it is not technology per se, but the pedagogically structured use of digital tools for collaboration, that drives improvements in communication skills [43–45].

The findings also have clear practical implications. For teachers, the study highlights the importance of designing communicative tasks that incorporate explicit interaction structures, visual scaffolds, and opportunities for formative peer feedback. For schools, integrating CSCL-oriented activities into the curriculum can create consistent conditions for meaningful communication practice. At the policy level, investment in teacher training and access to collaborative digital platforms can support the systematic development of communication and other 21st-century skills in primary education.

Overall, this study demonstrates that CSCL provides not only a statistically effective but also a pedagogically grounded approach to communication skill development. By addressing key limitations of traditional instruction—such as limited interaction, uneven participation, and insufficient scaffolding—CSCL offers a scalable and evidence-based framework for enhancing communication competence in primary education, particularly in multilingual and digitally evolving learning contexts.

A. Limitations and Future Research Directions

This study examined the influence of CSCL on the development of PSLs CS in the context of Kazakhstan. While the findings provide valuable insights into the potential benefits of CSCL in primary education, several limitations should be acknowledged.

First, the sample was limited to two intact Grade 4 classes, which may restrict the generalizability of the findings to other schools, grade levels, or cultural contexts. Second, the intervention was conducted over a relatively short period of eight weeks; therefore, the long-term effects of CSCL on CS development remain unknown. Third, although the study employed an author-developed analytic rubric with established validity and reliability, further research is needed to continue validating the assessment instrument and to examine the sustainability of CS gains over time.

Future research should address these limitations by (i) implementing CSCL interventions with larger and more diverse samples to enhance generalizability, (ii) examining the effects of longer-term interventions across different subjects and grade levels, (iii) investigating the specific contribution of individual CSCL components to learning outcomes, and (iv) exploring learners' perceptions and experiences with IDIS in varied educational contexts. These directions will help deepen understanding of how CSCL can effectively foster CS in primary education across diverse settings.

VI. Conclusion

This study investigated the development of PSLs CS and evaluated the effects of a CSCL intervention within Kazakh language education. The findings demonstrate that speaking fluency, interactional competence, pragmatic appropriateness, and communicative confidence are key dimensions of PSLs' CS.

The results indicate that CSCL can be effectively integrated into the regular curriculum, enhancing both expressive and receptive communication skills through structured collaborative activities. Compared to traditional instruction, CSCL significantly improved learners' CS, promoting active engagement, dialogic interaction, and shared knowledge construction.

Overall, this study provides empirical evidence supporting CSCL as an effective digital instructional strategy for fostering CS in primary education, particularly in multilingual or linguistically diverse contexts. The findings contribute to the broader understanding of how interactive digital approaches can enhance communication outcomes, offering practical implications for teachers, schools, and

policymakers seeking to implement technology-enhanced collaborative learning in primary classrooms.

APPENDIX

Table A1. CS assessment tasks and classroom observation checklist

Item	Scale / Format
Guided pair dialogue	Pair work
Picture-based oral description	Individual / Pair
Role-play task	Pair work
Collaborative problem-solving talk	Small group
Opinion-sharing prompt	Pair / Group
Use of digital tools	Yes / Partly / No
Peer interaction	Yes / Partly / No
Dialogic communication	Yes / Partly / No
Teacher facilitation	Yes / Partly / No
Feedback practices	Yes / Partly / No

Table A2. Student engagement checklist and CS analytic rubric

Section	Dimension	Description	Scale
Engagement	Turn-taking	Students follow conversational norms	✓ / ✗
Engagement	Participation	Most students actively participate	✓ / ✗
Engagement	Collaboration	Students support peers and work toward shared goals	✓ / ✗
Engagement	Communicative confidence	Students demonstrate willingness to participate in speaking activities	✓ / ✗
CS rubric	Speaking fluency	Smoothness and clarity of speech	✓ / ✗
CS rubric	Interactional competence	Ability to initiate and sustain interaction	✓ / ✗
CS rubric	Pragmatic appropriateness	Context-appropriate language use	✓ / ✗
CS rubric	Communicative confidence	Confidence and readiness to speak	✓ / ✗

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

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

REFERENCES

[1] F. Gabriel *et al.,* "Digital education strategies around the world: practices and policies," *Irish Educational Studies,* vol. 41, no. 1, pp. 85–106, 2022. doi: 10.1080/03323315.2021.2022513

[2] I. A. Romadhon *et al.,* "Classroom teacher strategies for fostering digital literacy awareness in elementary students: A literature review," *Journal of Innovation and Research in Primary Education*, vol. 4, no. 3, pp. 966–976, 2025. doi: 10.56916/jirpe.v4i3.1597

[3] G. Rabab'ah, "The effect of communication strategy training on the development of EFL learners' strategic competence and oral communicative ability," *Journal of psycholinguistic research*, vol. 45, no. 3, pp. 625–651, 2016. doi: 10.1007/s10936-015-9365-3

[4] M. I. Sinaga, B. Sinaga, and E. Napitupulu, "Analysis of students' mathematical communication ability in the application of Vygotsky's theory at high school level," *Budapest International Research and Critics in Linguistics and Education (BirLE) Journal*, vol. 4, no. 1, pp. 132–144, 2021. doi: 10.33258/birle.v4i1.15667

[5] A. Syomwene, "Vygotsky's social development and interaction theory: Implications to the teaching of the English language curriculum in Kenya," *European Journal of Education Studies,* vol. 1, no. 2, pp.150–158, 2016. doi: 10.46827/ejes.v0i0.52

[6] S. Abildina *et al.*, "Enhancing reading literacy among elementary school learners in Kazakhstan: The application and effectiveness of modern teaching techniques," *Journal of Infrastructure Policy and Development,* vol. 8, no. 8, 5905, 2024. doi: 10.24294/jipd.v8i8.590

[7] G. Kurebayeva *et al.*, "From tradition to innovation: Pre-service teachers' perceptions of digital transformation in language learning," *Forum for Linguistic Studies,* vol. 7, no. 3, pp. 351–361, Mar. 2025. doi:10.30564/fls.v7i3.8768

[8] B. M. Kyaw *et al.,* "Effectiveness of digital education on communication skills among medical students: systematic review and meta-analysis by the digital health education collaboration," *Journal of medical Internet research,* vol. 21, no. 8, 2019. doi: 10.2196/12967

[9] D. Son *et al.,* "Communication skills training and the conceptual structure of empathy among medical students," *Perspectives on medical education,* vol. 7, no. 4, pp. 264–271, 2018. doi: 10.1007/s40037-018-0431-z

[10] M. Z. Yao and R. Ling, "'What is computer-mediated communication?'—An introduction to the special issue," *Journal of Computer-Mediated Communication*, vol. 25, no. 1, pp. 4–8, 2020. doi: 10.1093/jcmc/zmz027

[11] Z. Zhumabayeva *et al.,* "Enhancing teaching skills through digital feedback in microteaching: A Study with prospective primary teachers," *International Journal of Information and Education Technology,* vol. 15, no. 9, pp. 1820–1828, 2025. doi: 10.18178/ijiet.2025.15.9.2383

[12] S. Nurgaliyeva *et al.,* "Evaluating student satisfaction of terminological apparatus with natural and mathematical textbooks in Kazakhstani schools," *Cogent Education,* vol. 12, no. 1, 2468563, 2025. doi: 10.1080/2331186X

[13] A. Sadreimova et al., "Teacher Perceptions of Neuroeducation: A Survey of Teachers in Kazakhstan," *TEM Journal,* vol. 15, no.1, pp. 611-619, 2026. doi: 10.18421/TEM151-57

[14] A. Syzdykbayeva *et al.,* "Development of the Digital Communication Culture of Prospective Teachers Based on Digital Etiquette Training in the Context of Kazakhstan," *Journal of Education and e-Learning Research*, vol. 12, no. 3, pp. 542–552, 2025. doi: 10.20448/jeelr.v12i3.7415

[15] T. Kulgildinova *et al.,* "The influence of an adaptive non-formal education model on student learning activity and engagement," *International Journal of Modern Education and Computer Science*, vol. 17, no. 5, 2025. doi: 10.5815/ijmecs.2025.05.06

[16] Z. Karibaev *et al.,* "Subjective well-being of students with disabilities in Kazakhstan: An exploration of practice," *Journal of Curriculum Studies Research*, vol. 6, no. 2, pp. 88–103, 2024. doi: 10.46303/jcsr.2024.12

[17] Y. Ospankulov *et al*., "Using physical education lessons to develop the autonomy of primary school children," *Cypriot Journal of Educational Sciences,* vol. 17, no. 2, pp. 601–614, 2022. doi: 10.35940/ijitee.A9152.119119

[18] S. Nurgaliyeva *et al*., "Kazakhstan's universities: Global challenges and local duties improving education quality", *International Journal of Evaluation and Research in Education,* vol. 14, no. 1, pp. 768–776, 2025. doi: 10.11591/ijere.v14i1.31852

[19] G. Ayapbergenova *et al.,* "Developing project skills in future prımary school teachers within the university-based initial teacher education," *Science for Education Today*, vol.10, no. 6, pp. 7–26, 2020. doi: 10.15293/2658-6762.2006.01

[20] P. Garzon and E. Inga, "Advancing primary education through active teaching methods and ICT for increasing knowledge," *Sustainability*, vol. 15, no. 12, 2023. doi: 10.3390/su15129551

[21] F. Siddiq, R. Scherer, and J. Tondeur, "Teachers' emphasis on developing students' digital information and communication skills (TEDDICS): A new construct in 21st century education," *Computers & Education*, vol. 92, pp. 1–14, 2016. doi: 10.1016/j.compedu.2015.10.006

[22] Y. Chung *et al.*, "Enhancing students' communication skills in the science classroom through socioscientific issues," *International Journal of Science and Mathematics Education*, vol. 14, no. 1, pp. 1–27, 2016. doi: 10.1007/s10763-014-9557-6

[23] Q. Yi, Z. Dong and H. Qiao, "Enhancing EFL listening and speaking skills: Strategies and practice for implementing multimedia and

multi-modal approaches," *Journal of Humanities, Arts and Social Science*, vol. 8, no. 9, 2024. doi: 10.26855/jhass.2024.09.032
[24] H. J. M. Ramirez, "Facilitating computer-supported collaborative learning with question-asking scripting activity and its effects on students' conceptual understanding and critical thinking in science," *International Journal of Innovation in Science and Mathematics Education*, vol. 29, no. 1, 2021. doi: 10.30722/IJISME.29.01.003
[25] A. Dhamija and D. Dhamija, "Impact of innovative and interactive instructional strategies on student classroom participation," *Handbook of Research on Digital Learning*, pp. 20–37, 2020. doi: 10.4018/978-1-5225-9304-1.ch002
[26] N. A. Ahmad *et al.*, "Effectiveness of instructional strategies designed for older adults in learning digital technologies: A systematic literature review," *SN Computer Science*, vol. 3, no. 2, 130, 2022. doi: 10.1007/s42979-022-01016-0
[27] N. L. U. Chusna, U. Khasanah, and F. Najikhah, "Interactive digital media for learning in primary schools," *Asian Pendidikan*, vol. 4, no. 2, pp. 72–78, Nov. 2024. doi: 10.53797/aspen.v4i2.10.2024
[28] C. Álvarez, G. Zurita, and A. Carvallo, "Analyzing peer influence in ethical judgment: Collaborative ranking in a case-based scenario," in *Proc. International Conference on Collaboration Technologies and Social Computing*, 2023, vol. 14199, pp. 19–35, Springer, Cham. doi: 10.1007/978-3-031-42141-9_2
[29] A. E. Adeshina, "The transformative role of digital resources in teaching and learning," *Open Journal of Educational Development*, vol. 5, no. 1, pp. 1–9, 2024. doi: 10.52417/ojed.v5i1.520
[30] Y. Chen, J. C. Preston, and Y. Li, "Enhancing collaboration and critical thinking in CSCL environments: The interplay between team dynamics and pedagogical innovation," *International Journal of e-Collaboration (IJeC)*, vol. 21, no. 1, pp. 1–24, 2025. doi: 10.4018/IJeC.376010
[31] T. Rahman, "Review of local research and glocal perspectives in English language teaching: Teaching in changing times," *Technology in Language Teaching & Learning*, vol. 5, no. 1, pp. 33–36, 2023. doi: 10.29140/tltl.v5n1.1047
[32] P. Krishnan, "A review of the non-equivalent control group post-test-only design," *Nurse Researcher*, vol. 33, no. 2, 2025. doi: 10.7748/nr.2018.e1582
[33] S. L. Siedlecki, "Quasi-experimental research designs," *Clinical Nurse Specialist*, vol. 34, no. 5, pp. 198–202, 2020. doi: 10.1097/NUR.0000000000000540
[34] Y. H. Chien, "Technology-enhanced learning: An optimal CPS learning application," *Sustainability*, vol. 11, no. 16, 4415, 2019. doi: 10.3390/su11164415
[35] F. Su and D. Zou, "Technology-enhanced collaborative language learning: Theoretical foundations, technologies, and implications," *Computer Assisted Language Learning*, vol. 35, no. 8, pp. 1754–1788, 2022. doi: 10.1080/09588221.2020.1831545
[36] R. Rintaningrum, "Technology integration in English language teaching and learning: Benefits and challenges," *Cogent Education*, vol. 10, no. 1, 2023. doi: 10.1080/2331186X.2022.2164690
[37] D. Noviana, O. Rosidin, and R. Yuliana, "Development of contextual teaching and learning based audiovisual learning videos in III grade of elementary school," *Jurnal Pendidikan Dasar Nusantara*, vol. 9, no. 1, 2023. doi: 10.29407/jpdn.v9i1.19164
[38] R. Shadiev and J. Yu, "Review of research on computer-assisted language learning with a focus on intercultural education," *Computer Assisted Language Learning*, vol. 37, no. 4, pp. 841–871, 2024. doi: 10.1080/09588221.2022.2056616
[39] S. Kharroubi and A. ElMediouni, "Conceptual review: Cultivating learner autonomy through self-directed learning & self-regulated learning: A socio-constructivist exploration," *International Journal of Language and Literary Studies*, vol. 6, no. 2, pp. 276–279, June 2024. doi: 10.36892/ijlls.v6i2.1649
[40] E. Shamsi and H. Bozorgian, "Collaborative listening using multimedia through metacognitive instruction: A case study with less-skilled and more-skilled EFL learners," *Asian-Pacific Journal of Second and Foreign Language Education,* vol. 9, no. 1, 25, 2024. doi: 10.1186/s40862-023-00248-8
[41] A. Van Hoe *et al.,* "Designing dialogic peer feedback in collaborative learning: The role of Thinq Tank," *Education Sciences*, vol. 14, no. 11, 1231, 2024. doi: 10.3390/educsci14111231
[42] W. Nielsen *et al.,* "Meaning making with multiple representations: A case study of a preservice teacher creating a digital explanation," *Research in Science Education*, vol. 52, no. 3, pp. 871-890, 2022. doi: 10.1007/s11165-021-10038-2
[43] J. Chen *et al.*, "The role of collaboration, computer use, learning environments, and supporting strategies in CSCL: A meta-analysis," *Review of Educational Research*, vol. 88, no. 6, pp. 799–843, 2018. doi: 10.3102/00346543187915
[44] C. Zhu, "The effect of cultural and school factors on the implementation of CSCL," *British Journal of Educational Technology*, vol. 44, no. 3, pp. 484–501, 2013. doi: 10.1111/j.1467-8535.2012.01333.x
[45] G. Stahl and K. Hakkarainen, "Theories of CSCL," in *International Handbook of Computer-Supported Collaborative Learning*, U. Cress, C. Rosé, A. F. Wise, and J. Oshima, Eds., Springer, Cham, 2021, pp. 23–43. doi: 10.1007/978-3-030-65291-3_2