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Fostering Pre-Service Primary Teachers' Capacity to Employ an Interactive Learning Tool

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ABSTRACT: This investigation examined the efficacy of a researcher-designed course intended to bolster primary student-teachers' capabilities in leveraging interactive learning through a smart voice device Alisa, the ubiquitous physical device popular among Russian-speaking demographics. An embedded mixed design was adopted, integrating qualitative explorations within a predominantly quantitative framework. Over ten weeks, 37 pre-service elementary teachers engaged in a program structured around interactive learning principles, Alisa classroom implementation, and microteaching sessions. Eventually, the teachers-in-training demonstrated notable advancement in crafting interactive, technology-enriched lesson plans. Furthermore, there was a step up in their teaching self-efficacy, with participants expressing increased confidence in harnessing the smart speaker. Semi-structured interviews revealed three primary deterrents encountered during the intervention: troubleshooting technical expectancies, puzzling over effectively embodying Alisa into relevant activities, and the considerable time investment required for planning interactive lessons with the voice-controlled assistants. By evaluating the potential pros and cons of integrating smart speakers into education, this study sets the stage for future inquiries. The findings foreground the potential of incorporating natural conversation assistants into primary teacher education programs while also pointing to the necessity of addressing the hurdles identified herein.

Keywords: artificial intelligence, elementary school, pre-service training, smart speakers, student-teachers, voice-controlled assistants.

I. INTRODUCTION

Interactive learning, a linchpin of effective 21st-century pedagogy, is an educational approach that emphasizes active student participation and knowledge construction [1]. This approach prioritizes learner-centric environments that manifest in three key forms: learner-to-learner, learner-to-educator, and, crucially learner-content interaction [2]. While a balanced interplay of all three is ideal, this study focuses specifically on enhancing student-content interaction, a vital yet challenging aspect of effective teaching. Literature acknowledges interactive learning as a new-generation learning milieu conducive to the application of technology in education [3]. In turn, using feedback-based learning devices enables students to adapt their knowledge and skills to the real world [4] as this way of interaction instigates an internal dialogue that involves reflecting and examining the content. However, not to forget, designing engaging activities that move beyond passive absorption requires innovative pedagogical strategies and careful planning [5]. This challenge is further amplified by the burgeoning educational technology, demanding new skills and approaches from educators [6, 7]. One such technology is voice-controlled intelligent personal assistants (VIPAs). These smart speakers backed by artificial intelligence (AI) produce voice feedback on the spot [8], afford customized learning opportunities [9], and scaffold complex concepts [10]. This is encouraging news, given that interaction along with tailored individualization and feedback are deemed cornerstones of fruitful learning [11]. Nonetheless, the potential of such technology's hinges on teachers' capacity to effectively embed them into the teaching-learning praxis.

1. PROBLEM STATEMENT AND RESEARCH QUESTIONS

Despite the escalating availability of AI-enabled educational tools, teacher education programs, particularly at the elementary level, yet fall short in preparing student-teachers for leveraging instructional models saturated with relevant technology [12 – 14]. This infers that, upon entering the role of teacher, graduates of these programs would be either acquire the skills on-the-fly, with schoolchildren as test subjects, or these novice teachers would simply not penetrate the unknown, staying in their comfort zone and depriving students of fascinating learning experiences and the potential boons of state-of-the art tools. This study seeks to address the outlined void by introducing a specially designed course for primary education student-teachers, guiding them to harness interactive learning facilitated by Alisa, a commercial VIPA. To be more specific, this capacity-building investigation is an endeavor to get hold of the answers to three research questions:

1. RQ1. How does the interactive classroom intervention affect primary education student-teachers' ability to craft interactive lesson plans?
2. RQ2. How does the interactive classroom intervention affect primary education student-teachers' teaching self-efficacy?
3. RQ3. What are the challenges encountered by student-teachers during the intervention?

In particular, this study utilizes Alisa, a leading VIPA widely adopted in Russian-speaking countries, which distinguishes itself through its localization and popularity in these regions, thereby enhancing its relevance and effectiveness in the context of this research. Alisa offers specific features and user experiences tailored to the cultural and educational landscape of Russian-speaking populations, which have not been extensively explored in earlier studies.

2. RESEARCH SIGNIFICANCE

The worth of this research lies in its potential to narrow the chasm between the blistering advancement of educational technologies and the capabilities of future educators to deploy them. By focusing on the utilization of voice-activated AI assistants, this study not only explores an innovative educational tool but also examines its implications for teaching and learning in primary education contexts. First, the integration of VIPAs in classroom settings offers a unique opportunity to boost student-content interaction, a domain that is pivotal for the cognitive development of young learners. Second, this study makes an input to the broader goal of setting up educators who can consolidate their technological and pedagogical content knowledge domains. Moreover, gleaning the roadblocks amidst the implementation of VIPAs in classrooms could inform initiatives aimed at integrating technology in vaster educational frontiers.

II. LITERATURE REVIEW

Interactivity stands as a bedrock of adequate education, profoundly impacting learners, instructors, and the very fabric of educational content. Its significance transcends delivery modes, proving essential for both traditional face-to-face instruction and the blooming scenery of online platforms [15]. Interactivity, however, is not a mere feature of a learning system or simply a cognitive process within the learner. It is a dynamic, reciprocal dance between the two. The learner's actions and responses are intrinsically linked to those of the interactive system, creating a continuous loop of engagement and feedback [16, 17]. In essence, the learner occupies the central role, forging a meaningful relationship with the learning environment to unlock the potential for truly effective learning [18]. This dynamic interaction is often facilitated by interactive learning resources, digital tools such as multimedia content and simulations, designed to actively engage students in the learning process [19]. In today's educational landscape, these interactive methods have become indispensable. They appeal to students' visual and auditory senses, fostering a more enjoyable learning experience while bolstering motivation and sustained engagement [20]. Particularly in early childhood education, cultivating an interactive learning environment that promotes high-quality learning is paramount. This necessitates focused professional development for educators, equipping them with the skills to meaningfully put technology-enhanced learning environments into practice [21]. The rapid advancement of AI and natural language processing has ushered in a new era of interactive learning possibilities, spearheaded by the intelligent personal assistants (IPAs). These systems - also referred to as voice-controlled assistants, conversational agents, virtual personal assistants, and lots more - leverage multimedia inputs to provide assistance by responding to natural language queries [22, 23]. Commercial items like Siri exemplify the potential of this technology. Moreover, the emergence of sophisticated language models has fueled the development of advanced IPAs, including empathic pedagogical conversational agents, designed to provide tailored and supportive learning experiences [24]. Smart speakers, stand-alone physical devices equipped with web connectivity and voice recognition capabilities, represent a particularly promising iteration of IPAs [25]. These wearable devices can process human speech, execute tasks based on user input, and respond with synthesized voices, creating a natural, conversational interaction that mimics human-to-human communication [26, 27].

The ubiquitous presence of smartphones and tablets has propelled the rise of speech-based inputs, reflecting the inherent efficiency and naturalness of voice interaction [28]. Within educational research, voice-based assistants have gained traction, particularly in second language learning. Studies have demonstrated their effectiveness in promoting listening and speaking skills through repeated interaction [29]. For instance, Google Assistant has been shown to provide engaging and interactive listening experiences for English as a Foreign Language (EFL) learners, fostering collaboration and adding a layer of authenticity and enjoyment to the learning process [30]. However, research also underscores the critical role of educator guidance in maximizing the benefits of technology-mediated assistance. Findings [31] indicate that sustained teacher guidance, in the form of regular feedback, better boosts EFL learners' speaking skills relative to scenarios without such support. Hence, it is worth to recognize that technology alone is not a panacea. The successful implementation of interactive learning requires a holistic approach that combines up to date technology with the expertise and guidance of educators, ensuring that the learner remains at the heart of the educational experience.

III. METHOD

1. RESEARCH DESIGN

This research employs a mixed-methods embedded design where the qualitative data collection is nested within a primarily quantitative study focused on the impact of the intervention. The interview-obtained data serves to provide a richer understanding of the quantitative findings, specifically exploring the obstacles faced during the course which may help explain the observed effects on lesson planning and self-efficacy.

2. PARTICIPANTS

The initially recruited population of this study was a total of 81 individuals studying to become generalist primary teachers. They were varying year students enrolled in the corresponding undergraduate program at the first author's entity of affiliation. The Ethical Committee of the sampled university has granted approval for this study. For recruitment, potential partakers were approached by the faculty members face-to-face in order to brief the intervention objectives and content, as well as participants' rights (including the right to bow out at any stage without disadvantage or prejudice) and what they would be asked to do (complete baseline and post-experimental evaluations, attend the intervention sessions, design lesson plans, and take part in microteaching activities). The confidentiality of the data that would be collected during the investigation was communicated to student-teachers.

Those who consented to be part of this research project were disseminated using an online randomizer to a treatment group (n = 41) supposed to complete all the intervention steps versus a no-action reference group (n = 40). However, in an intervention group, one individual was lost for pre-test and three failed to accomplish all required activities. In a control group, two persons missed a baseline measurement and four were lost for post-assessment. Thus, the eventually analyzed sample comprised 71 primary education program students (97.2% females, mean age = 19 years and four months) located in an experimental group (n = 37) and a comparison group (n = 34).

3. EXPERIMENTAL PROCEDURES

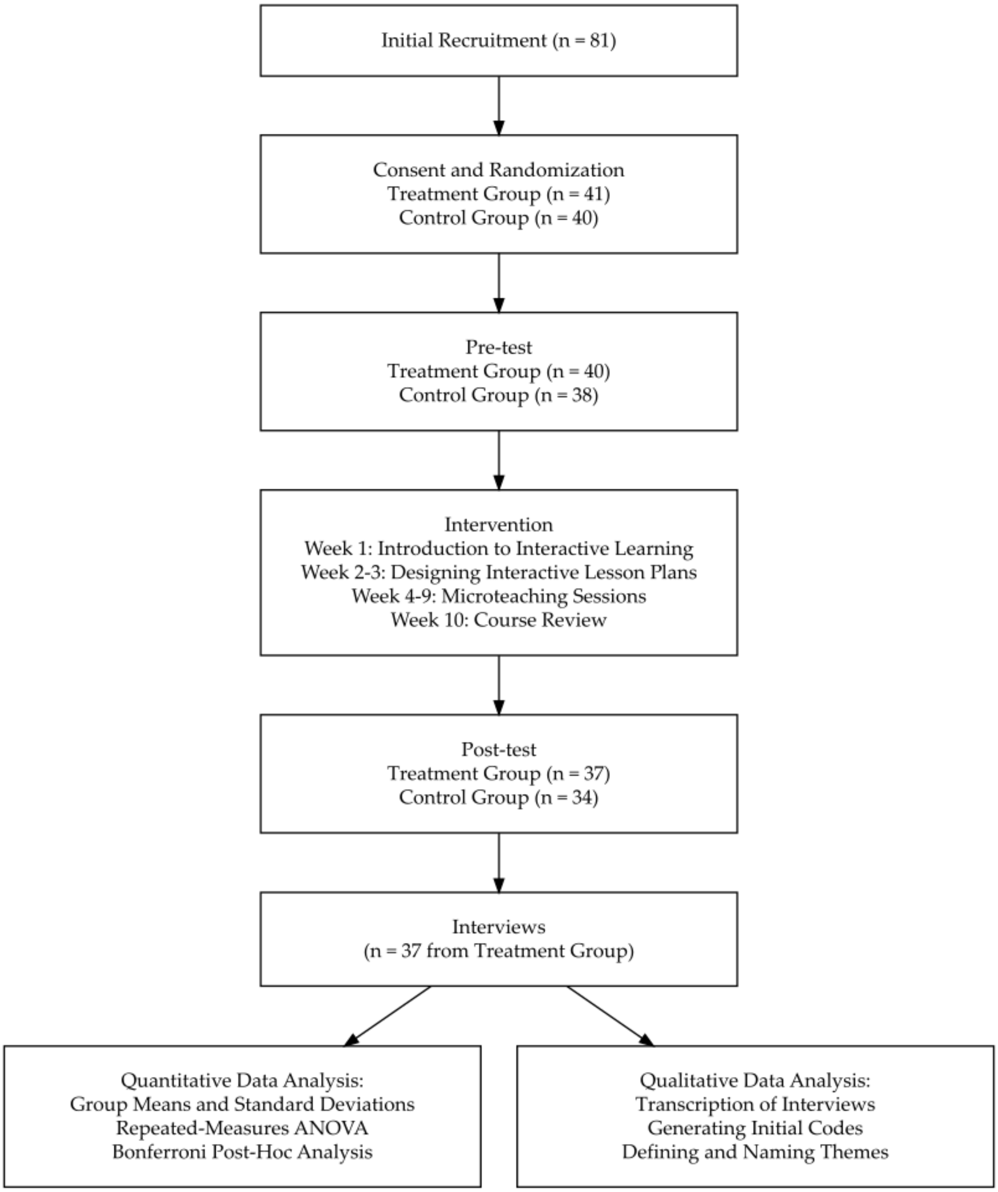

FIGURE 1. Research flowchart.

This intervention took place in Spring 2024. The course syllabus is as follows:

- Week 1:
  a. Introduction to Interactive Learning and VIPAs
  b. Introduction to interactive learning and its benefits.
  c. Discussion of the benefits and challenges of using VIPAs in teaching.
  d. Introduction to Alisa's functionalities and potential applications in primary education.
  e. Activity: Participants analyze existing lesson plans and identify opportunities for incorporating interactive elements and Alisa.
- Week 2: Designing Interactive Lesson Plans (Part 1)
  a. Principles of designing engaging and effective interactive lesson plans.
  b. Incorporating Alisa into lesson plans: Identifying appropriate points of integration.
  c. Activity: Participants begin drafting interactive lesson plans for their chosen topic.
- Week 3: Designing Interactive Lesson Plans (Part 2)
  a. Review and refinement of lesson plans.
  b. Addressing potential challenges and troubleshooting common issues.
  c. Peer feedback and collaborative lesson plan improvement.
- Week 4-9: Microteaching Sessions
  a. Each week, participants present their designed interactive mini-lessons with Alisa incorporation.
  b. Feedback from peers and instructor on teaching performance, lesson design, and Alisa integration.
- Week 10: Course Review
  a. Review of key takeaways from the course.
  b. Each session lasted about two hours and was facilitated by the second and third authors. The research process is summarized in Figure 1.

4. INSTRUMENTS

Before and after the experimental phase, student-teachers were asked to craft a lesson plan based on a case scenario describing a hypothetical elementary classroom where pupils had their individual smart speakers. As a measurement tool, two criteria (Overarching conception and Instructional strategies) with two performance indicators each were adapted from the TPACK Levels Rubric [32], piloted, and handled to the two independent raters so that they could uniformly score the documents. Each criterion was scored using a five-point scheme ranging from zero to five, depending on whether none (0.0), one (0.5-1.5-2.5-3.5-4.5) or both (1.0-2.0-3.0-4.0-5.0) performance indicators (teacher-related and student-related) were met. The mean of the two criteria-wide scores represented a total lesson plan score.

Participants' self-efficacy beliefs in performing technology-enriched lessons, statements from the composite 8-item self-efficacy scale [33] were aligned with the research topic, resulting in phrases like "I can design and implement lessons that support discovery learning using smart speakers." Participants were invited to assign each ability a degree of how much they perceive it as their case, expressed between zero and five.

To explore the troubles encountered by student-teachers during the intervention, a series of semi-structured interviews were conducted. An interview protocol was developed, consisting of open-ended questions such as "Could you describe any difficulties you faced while incorporating Alisa into your lesson plans?" The protocol was pilot-tested with two student-teachers who were not part of the study sample, leading to minor refinements in question phrasing.

5. DATA COLLECTION

Over two weeks prior to the course enactment, individual lesson plans and a questionnaire were completed in a paper-and-pencil format. Within two weeks following the completion of the 10-week course, individual interviews were conducted with 37 participants from the experimental group in parallel to quantitative data collection. Two trained interviewers from the Department of Journalism carried out the interviews to minimize potential bias, as they were not involved in the course delivery. Each interview lasted approximately 10 minutes and was conducted in a quiet room at the university. The interviews were audio-recorded with participants' consent. To ensure participant comfort and authenticity of responses, interviewers began with general questions about the course before proceeding to specific queries about roadblocks encountered.

6. VALIDITY AND RELIABILITY

Face validity and clarity of the lesson quality and self-efficacy measures were ensured during the adaptation phase when the forms were translated to Russian, followed by back-translation, iterative colloquial expertise, and a pilot administration. Both quantitative tools had Cronbach's alpha 0.74–0.91, signifying internal consistency above the minimum threshold. To ensure the trustworthiness of the interview analysis, two coders, one from the Department of Philology and one from the Department of Information Systems, independently coded 20% of the transcripts. The initial inter-rater reliability coefficient (Cohen's Kappa) was 0.83, indicating strong agreement.

7. DATA ANALYSIS

The group means and standard deviations were estimated for the results of the assessments. How much the course influenced outcomes was tested by repeated-measures analysis of variance. The factors were the intervention span, group membership, and their interaction. For pairwise comparisons, Bonferroni a posteriori analysis was run. The significance boundary was set at $p < 0.05$. The audio recordings were transcribed verbatim and analyzed using thematic analysis. The analysis followed a six-phase approach: familiarization with data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. Initial coding was conducted independently by two researchers, who then collaborated to organize codes into broader themes. The process was iterative, with researchers regularly returning to the data to refine and validate emerging themes. To protect participant privacy, pseudonyms were assigned to all interviewees, and these pseudonyms are used in reporting direct quotes.

IV. RESULTS

1. LESSON PLANNING

Regarding ANOVA assumptions, the curvature of data on the quantile-quantile plot (not shown here) suggests that residuals are normally distributed. The equality of variances was the case for both pre-existing data ($F(1, 69) = 0.653$; $p = 0.422$) and post-evaluation ($F(1, 69) = 0.356$; $p = 0.553$). Per the repeated measures analysis, the digital assistant intervention appears to be effective. While the main group effect, i.e. considering both pre- and post-tests, emerged as non-significant ($F(1, 69) = 3.435$; $p = 0.068$), there were statistically observable main effects of time ($F(1, 69) = 27.359$; $p < 0.01$) and group x time interaction ($F(1, 69) = 18.671$; $p < 0.01$).

Before this study was launched, students who were about to enter the experimental course had a non-significantly higher quality of voice assistant infusion into lesson plan (by 6.4%; Bonferroni post-hoc: $t = -0.709$, $p = 1.0$) compared to business-as-usual individuals. The latter had a negligible 2.0% increase from pre-test to post-test (Bonferroni post-hoc: $t = -0.630$, $p = 1.0$). Participants in the treatment group had a 20.2% improvement in mean post-test lesson planning score relative to baseline (Bonferroni post-hoc: $t = -6.901$, $p < 0.01$) and ended up 25.2% better at the study completion in comparison to the reference group (Bonferroni post-hoc: $t = -2.883$, $p = 0.021$). Notably, the treatment group demonstrated significant improvements in their ability to design lesson plans that incorporated the use of Alisa, particularly in terms of overarching conception and instructional strategies. Specifically, their lesson plans showed a greater emphasis on using technology to enhance student learning, with more opportunities for students to engage in inquiry tasks and make connections between ideas. Additionally, the treatment group's lesson plans demonstrated a greater focus on using instructional technology to support subject matter development, with more use of deductive and inductive instructional strategies that promoted student reflection and experimentation. Descriptives and boxplots are provided in Figure 2

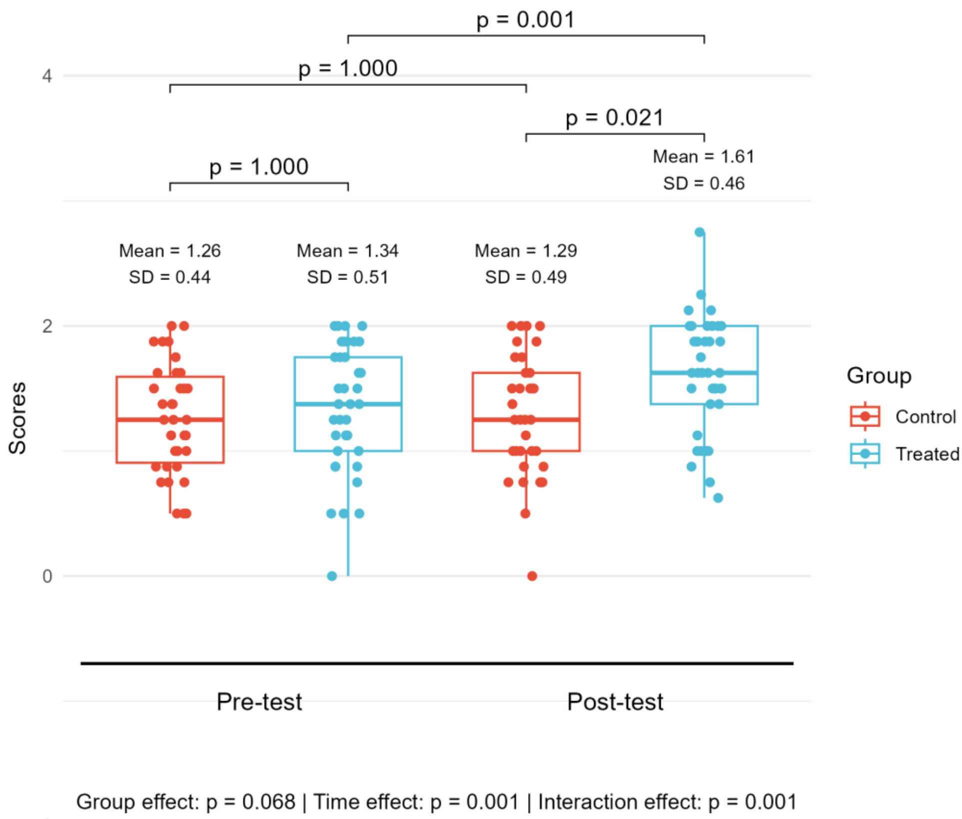

FIGURE 2. Lesson planning ability: individual scores (dots) and boxplots. P values above brackets are from post-hoc Bonferroni-adjusted t-test.

2. *TEACHER SELF-EFFICACY*

A Gaussian distribution of data was inferred. Variances were equal at pre-test ($F(1, 69) = 1.319$; $p = 0.255$) and post-test ($F(1, 69) = 1.705$; $p = 0.196$). The significant main effect of time ($F(1, 69) = 9.470$; $p < 0.01$) indicates that there was a change in teacher self-efficacy across the pre-test and post-test for at least one group. The descriptives (7.3% surge from baseline to post-experimentation) and Bonferroni-corrected post-hoc test ($t = -6.143$, $p < 0.01$) clarify that this was the treatment group. Conversely, the no-intervention group had a 1.9% drop over the 10 weeks (Bonferroni post-hoc: $t = 1.626$, $p = 0.357$). The significant group x time interaction ($F(1, 69) = 29.432$; $p < 0.01$) confirms that the change over time differed between the two groups and that it was unlikely due to chance. However, the main group effect ($F(1, 69) = 0.021$; $p = 0.886$) signals that there was no statistically discernible intergroup contrast in terms of overall self-efficacy beliefs across both time points. Specifically, prior to the research, the treatment subjects reported 3.8% lower self-efficacy than controls (Bonferroni post-hoc: $t = 0.768$, $p = 1.0$). Afterwards, the course participants outscored their counterparts by 5.3% (Bonferroni post-hoc: $t = -1.006$, $p = 1.0$).

These results imply that the experimental manipulations yielded a shift in teacher self-efficacy within the intervention group (in particular, in their ability to design and implement technology-enriched lessons that support discovery learning using smart speakers), but it did not result in the latter perceiving their self-efficacy higher than the comparison group overall. Figure 3 illustrates the findings.

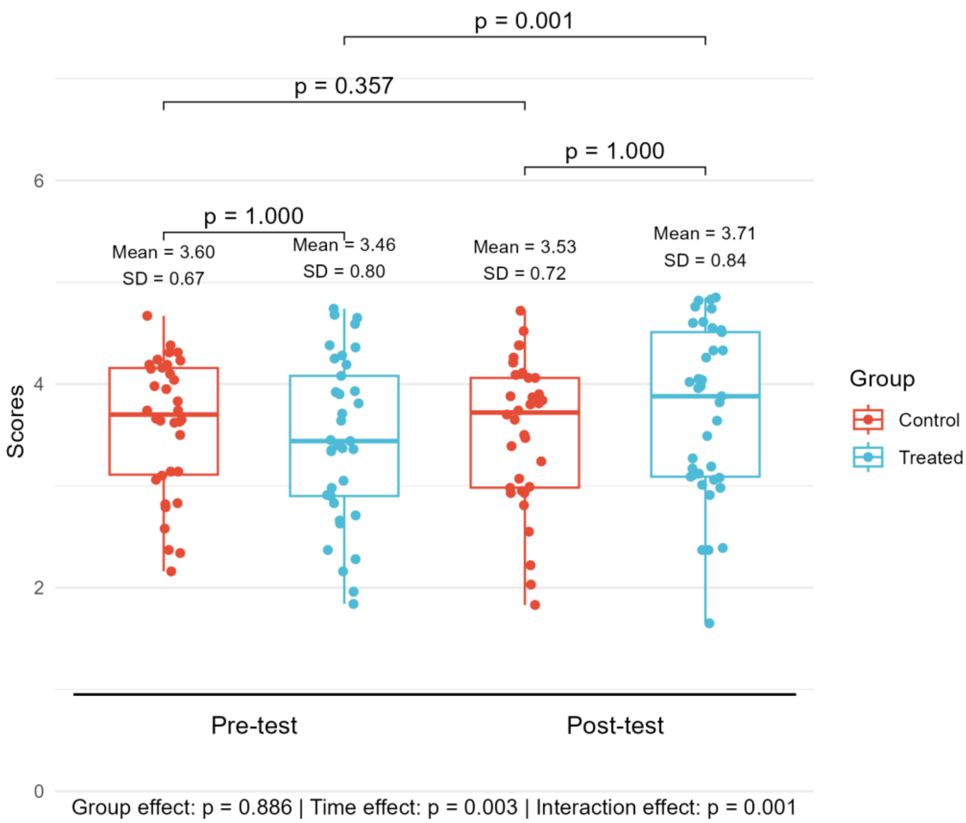

FIGURE 3. Teacher self-efficacy: individual scores (dots) and boxplots. P values above brackets are from post-hoc Bonferroni-adjusted t-test.

3. *INTERVIEWS*

The interviews unveiled three predominant challenges faced during the implementation of interactive learning with Alisa. The themes that emerged from the interviews are summarized in Table 1.

Table 1. Summary of interview-identified challenges in implementing Alisa.

Theme	Description
Technical troubleshooting	Challenges related to technical issues during lesson delivery, including Alisa's inability to understand commands, providing unrelated responses, and disrupting the lesson flow.
Pedagogically meaningful integration	Difficulties in designing lessons that meaningfully incorporate Alisa while achieving learning objectives, including struggles with creating engaging and pedagogical activities.
Time-intensive planning	Increased time commitment required for planning interactive lessons incorporating Alisa, including time spent figuring out how to fit Alisa into the lesson and testing lesson plans.

The foremost obstacle, consistently highlighted across the interviewees, was troubleshooting technical issues during lesson delivery. This concern was echoed by numerous participants, as exemplified by one respondent who articulated: “Sometimes Alisa would not understand the learners’ commands, or would provide an unrelated response, which disrupted the flow of the lesson and frustrated both the learners and myself.” (Diana, 22 years old). Another participant expressed: “While trying to ensure Alisa responded appropriately to students’ queries, I found it challenging to maintain the lesson’s pace and keep all students engaged. Sometimes, the technology became more of a distraction than a learning tool” (Maya, 19 years old). One student-teacher remarked: “The fear of technical malfunction during a lesson created additional stress. I needed to constantly prepare backup plans in case the technology failed” (Helen, 20 years old). Echoing this sentiment, another participant added: “While I understood the potential of using Alisa to make lessons interactive, it was sometimes hard to predict how well it would engage the students or handle unexpected queries from them. There was always this uncertainty if Alisa would enhance the learning experience or if it might lead to disruptions” (Jenni, 21 years old). Another pre-service teacher elaborated on this concern: “Coordinating multiple students interacting with Alisa simultaneously proved particularly challenging. When several learners attempted to engage with the device at once, it became difficult to maintain an organized learning environment and ensure equal participation” (James, 20 years old). The second major challenge centered around the integration of Alisa into pedagogically meaningful activities. Many participants struggled with designing lessons that meaningfully incorporated the voice assistant while achieving learning objectives. As one student-teacher explained, “The initial excitement of using Alisa wore off quickly when I realized how difficult it was to create activities that were genuinely engaging and pedagogical. I often felt like I was shoehorning her into the lesson plan rather than using her to enhance learning” (Karen, 19 years old). Another participant added: “Understanding how to effectively engage students using Alisa was tougher than I anticipated. I was not sure when to let Alisa take the lead or when I should step in to guide the discussion” (Mary, 21 years old). Likewise, another participant noted: “The challenge lies in balancing traditional teaching methods with interactive technology. While Alisa offers exciting possibilities, ensuring it genuinely supports learning outcomes rather than overshadowing them proved difficult” (Kate, 22 years old).

The third notable recurring theme was the time-intensive nature of planning interactive lessons incorporating Alisa. Particularly, as one student-teacher put it, “I spent quite much time just figuring out how to fit Alisa into the lesson in a way that felt natural. I had to think about how the technology would interact with the students and the content” (Leila, 20 years old). Supporting this perspective, another interviewee shared a similar experience: “I had to not only design the lesson plans but also test them to ensure that Alisa was working correctly. This added a lot of extra time to the planning process” (Aisha, 21 years old). In summary, the interviews revealed that while student-teachers were enthusiastic about the potential of using Alisa, they faced some challenges related to technical troubleshooting, pedagogically meaningful integration, and the increased time commitment required for lesson planning. These interview responses highlight the complexities of integrating interactive learning strategies and voice-controlled assistants like Alisa into elementary education.

V. DISCUSSION

This study investigated the impact of a specialized course designed to equip primary education student-teachers with the skills to leverage interactive learning through Alisa, a commercial VIPA. Specifically, the research sought to understand how the intervention influenced their ability to design interactive lesson plans, their teaching self-efficacy, and the roadblocks they encountered during the process. The findings indicate significant improvements in lesson planning skills and self-efficacy, along with a clear delineation of the technical and pedagogical impediments faced during the integration of Alisa into educational activities. When compared to earlier research, notably the paper [21], which examined the effects of interactive tools on early childhood mathematics teachers, our findings resonate with the positive impact of integrating interactive technologies in educational settings. The authors [21] reported that professional development programs incorporating interactive digital environments significantly improved teachers’ beliefs in using such technologies to support discovery learning and computational skill acquisition. This evidence indicates a parallel in how interactive tools can positively influence teaching practices across different educational contexts. However, the current paper extends this understanding specifically to the use of voice-enabled AI tools in primary education, a domain less explored in past research. The observed improvement in lesson planning skills among the intervention group can be attributed to the structured guidance along with hands-on and minds-on experience provided by the course [34]. The iterative process of designing, presenting, and receiving feedback on interactive activities, coupled with the focused exploration of Alisa's functionalities, likely equipped student-teachers with more sophisticated instructional strategies [35]. Similarly, the increase in teaching self-efficacy may be explained by the mastery experiences gained through repeated successful implementation of Alisa in microteaching sessions [36]. This, combined with social persuasion from peers and the instructor, likely contributed to a sense of competence and confidence in using technology as a teaching aid.

1. IMPLICATIONS

This study contributes to both research and practice in meaningful ways. It offers rare empirical evidence on voice-interactive technology incorporation training for pre-service elementary teachers. A comprehensive review of existing literature, using the search string ((“personal assistant” or “smart assistant” or “smart speaker” or “voice assistant” or “intelligent assistant” or “voice-activated” or “voice-controlled”) and (“student” or “school” or “learner” or “classroom”)) across various research databases, reveals no studies specifically examining the use of VIPAs in educational settings, particularly within primary teacher training. This gap can be attributed to the relatively recent introduction of voice-activated smart devices into the consumer market, where they are primarily used for personal and domestic purposes. To our knowledge, the only documented instance of employing smart speakers in classrooms for educational purposes is the study [37] reporting how 7-12 years old schoolchildren interacted with Google Home in their classroom, yet it did not focus on teacher training or lesson planning. The paucity of similar research further underscores the novelty of our investigation and sheds light on a significant gap in understanding the potential and challenges of deploying such solutions in primary education.

Practically, the findings offer some guidance for teacher education programs aiming to integrate advanced technologies into their curricula. By addressing the identified challenges, such programs can better set up prospective educators to harness interactive tools effectively, ultimately enhancing educational outcomes in elementary classrooms. Based on the findings, it is recommended that educators who intend to incorporate VIPAs into their teaching consider (a) holding collaborative lesson planning sessions where trainees can share and refine their use of interactive technology in education, (b) planning for technical contingencies, and (c) designing lesson activities that take advantage of the interactive capabilities of VIPAs to prompt pedagogical outcomes rather than merely adding a technological layer.

VI. CONCLUSION

To resume, the current research found support from practice for the positive effects of training focused on incorporating voice-controlled devices on both interactive technology-boosted lesson planning capacity and teaching self-efficacy perceptions among elementary student-teachers. This paper stands as the first to provide empirical evidence on the topic. By addressing both the promises and pitfalls of integrating technologies like Alisa into educational contexts, this research lays the groundwork for future investigations and informs the development of more effective teacher training programs. While challenges exist, the findings suggest that with appropriate training and support, it is possible to prepare pre-service teachers for exerting the power of VIPAs to create more interactive, personalized, and effective learning experiences for young learners. Concerning limitations, the most prominent one is that the study was conducted in a controlled university setting, which may not fully replicate the complexities of a real classroom. Diversifying the populations and settings of further inquests in this domain is an obvious nostrum. An intriguing avenue for future research is to reproduce the intervention using other state-of-the-art interactive technologies. This approach would help isolate the specific effects of the intervention from those attributable to the specific technology per se.

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Author Contribution

All authors made an equal contribution to the development and planning of the study. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Data are available from the authors upon request.

Acknowledgments

Not applicable.

II. REFERENCES

1. Purwar, D., Flacke, J., & Sliuzas, R. (**2024**). Improving community understanding of cascading effects of critical infrastructure service failure: An experimental interactive learning process. *Progress in Disaster Science, 100383*.
2. Getman, A., & Pekeleu, M. (**2024**). Maximising academic achievement in online learning: The role of student-content engagement strategies and profiles. *Interactive Learning Environments*. Advance online publication.
3. Efe, H., & Topsakal, Ü. U. (**2024**). A meta-synthesis study in interactive learning environments: Digital games in health education. *Interactive Learning Environments, 32*(4), 1319–1329.
4. Roque-Hernández, R. V., López-Mendoza, A., & Salazar-Hernandez, R. (**2024**). Perceived instructor presence, interactive tools, student engagement, and satisfaction in hybrid education post-COVID-19 lockdown in Mexico. *Heliyon, 10*(6), e27342.
5. Kong, S., & Wang, Y. (**2024**). The impact of school support for professional development on teachers' adoption of student-centered pedagogy, students' cognitive learning and abilities: A three-level analysis. *Computers and Education, 215*, 105016.
6. Suparman, S., La'ia, H. T., Parinters Makur, A., Turmudi, T., Juandi, D., Helsa, Y., & Masniladevi, M. (**2024**). Development of Ucing Sumput digital game to stabilize students' achievement emotions in mathematics. *Qubahan Academic Journal, 4*(4), 156–177.
7. Nguyen, L. A. T., & Habók, A. (**2024**). Tools for assessing teacher digital literacy: A review. *Journal of Computers in Education, 11*(1), 305–346.
8. Zhang, M. (**2024**). Enhancing self-regulation and learner engagement in L2 speaking: Exploring the potential of intelligent personal assistants within a learning-oriented feedback framework. *BMC Psychology, 12*, 421.
9. Choi, S., Jang, Y., & Kim, H. (**2024**). Exploring factors influencing students' intention to use intelligent personal assistants for learning. *Interactive Learning Environments, 32*(8), 4049–4062.
10. Rad, H. S. (**2024**). Revolutionizing L2 speaking proficiency, willingness to communicate, and perceptions through artificial intelligence: A case of Speeko application. *Innovation in Language Learning and Teaching, 18*(4), 364–379.
11. Hobert, S., & Berens, F. (**2024**). Developing a digital tutor as an intermediary between students, teaching assistants, and lecturers. *Educational Technology Research and Development, 72*(2), 797–818.
12. Karlsson, G., & Nilsson, P. (**2023**). Capturing student teachers' TPACK by using T-CoRe and video-annotation as self-reflective tools for flexible learning in teacher education. *Technology Pedagogy and Education, 32*(2), 223–237.
13. Mikeska, J. N., Howell, H., & Kinsey, D. (**2023**). Inside the black box: How elementary teacher educators support preservice teachers in preparing for and learning from online simulated teaching experiences. *Teaching and Teacher Education, 122*, 103979.
14. Stumbrienė, D., Jevsikova, T., & Kontvainė, V. (**2024**). Key factors influencing teachers' motivation to transfer technology-enabled educational innovation. *Education and Information Technologies, 29*, 1697–1731.
15. Chou, C., & Wei, H. (**2024**). A tale of two formats: Graduate students' perceptions and preferences of interactivity in responsible conduct of research education. *Accountability in Research*. Advance online publication.
16. Ploetzner, R. (**2024**). The effectiveness of enhanced interaction features in educational videos: A meta-analysis. *Interactive Learning Environments, 32*(5), 1597–1612.
17. Teng, M. F. (**2024**). Metacognition and autonomy in building a community for language learning through VR digital gaming. *Computers and Education X Reality, 4*, 100060.
18. Lehikko, A., Nykänen, M., Lukander, K., Uusitalo, J., & Ruokamo, H. (**2024**). Exploring interactivity effects on learners' sense of agency, cognitive load, and learning outcomes in immersive virtual reality: A mixed methods study. *Computers and Education X Reality, 4*, 100066.

19. Hu, J., Huang, Z., Li, J., Xu, L., & Zou, Y. (**2024**). Real-time classroom behavior analysis for enhanced engineering education: An AI-assisted approach. *International Journal of Computational Intelligence Systems, 17*(1), 167.
20. Ordu, Y., Aydogan, S., & Caliskan, N. (**2024**). The effect of interactive learning method on nursing students' learning of movement requirement: A randomized controlled study. *Nurse Education Today, 137*, 106163.
21. Alsaeed, M. S., & Aladil, M. K. (**2024**). Digital and physical interactive learning environments: Early childhood mathematics teachers' beliefs about technology through reflective writing. *Education Sciences, 14*(5), 517.
22. Ardaç, H. A., & Erdoğmuş, P. (**2024**). Question answering system with text mining and deep networks. *Evolving Systems, 15*, 1787–1799.
23. König, C. M., Karrenbauer, C., & Breitner, M. H. (**2024**). Development guidelines for individual digital study assistants in higher education. *International Journal of Educational Technology in Higher Education, 21*, 9.
24. Ortega-Ochoa, E., Arguedas, M., & Daradoumis, T. (**2023**). Empathic pedagogical conversational agents: A systematic literature review. *British Journal of Educational Technology, 55*(3), 886–909.
25. Chen, H. H., Yang, C. T., & Lai, K. K. (**2020**). Investigating college EFL learners' perceptions toward the use of Google Assistant for foreign language learning. *Interactive Learning Environments, 31*(3), 1335–1350.
26. Jnr, A. B. (**2024**). Examining the use of intelligent conversational voice-assistants for improved mobility behavior of older adults in smart cities. *International Journal of Human-Computer Interaction*. Advance online publication.
27. Bräuer, P., & Mazarakis, A. (**2024**). How to design audio-gamification for language learning with Amazon Alexa? – A long-term field experiment. *International Journal of Human-Computer Interaction, 40*(9), 2343–2360.
28. Song, Y., Wong, R. C., & Zhao, X. (**2024**). Speech-to-SQL: Toward speech-driven SQL query generation from natural language question. *VLDB Journal, 33*, 1179–1201.
29. Wu, J., Li, Y., Zhou, J., & Chen, S. (**2024**). The impact of intelligent personal assistants on Mandarin second language learners: Interaction process, acquisition of listening and speaking ability. *Computer Assisted Language Learning*. Advance online publication.
30. Tai, T. Y., & Chen, H. H. J. (**2024**). The impact of intelligent personal assistants on adolescent EFL learners' listening comprehension. *Computer Assisted Language Learning, 37*(3), 433–460.
31. Yang, C. T. Y., Lai, S. L., & Chen, H. H. J. (**2024**). The impact of intelligent personal assistants on learners' autonomous learning of second language listening and speaking. *Interactive Learning Environments, 32*(5), 2175–2195.
32. Lyublinskaya, I., & Kaplon-Schilis, A. (**2022**). Analysis of differences in the levels of TPACK: Unpacking performance indicators in the TPACK Levels Rubric. *Education Sciences, 12*(2), 79.
33. Thurm, D., & Barzel, B. (**2020**). Effects of a professional development program for teaching mathematics with technology on teachers' beliefs, self-efficacy and practices. *ZDM Mathematics Education, 52*(7), 1411–1422.
34. Spaan, W., Oostdam, R., Schuitema, J., & Pijls, M. (**2024**). Analysing teacher behaviour in synthesizing hands-on and minds-on during practical work. *Research in Science and Technological Education, 42*(2), 219–236.
35. Choi, L. J. (**2024**). Pre-service English teachers' beliefs and practices in the use of digital technology: The case of a technology-enhanced teacher preparation course in South Korea. *Innovation in Language Learning and Teaching*. Advance online publication.
36. Gordon, D., Bourke, T., Mills, R., & Blundell, C. N. (**2024**). Understanding how education reform influences pre-service teachers' teacher self-efficacy. *International Journal of Educational Research Open, 7*, 100338.
37. Butler, L., & Starkey, L. (**2024**). OK Google, help me learn: An exploratory study of voice-activated artificial intelligence in the classroom. *Technology Pedagogy and Education, 33*(2), 135–148.