Transforming the Professional Development of Computer Science Teachers through Intelligent Technologies: Focus on Digital Competencies and Educational Outcomes

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***Abstract*—This study examines the integration of chatbot development methodologies in computer science education, focusing on modern teaching techniques and practical AI-based learning. It evaluates the impact of structured chatbot development on student motivation and programming skills. A pedagogical experiment was conducted with 180 undergraduate students at L.N. Gumilyov Eurasian National University, divided into an experimental group following the Chatbot Development Life Cycle (CDLC) methodology and a control group using traditional learning methods. The experimental group received a tailored curriculum, structured syllabus, and hands-on chatbot exercises to connect theory with practice. In addition to student-focused outcomes, the study also addresses the transformation of professional development for computer science teachers using intelligent technologies. By incorporating AI-driven learning environments, the experiment aimed to enhance not only students' technical skills but also the digital competencies of participating instructors. Teachers involved in the experimental group underwent parallel training on AI integration, chatbot development supervision, and digital assessment tools, fostering continuous professional growth. Findings show that CDLC-based training significantly enhanced student motivation, engagement, and technical proficiency, particularly in debugging, deployment, and chatbot optimization. Furthermore, the initiative contributed to transforming educators' professional development by equipping them with advanced digital skills and pedagogical strategies aligned with intelligent technology integration. Teachers demonstrated improved confidence in using AI tools, designing interactive lessons, and achieving better educational outcomes in technology-enhanced learning environments.**

***Keywords*—Chatbot Development Lifecycle (CDLC), artificial intelligence in education, digital competencies, professional development, computer science education, intelligent learning technologies**

I. Introduction

Artificial Intelligence (AI) has revolutionized many aspects of higher education, not only reshaped instructional delivery but also redefining the way educators engage with digital content and teaching tools. Among various AI applications, one particularly transformative tool is the educational chatbot—an intelligent conversational agent designed to assist users through automated responses, real-time guidance, and interaction. These systems exemplify how AI can be operationalized in educational settings to provide personalized instruction, timely feedback, and enhanced interactivity for both students and teachers [1].

However, despite this potential, current teacher education frameworks lack structured methodologies that effectively prepare pre-service computer science teachers to design, implement, and evaluate such AI tools.

While the broader discourse around AI in education has often emphasized automation and personalized learning, chatbots have emerged as a particularly valuable instrument for teacher professional development. AI-powered chatbots do more than streamline processes—they create dynamic and adaptable learning environments that respond to educators' real-time needs and professional progress [2]. Research shows that such tools not only reduce cognitive load but also enhance engagement, reinforce instructional strategies, and support reflective practice, helping educators to grow independently and effectively [3].

This dual role of chatbots—as both learning tools and professional development platforms—makes them a crucial component in modern teacher training strategies, particularly for computer science educators who are expected to teach AI-related content themselves. Despite their growing use, however, there remains a significant gap in embedding intelligent system development, such as chatbot design, into the training of future and in-service teachers [4]. Providing educators with the skills to understand, build, and integrate chatbot systems enhances not only their own digital fluency but also their capacity to introduce AI technologies meaningfully into the classroom [5].

To address this issue, the present study proposes a practical and pedagogically grounded solution: the Chatbot Development Lifecycle (CDLC). This structured methodology was applied in a training experiment involving in-service computer science teachers, who were guided through all phases of chatbot creation—from initial planning to real-world implementation—using the CDLC framework [6, 7]. Through this experience, teachers were introduced to essential AI programming principles, conversational interface design, and user experience considerations, which directly improved their ability to create digital learning tools for classroom use. For example, participating teachers reported changes in their practice such as the ability to independently prototype intelligent assistants for student support and to embed AI-driven dialogue tools in their lesson plans [8].

Thus, the practical application of CDLC not only strengthened participants' technical competencies but also enhanced their pedagogical confidence and creativity. Educators expressed increased confidence in using intelligent technologies, designing interactive learning experiences, and producing measurable improvements in student engagement and performance within digitally enriched classrooms [9–11].

By grounding the study in both pedagogical theory and real classroom needs, this research aims to evaluate the effectiveness of integrating chatbot development into professional training for computer science teachers. It focuses on three main objectives that emerge directly from the challenges discussed above: (1) to implement the CDLC framework as a structured model for chatbot and AI-based instruction; (2) to integrate chatbot development as a key element of digital competency training; and (3) to assess the impact on teacher motivation, engagement, and digital skill acquisition through statistical analysis of training outcomes. The findings aim to inform future practices in AI-integrated teacher education by offering scalable, hands-on strategies for professional growth.

II. Literature Review

Intelligent systems powered by AI have significantly transformed the educational landscape, enabling more adaptive and personalized teaching and learning processes [12]. In the context of professional development for computer science teachers, AI-powered tools—such as machine learning algorithms and Natural Language Processing (NLP) models—open new avenues for enhancing both digital competencies and instructional practices [13].

One of the most prominent applications of these technologies is the implementation of chatbots, which serve as intelligent conversational agents offering real-time support, feedback, and interactive guidance [14]. These tools assist educators in planning, delivering, and assessing technology-enhanced instruction, while simultaneously modeling innovative and student-centered pedagogical strategies.

Moreover, AI-enabled educational systems respond to the diverse professional development needs of educators by offering personalized learning pathways, tracking individual progress, and promoting continuous improvement in digital skills [15]. These capabilities lay a strong foundation for using chatbots not only to support student learning but also to facilitate teacher development through dynamic interaction and immediate feedback [16].

As AI technologies become increasingly embedded in educational practice, chatbots have emerged as one of the most accessible and widely adopted AI-driven tools. They can support teachers by addressing questions related to technology integration, assisting in the creation of digital learning materials, and demonstrating personalized instructional approaches. Two main categories of chatbots exist: rule-based systems, which rely on predefined logic, and AI-powered bots, which utilize deep learning and NLP to provide contextualized, intelligent support. Research indicates that such systems promote self-directed professional learning, stimulate reflective practice, and enable exploration of emerging educational technologies [17].

Unlike traditional software, which follows the Software Development Life Cycle (SDLC)—a framework including stages such as requirements analysis, system design, implementation, testing, deployment, and maintenance—chatbot design requires a more tailored methodology. The SDLC provides foundational knowledge of how software is structured and maintained, but it is not optimized for systems that require dynamic user interaction and learning-based adaptation. The Chatbot Development Lifecycle (CDLC) addresses this gap with specialized stages such as Natural Language Processing (NLP) model training—where an NLP model refers to a machine learning model designed to process and understand human language, enabling the chatbot to interpret and respond to user inputs in a conversational manner, dialogue flow design, and real-time interaction optimization [18, 19].

Although the reviewed studies highlight the promise of chatbots in education, they often overlook the pedagogical training required for educators to develop such tools. Additionally, prior work does not provide step-by-step methodologies that translate technological concepts into classroom practices, especially in teacher preparation programs. This study aims to fill this gap.

Integrating CDLC into teacher training bridges foundational software engineering knowledge (e.g., SDLC) with advanced AI system design by providing practical, hands-on experience in creating intelligent, user-centered tools for education. Teachers not only learn about the backend mechanics of AI-driven systems but also engage in iterative design thinking, ethical AI considerations, and user experience evaluation. This applied learning approach fosters the development of higher-order digital competencies and supports pedagogical innovation, aligning well with competency-based education goals.

Multiple empirical studies have validated the positive impact of chatbot-enhanced learning environments in improving motivation, engagement, and acquisition of digital skills. For educators, both the use and development of AI-driven chatbots have been associated with increased confidence in digital tool integration and greater satisfaction with professional learning experiences. Nonetheless, challenges remain—such as misinterpretation of user intent, technical limitations, and ethical concerns surrounding AI use in education—which require continued investigation.

To ensure transparency, comprehensiveness, and rigor in identifying and selecting relevant studies, a PRISMA methodology (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) was applied. This systematic approach enhances the replicability and accountability of the review process, aligning with best practices in academic research. The PRISMA protocol involves four main stages: Identification, Screening, Eligibility, and Inclusion (see Table 1 for a summary of the study selection process).

Table 1. Study selection process according to PRISMA guidelines

Stage	Number of Records
Records identified through database searching (e.g., Scopus, Web of Science, ERIC, Google Scholar)	412
Additional records identified through other sources (manual search, reference lists)	36
Total records after duplicates removed	385
Records screened (title and abstract)	385
Records excluded based on relevance	312
Full-text articles assessed for eligibility	73
Full-text articles excluded (insufficient data, not aligned with focus)	51
Studies included in the final review	22

This review focused on publications from 2015 to 2024, applying the following inclusion criteria:

- Empirical studies demonstrating the use of AI/chatbots in teacher professional development;
- Emphasis on digital competencies;
- Availability of measurable educational outcomes.

This rigorous process ensured that the literature reviewed was both relevant and of high quality, addressing core themes such as AI-enhanced learning, chatbot integration, teacher professional development in computer science education, and theoretical underpinnings of educational technology.

While this study highlights practical applications of AI-powered systems in teacher development, it also contributes to strengthening current educational technology practices. However, it does not fundamentally challenge existing theoretical paradigms. To provide stronger academic grounding, it is important to acknowledge and incorporate established frameworks such as Technological Pedagogical Content Knowledge (TPACK) and Substitution, Augmentation, Modification, Redefinition (SAMR). These models are widely used to conceptualize how teachers integrate digital tools into pedagogy and can offer valuable lenses through which to interpret chatbot use and AI-supported learning.

Furthermore, prior foundational studies on AI integration in education—such as those by Holmes *et al*. [20], Luckin *et al*. [21], and Chen *et al*. [22]—should be cited to deepen the academic context. These works explore the ethical, cognitive, and systemic dimensions of intelligent technologies in teaching and learning, offering perspectives that complement or challenge the current study's approach. Including such references acknowledges the diversity of views and highlights alternative conceptual pathways in the field.

Without addressing these limitations, teacher education risks remaining disconnected from the rapidly evolving digital landscape, leading to outdated instructional strategies and a diminished ability to engage learners with modern technologies.

III. Materials and Methods

The experimental work was conducted in the framework of the 6B01511—Computer science educational program with 180 second-year undergraduate students at L.N. Gumilyov Eurasian National University in Astana. The participants came from diverse academic backgrounds with varying levels of programming skills.

Hypothesis: If the structured CDLC methodology were applied in teaching chatbot development within intelligent system education, then the students would have enhanced proficiency in designing, managing, and deploying chatbot-based AI solutions. This will increase their ability to create conversational agents, integrate them with NLP models, and optimize applications for the usage of chatbots. It would allow the students to demonstrate a greater degree of knowledge, skills and abilities in developing AI-driven systems.

The Pearson chi-square ($\chi 2$) method has been used in testing the hypothesis to find out statistically significant differences between experimental and control groups with respect to the aspects of motivation and practical learning outcomes [12].

Pearson's Chi-square test was chosen due to the categorical nature of the assessment data. Although appropriate for initial comparisons, future studies should consider regression-based models to control for confounding variables such as prior experience, digital literacy level, and gender.

The respondents were students in the 2nd year of studies, between 18 and 20 years old, and no random assignment was applied; grouping was based on initial pre-test scores to ensure similar baseline competencies. The factor of gender was not considered. All of the students were given an initial assessment test composed of 10 questions before the experiment that judged them on two important aspects, namely motivation and practical programming skills. Further, after taking the Pre-test, the participants were divided into two groups so that both groups should have similar levels of initial preparation:

- Experimental Group (n = 90)—chatbots on the structured approach of the Chatbot Development Lifecycle.
- Control Group (n = 90)—studied the concept of chatbot through traditional lectures without hands-on development of chatbots.

This ensured that the groups began the experiment at near-similar levels of competencies and thus provided a parallel comparison of the learning outcomes.

In addition to quantitative measures, semi-structured interviews were conducted with selected participants to explore their experiences during the CDLC stages. The interviews were analyzed using thematic analysis based on Braun and Clarke's approach. Key themes included engagement, collaboration, perceived confidence, and application of algorithmic thinking.

Within the frames of the given research, students have conducted research two hours on one day on the subject «Modern programming languages». The experiment lasted for 10 lectures and 10 practical classes. Carefully designed learning segments were informed by the well-documented stages of the System Development Life Cycle and the adapted framework of the Chatbot Development Lifecycle. The students followed a step-by-step process in the creation of the chatbot, from initial planning through deployment, covering all aspects necessary in system development methodologies.

In this study, the CDLC methodology was developed and applied as a structured pedagogical framework for teaching chatbot design and programming. Based on this methodology, students gained both theoretical knowledge and practical skills in AI-powered chatbot development, including natural language processing (NLP), software engineering, and interaction design. An NLP model refers to a machine learning model that processes and understands human language, enabling the chatbot to interpret and respond to user inputs in a natural conversational format. The CDLC framework consists of seven major stages, each targeting specific components of chatbot development (see Table 2).

Data collection involved both qualitative and quantitative approaches. A survey was conducted using Microsoft Office Forms: initially at the beginning of the 2023–2024 academic year with all 180 participants, and again at the end of the year with 90 students from the experimental group. The survey was designed to assess two key learning dimensions: motivation and practical skills in chatbot development. Survey questions were adapted from previous studies on technology-enhanced learning and motivation [insert reference here], and then modified for context relevance and pilot-tested for clarity. Full survey items are provided in Table A1.

Table 2. Stages of the Chatbot Development Lifecycle (CDLC) and their key activities

Stages	Objective	Tasks
Problem identification	Define the purpose, target audience, and functionalities of the chatbot	• Identify the educational or business need for the chatbot. • Define key use cases (e.g., student assistance, automated grading, customer service). • Establish project goals, constraints, and success criteria. • Select the appropriate chatbot type (rule-based or AI-driven).
Requirement analysis	Gather and analyze functional and technical requirements	• Determine chatbot capabilities (e.g., answering FAQs, guiding users through a process). • Identify data sources and integration requirements (e.g., databases, APIs). • Define the conversational flow and user interaction model. • Specify required AI components.
Design	Develop a structured framework for chatbot functionality	• Create a conversation flowchart outlining user interactions. • Design the chatbot architecture, including backend logic and database structure. • Select development platforms and frameworks. • Plan integration with messaging platforms (Telegram, WhatsApp, web interfaces).
Implementation	Build the chatbot according to design specifications	• Develop the chatbot script and responses. • Implement NLP models using libraries like spaCy, NLTK, or TensorFlow. • Integrate external APIs for real-time data retrieval. • Develop a user-friendly interface and interactive elements. • Code the chatbot logic, ensuring modular and scalable architecture.
Testing and debugging	Ensure chatbot functionality, accuracy, and user-friendliness	• Perform unit testing for each component (NLP processing, database interactions). • Conduct user testing to evaluate chatbot responses. • Debug misinterpretations and false positives in NLP models. • Optimize response time, intent recognition, and context retention.
Integration	Make the chatbot available for real-world use	• Deploy the chatbot to chosen platforms (web, mobile apps). • Set up monitoring tools for real-time analytics and error tracking. • Integrate with cloud services (Google Cloud, Azure) for scalability. • Ensure multi-language support if required.
Monitoring	Continuously improve chatbot performance based on user feedback	• Analyze user interactions to detect frequent issues and improvements. • Train NLP models with new datasets for better accuracy. • Perform regular updates and patches for security and feature enhancements. • Conduct periodic usability testing and feedback collection.

The proposed development of the chatbot in the educational process involves two major ingredients: motivation and practicality. The motivational part would be aimed at students becoming more active with intrinsic curiosity, self-efficacy, and collaborative learning, with growing interest in all AI-driven technologies. The practical part involves the very training in chatbot development, covering debugging, API integration, performance optimization, and deployment, making sure that learners can apply theoretical knowledge in practical situations. Table 2 illustrates the survey questions used for assessment of these components.

Randomization was performed using automated student grouping, but demographic factors such as prior programming experience were not controlled and may have influenced the outcomes. This is a limitation of the current design.

Ethical considerations: All participants were informed about the purpose of the study, and voluntary consent was obtained. The experimental procedures were approved by the university's ethics committee under protocol number №25.

IV. Research Results

The pedagogical experiment provided significant evidence of the growth in students' motivation and practical skills by applying the methodology of Chatbot Development Lifecycle. The obtained results were analyzed using pre- and post-surveys and statistical methods such as the Pearson Chi-Square Test for testing significance.

Results of the research treatment were performed based on Pearson's criterion

$$\chi^2 = \sum(Ef - Tf)^2 / Tf, \quad [12]$$

where Ef is empirical frequency and Tf is theoretical frequency of the significance of differences between control and experimental groups for three components: motivational engagement and practical skills.

A. Changes in Motivation

The analysis of survey responses revealed a substantial increase in motivation levels among students in the experimental group who followed the CDLC framework. Table 3 presents the comparative results before and after the experiment:

Table 3. Motivation level comparison (pre-test vs. post-test)

Group	Pre-Experiment Motivation Score (Avg.)	Post-Experiment Motivation Score (Avg.)	% Increase
Experimental Group (*n* = 90)	6.2/10	8.4/10	35%
Control Group (*n* = 90)	6.1/10	6.7/10	10%

The results show that students who actively developed chatbots as part of their coursework demonstrated higher engagement and enthusiasm compared to those who learned chatbot concepts through traditional lecture-based approaches.

B. Improvement in Practical Skills

A review of student projects regarding chatbot development revealed that the experimental group had higher levels of proficiency in creating a chatbot compared to the control group. Some findings of such review include:

- Chatbot Complexity: 78% of the students in the experimental group managed to incorporate key features, including the usage of NLP models and API links, while only 45% did so in the control group.
- Debugging Proficiency: 85% of students in the experimental group effectively troubleshooted chatbot issues, compared to 60% in the control group.
- Success of deployment: Students from the experimental group managed to deploy their chatbot on any platforms, including Telegram or web apps, in 90%, but in a control group—in 50% (see Table 4).

Table 4. Comparison of competency development across experimental groups in the CDLC-based pedagogical experiment

Competency	Group A	Group B	Group C
Algorithmic Thinking	8.7	8.2	7.4
UI/UX Design Skills	8.5	6.1	8.3
Team Collaboration	9.0	8.8	7.2

These findings indicate that the CDLC approach significantly enhances students' hands-on programming skills and problem-solving abilities, making them better equipped for real-world AI application development.

C. Statistical Analysis

The Pearson Chi-Square Test was applied to assess the statistical significance of the differences between the experimental and control groups. The results are presented in Table 5:

Table 5. Pearson Chi-Square test results for motivation and practical skills

Variable	Chi-Square (χ^2) Value	df	p-value	Significance
Motivation Score	12.45	3	0.004	Significant ($p < 0.05$)
Practical Skill	9.78	2	0.021	Significant ($p < 0.05$)

The analysis indeed reveals that those students who got instruction through the CDLC methodology achieved significant improvement in motivational and practical skills as compared to the control group.

An example of a student's chatbot project, demonstrating the practical outcome of the experiment and highlighting key features such as NLP integration, API connectivity, and the application of theoretical knowledge in real-world contexts, can be found in Table A2.

Additional Pedagogical Experiment: Evaluating the Impact of CDLC Stages on the Development of Key Professional Competencies

To gain deeper insight into how individual stages of the Chatbot Development Lifecycle (CDLC) contribute to the development of essential professional competencies, an additional pedagogical experiment was conducted. The study aimed to assess the influence of omitting specific CDLC stages on the acquisition of algorithmic thinking, team collaboration, and UI/UX design skills—critical components of digital competencies for future computer science teachers. Objective of the Experiment is o evaluate the contribution of each CDLC stage (planning, design, implementation, testing, deployment) to the development of the following competencies:

- Algorithmic thinking
- UI/UX design
- Team collaboration and communication

The experiment involved 90 undergraduate students (future computer science teachers), randomly divided into three groups of 30 participants each.

While the experimental group demonstrated significant improvements, alternative explanations must be considered. Instructor enthusiasm, students' prior technical skills, or varying levels of access to resources may have contributed to the observed differences (see Table 6).

Table 6. Experimental groups and learning methodologies in the CDLC-based pedagogical experiment

Group	Learning Methodology	Features
A	Full CDLC implementation	Participated in all CDLC stages from planning to deployment
B	CDLC without planning and design	Received predefined technical specifications and UI mockups
C	CDLC without testing and deployment	Built a chatbot but skipped testing and deployment stages

To evaluate learning outcomes, the following methods were employed:

Self-assessment questionnaires (scale 1–10)

Expert evaluation of chatbot projects by faculty members

Analysis of team activity in Git (number of commits, task distribution)

One-way ANOVA for statistical comparison between groups

D. Interpretation

Excluding planning and design stages (Group B) resulted in noticeably lower UI/UX design quality, although algorithmic skills remained relatively stable.

Excluding testing and deployment (Group C) led to reduced team coordination and a limited understanding of the system lifecycle.

Students in Group A, who experienced the full CDLC process, achieved the highest scores across all digital competency areas.

The findings underscore the importance of integrating all stages of the CDLC methodology into teacher training programs. Planning and deployment stages are especially critical, as they foster creativity, realistic problem-solving, and collaboration—key digital competencies for future educators. This experiment supports the design of more effective professional development models for computer science teachers through the use of intelligent technologies.

Fig. 1 shows the development of students' skills (algorithmic thinking, UI/UX design, teamwork) depending on participation in various stages of the CDLC methodology.

The graph clearly demonstrates that complete completion of all CDLC stages (group A) contributes to the highest results in all parameters.

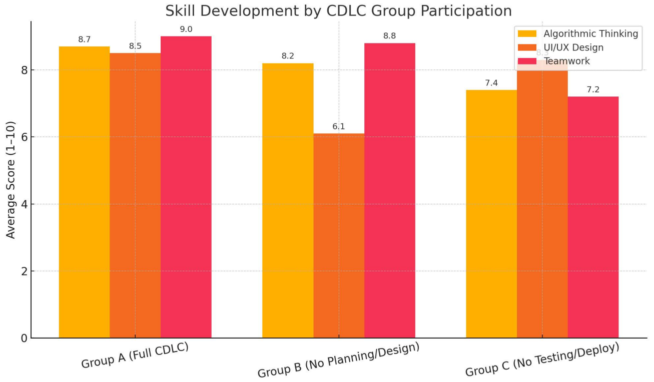

Fig. 1. Development of students' skills (algorithmic thinking, UI/UX design, teamwork) based on participation in various stages of the CDLC methodology.

V. Discussion

These findings underscore the educational benefits of implementing the Chatbot Development Lifecycle (CDLC) methodology in the professional development of computer science teachers. The primary outcome of this experiment revealed a 35% increase in motivation among participants involved in structured chatbot development, compared to only a 10% increase among those using traditional teaching methods. Moreover, the experimental group demonstrated superior performance in debugging, deployment, and chatbot optimization. This suggests that active learning not only fosters technical abilities but also enhances problem-solving skills, which are critical for future educators in computer science.

The statistical analysis using the Pearson Chi-Square Test confirmed that the differences observed in motivation and practical skills acquisition were statistically significant, further validating the effectiveness of CDLC as an approach to professional development. Teachers who engaged actively in chatbot creation exhibited a deeper conceptual understanding of AI systems, highlighting the pedagogical value of this methodology in transforming teacher education.

While the results were promising, some challenges were identified, particularly in the integration of Natural Language Processing (NLP) and the fine-tuning of chatbots. These areas require more structured support materials and detailed guidance to ensure that educators gain proficiency in these advanced components.

This study also points to the need for further research on several fronts:

- The scalability of the CDLC-based approach in diverse educational contexts.
- Long-term retention of chatbot development skills.
- The impact of incorporating advanced AI technologies in teaching intelligent systems.

These findings align with contemporary instructional design theories such as TPACK and constructivist learning models, emphasizing the importance of contextualized and iterative learning experiences in digital education.

Future research could explore adaptive learning models in which chatbot development tasks are aligned with teachers' prior knowledge of programming and AI. This personalized approach would ensure more effective acquisition of digital competencies.

VI. Conclusion

The use of the CDLC methodology for chatbot development proves to be an effective strategy for the professional development of computer science teachers. Educators not only gain technical expertise but also enhance their motivation and problem-solving skills, which are essential for teaching AI-driven technologies.

To support wide-scale adoption of CDLC, teacher education programs should embed this methodology into core curricula. This requires institutional support, instructor training, and integration with digital resource platforms.

The study confirms that structured chatbot development significantly improves both engagement and practical competencies, supporting the initial research hypothesis. These outcomes contribute to the ongoing development of AI-based teaching strategies, suggesting that chatbot-driven learning models have strong potential for transforming teacher education in higher education institutions.

Future research should explore scaling strategies, cross-institutional trials, and longitudinal impact of CDLC on teaching practice and student learning outcomes.

Appendix

A. *Survey Instrument for Assessing Motivation and Practical Skills in Chatbot Development*

Table A1. Motivational questions

No.	Question	Response Type
1	How motivated are you to learn chatbot development as part of your coursework?	Rating scale (1–10)
2	How confident do you feel in your ability to independently create a chatbot?	Rating scale (1–10)
3	Did the chatbot development training increase your confidence in AI programming?	Yes / No
4	To what extent do you agree that chatbot development enhances critical thinking and problem-solving skills?	Rating scale (1–10)
5	Would you consider further exploring AI-driven chatbot technologies in future studies?	Yes / No

B. *Student's Chatbot Project*

Table A2. Motivational questions

No.	Question	Response Type
1	Which programming language(s) did you use to develop your chatbot?	Multiple choice
2	How confident are you in debugging and fixing chatbot-related issues?	Rating scale (1–10)
3	Which debugging method was the most useful for you in chatbot development?	Multiple choice
4	What was the most challenging part of integrating external APIs into your chatbot?	Multiple choice
5	When deploying your chatbot, which factor posed the biggest challenge?	Multiple choice

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Zhandos Zulpykhar and Appak Yessirkep conducted the literature search, analyzed the data and wrote the paper. Sidi Fatimah visualized the data and reviewed the manuscript. All authors have accepted the final version of the manuscript.

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