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A Conceptual Framework Highlighting Design Factors for Emotion-Aware Expert Systems in Education

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ABSTRACT

In today's classrooms, teachers are unable to give individual attention to each student, which delays timely feedback and personalized support to students. AI-based educational tools, such as Chatbots, are utilized by teachers to assist them in various routine tasks, including answering repeated student queries, preparing notes, setting test questions, and conducting quizzes. Research has shown that student emotions play a vital role in their learning. However, these tools do not consider the feelings of students in any aspect and hence, an adaptive learning environment is not available to them. To address this gap, this study proposes a conceptual framework for an emotion-aware expert system. The framework integrates a chatbot, a sentiment analysis engine and a teacher dashboard to enhance the teachers' pedagogy and the students' learning experience. Initially, a systematic literature review was conducted to identify the critical design factors required for developing a chatbot. A survey was conducted among the students and teachers to understand their perception of the design factors of an emotion-aware chatbot. The consolidated factors are used to develop the conceptual framework of the system. This framework understands learners' emotions, enhances student engagement and supports teachers in making better pedagogical decisions.

Keywords: educational chatbots, sentiment analysis, pedagogical feedback loop, expert systems in education, intelligent learning systems

Introduction

In conventional classrooms, a teacher delivers a one-hour lecture to a group of approximately 30-40 students. Teachers follow a constant teaching style and the interaction with the students is very limited. Consequently, they do not have opportunities to provide individual attention to students and to monitor students' emotions, during the learning process. Students may have diverse academic backgrounds, different learning needs and may have varying cognitive processing speeds. Many a times students may need different instructional approaches for understanding and diverse pedagogical approaches to retain the knowledge. Also, in classroom activities, students may experience different emotions like confusion, frustration, anxiety or disengagement which are often unnoticed, due to the absence of structured emotional feedback mechanisms. This results in reduced learning outcomes and diminished teaching productivity. These limitations highlight the need for innovative, AI-driven solutions to strengthen student learning and teacher effectiveness.

Artificial Intelligence (AI) is transforming conventional education settings with new forms of automation, personalised learner support and data-driven teaching strategies. A significant part of this transformation is the usage of educational chatbots. These chatbots provide immediate explanations, interactive guidance and personalised assistance during learning. Several studies have reported that educational chatbots promote student engagement, improve learning efficiency and reduce the time teachers spend on repetitive academic tasks [1],[4],[5]. Despite these advantages,

most of the chatbots do not understand the emotions behind the students' text messages and no helpful insights are generated for the teachers. Also, many design factors which are very much necessary are not given importance during development. This makes the teachers to miss the opportunities for timely pedagogical intervention and limits the potential of AI to enhance teaching productivity.

In parallel, research advancements in sentiment analysis and affective computing offer promising opportunities to detect emotions from text inputs. Also, studies have emphasized that emotion-aware systems have potential to provide contextualised support to students and enhance self-regulated learning [3],[12],[15]. However, their integration into real-time educational environment is very limited.

Simultaneously, learning analytics dashboards for teachers have emerged as important tools for educators. These dashboards help teachers to identify struggling learners, to interpret trends of student performance in various academic tasks and to make education personalised to individual students [11],[16]. Yet, these dashboards do not provide emotional insights derived from student-chatbot interactions. If emotional insights are drawn from the chatbot text messages, educators can make informed instructional decisions by adjusting teaching strategies to meet student needs and improve their learning.

This study addresses the above challenges by identifying the critical design factors required for developing an expert system that integrates personalized educational chatbot with sentiment analysis engine with a pedagogical feedback loop for teachers. The main objective of the study is to develop a conceptual framework for an expert system which integrates the three components, say, (i) Chatbots, to interact with students (ii) Sentiment Analysis Engine, to detect the sentiment. A Systematic Literature Review was conducted to explore the technological, pedagogical, sentimental and ethical factors for designing the expert system. Further, student and teacher questionnaires were developed to validate the design factors identified through the review. Based on these factors, a conceptual framework is proposed for developing an expert system integrating chatbots, sentiment analysis engine and pedagogical feedback loop. Based on the above study, three research questions were focused and the research paper is organised as follows: First, a systematic literature review is conducted, to identify the design factors for the expert system, then the identified design factors are validated with students and teachers survey, followed by the proposal of a conceptual framework for the expert system and finally, the findings are discussed in conclusion and future research directions are elaborated.

2. Literature Review

In recent years, the field of Artificial Intelligence (AI) has been integrated into education with key emerging areas of innovation like Chatbots and Sentiment analysis. This section synthesizes the scholarly evidences relevant to the design of an expert system integrating chatbots, sentiment analysis and teacher dashboards for pedagogical feedback loops. The review was organized around four domains: (1) Educational chatbots (2) Sentiment analysis and Affective computing in learning (3) Learning Analytics and Teacher dashboards and (4) Ethical, Transparency and Usability concerns in Educational AI tools.

2.1 Educational Chatbots

Recent studies show that educational chatbots improve learning efficiency of the students through understandable explanations, interactive learning and handling routine teaching tasks. It is established that AI-driven chatbots powered by Natural Language Processing (NLP) and Machine Learning (ML) provide personalized learning assistance [21]. Systematic reviews also report that

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chatbots can increase student engagement by supporting basic tutoring functions and reducing the number of repetitive questions answered by teachers [1],[4]. It is also demonstrated that chatbots capable of responding to various emotional states of students significantly improve student motivation and act as affective learning companions [22]. Empirical research reiterates that chatbot-supported learning environments improve student motivation and help students to manage and regulate their own learning [5]. However, teachers express different opinions on adopting chatbots in their classrooms. Research, with pre-service teachers, shows that many educators welcome chatbots as helpful teaching tools, but, they often feel that they lack the training to use them effectively [6]. These findings underscore the need for the chatbot systems to be technically strong as well as aligned with teaching and learning needs.

2.2 Sentiment Analysis and Affective Computing in Learning

Sentiment analysis and affective computing are becoming more important for understanding students' emotions during learning and to monitor learner engagement. Research shows that emotions such as frustration, confusion or confidence strongly affect learning outcomes and student persistence in learning [12],[13]. Modern deep learning and transformer models have improved the accuracy in emotion detection. Despite those improvements, there are problems in transparency and interpretability of the models [7],[19]. Recent study has confirmed that real-time recognition and analysis of facial expressions has enabled teachers to dynamically adjust their pedagogical strategies [23]. These studies confirm that both chatbots and real-time sentiment analysis offer a number of benefits ranging from personalized learning to enhanced student engagement. Despite their potential, a significant gap remains between the availability of these tools and their actual use in everyday teaching.

2.3 Learning Analytics and Teacher Dashboards

Learning analytics and teacher dashboards are emerging as important tools in supporting teaching and learning. The dashboards allow teachers to view student/class performance, monitor their engagement and identify students who may need additional help [11]. But, many existing dashboards do not include emotional data to understand the affective factors that influence learning [16]. Studies suggest that dashboards, instead of just providing raw numerical data, should provide specific instructional recommendations [13],[17]. Studies also highlight that the teachers must remain in control of how analytics are interpreted and used in the classroom [18]. Thus, dashboards should be based on real-time student interactions and should offer complete picture of learner needs and progress.

2.4 Ethical, Transparency and Usability concerns in Educational AI tools

The use of AI-based tools in education raises several ethical issues like data privacy, emotional safety, bias in AI-models, transparency and user consents [2],[7]. As emotion detection systems deal with sensitive information and errors in emotion classification can affect students negatively, a careful handling mechanism of AI tools is needed. Research warns that if AI models are not trained on diverse datasets especially which lacks linguistic or cultural diversity, they may inadvertently show bias [19]. Teachers need transparency and interpretability to understand how emotional insights are produced before using them for making informed decisions [10]. Usability studies show that complex interfaces reduce teacher adoption, while clear visualizations and simple workflows improve effective use of dashboards [6], [16]. Thus, careful consideration of privacy, fairness, transparency and usability is crucial for developing emotion-aware education systems.

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2.5 Research Gaps identified in the Literature

The review of literature highlights several research gaps that hinder the development of an expert system in education, integrating chatbots, sentiment analysis engine and teacher dashboards for pedagogical feedback loops. The research gaps are:

- Despite evidence of studies showing emotions strongly influence learning, educational chatbots rarely include emotional understanding.
- Sentiment analysis tools are seldom linked to teacher intervention in classrooms.
- Teacher dashboards do not include emotional analytics and do not provide actionable guidance.
- Ethical issues like fairness, privacy, transparency and interpretability remain as significant obstacles for teachers to adopt the systems.

These gaps show that there is a need for an integrated expert system that connects chatbot, sentiment analysis and teacher dashboards. The conceptual framework proposed later in this paper is designed to address these issues and make teaching and learning more effective.

3. Methodology

3.1 Research Design Overview

This study adopted a three-phase methodology to identify the critical design factors required for developing an expert system that integrates educational chatbots, sentimental analysis and teacher dashboard for pedagogical feedback loop. In the first phase, a systematic literature review was conducted, to identify the essential design factors from peer-reviewed studies published from 2018 to 2025. In the second phase, a pilot study involving undergraduate students and teachers was conducted to empirically validate the design factors identified in the previous phase. Two structured questionnaires were developed to capture the students' and teachers' perception regarding the significance and feasibility of the design factors for the development of educational chatbots. In the third phase, a conceptual framework for the expert system is proposed by integrating all the validated design factors into a unified architecture capable of real-time emotional analytics and instructional decision support.

To guide this research process, the following research questions were formulated:

RQ1: What are the design factors identified from the systematic literature review for developing an educational chatbot integrated with sentiment analysis engine and a pedagogical feedback loop?

RQ2: Do teachers and students empirically validate the same design factors identified in the systematic literature review?

RQ3: How can the validated design factors are operationalized into a conceptual expert system capable of detecting learner emotions, enhancing student engagement and supporting teachers' instructional decision-making?

3.2 Phase 1: Systematic Literature Review (SLR)

3.2.1 Sources

A systematic search was conducted across various scholarly databases which were publicly available in digital libraries like IEEE Xplore, ACM Digital Library, ScienceDirect, Scopus Web of Science, arXiv, Springer, MDPI.

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3.2.2 Search Strategy

The core search terms used to search the digital libraries were: "Educational chatbot", "AI Chatbot", Intelligent tutoring systems", "Sentiment analysis", "Affective computing", "Emotion detection", "Teacher dashboard", "Feedback loop", "Learning analytics", "Design factors", "System design", "Framework". Boolean operators like OR and AND were used to combine the core search terms. The search string was

("educational chatbot" OR "AI chatbot" OR "intelligent tutoring system") AND ("sentiment analysis" OR "affective computing" OR "emotion detection") AND ("teacher dashboard" OR "feedback loop" OR "learning analytics") AND ("design factors" OR "system design" OR "framework").

3.2.3 Inclusion and Exclusion Criteria

The peer-reviewed journal articles, conference papers and studies, published between 2018 and 2025, relating to chatbot-based learning systems combined with the studies discussing emotion detection, sentiment analysis and pedagogical feedback loops in education, were included for the SLR. The studies relating to non-AI chatbots, chatbots unrelated to education and non-English publications were excluded for the SLR.

3.2.4 Screening and Selection process

A PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) workflow was adopted. The search initially identified 312 articles across all databases. On duplicate removal, the search resulted in 247 unique articles. Against the inclusion and exclusion criteria, the titles and abstracts of the articles were screened, reducing the count to 78 studies. Detailed full-text evaluation of 78 articles resulted in 24 articles. After final quality assessment, 20 studies were retained for final synthesis.

3.2.5 Data Extraction and Coding

A data extraction table was constructed to systematically capture information from each study. The extracted information included Citation, Study Focus, Key Findings and Relevance to design factors. Using thematic synthesis approach, the findings were grouped into four design factor themes. The themes identified were: (i) Chatbot-Student interaction factors (ii) Sentiment analysis and emotion detection factors (iii) Teacher dashboard and pedagogical feedback loop factors and (iv) ethical and usability factors. These themes formed the foundation for identifying the critical design factors needed for the integrated expert system.

3.2.6 Thematic Synthesis

Theme 1: Chatbot-Student interaction factors

The first theme focused on the design principles on how educational chatbots interact with students. From the analysis, the factors considered important were increased personalization, good conversational quality, accurate real-time responses and support for self-regulated learning.

Theme 2: Sentiment analysis and emotion detection factors

The second theme focused on detection of learner emotions, sentiment analysis and affective computing. Critical design factors on this theme were: accuracy of emotion detection, transparent and explainable sentiment analysis, real-time processing and the ability to translate emotional data into meaningful insights for teachers.

Theme 3: Teacher dashboard and pedagogical feedback loop factors

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The third theme addressed the role of teacher dashboard in assisting with pedagogical feedback loops. The design factors needed for designing dashboards are: real-time visualization of emotional patterns, alerts for negative sentiments, recommendations to adapt teaching strategies, teacher ability to improve chatbot content.

Theme 4: Ethical and Usability factors

The fourth theme was related to ethics, transparency, privacy, usability and trust. Critical design factors must include data privacy safeguarding mechanisms, ability to explain, mitigation of bias, interface usability and transparency in making recommendations to teachers.

Integrating all the four themes, the SLR identified the critical design factors required to develop an expert system integrating chatbots, sentiment analysis, teacher dashboard and pedagogical feedback loop.

3.3 Phase 2: Empirical Validation

Two structured questionnaires, Student Perception Questionnaire and Teacher Perception Questionnaire, were created for the pilot study to validate the relevance and practicality of the design factors identified from the SLR. Each item in the questionnaire is mapped with one design factor and used a 5-point Likert scale (1-Strongly disagree to 5-Strongly agree). The participants for the pilot study were the undergraduate students enrolled in computer science-oriented courses and the teachers who are involved in digitally supported teaching. Convenience sampling was applied. Questionnaires were distributed digitally through Google Forms. Participation was voluntary, anonymous and the respondents provided informed consent before participation. 190 students and 24 teachers responded to the pilot study.

Students Perception

On the theme Utility and Learning, 71.6% of students agreed that the chatbot explanations are easy, 69.5 % responded that they feel comfortable talking to Chatbot and 65.8% recommended personalised chatbot responses. These findings imply that simple and clear explanations with a comfortable interface and providing tailored content to students needs are necessary for chatbot adoption.

On the theme emotional and social comfort, 61.6% of students feel comfortable sharing their doubts and 55.8% of students have improved their confidence level with encouraging messages from the chatbots. This implies that strong emotion recognition and empathetic response generation are critical factors for designing the chatbots.

60.0% of students acknowledged that their learning improves if there is a feedback mechanism to support teachers to identify student's confusion on a particular topic of the subject. 61.6% have acknowledged that the educational chatbots save teacher's workload. 65.0% of students expected a user-friendly experience with the chatbots.

There was low agreement (40.5%) on questions relating to data privacy, which indicates that there is a need for explicit data security feature in the framework.

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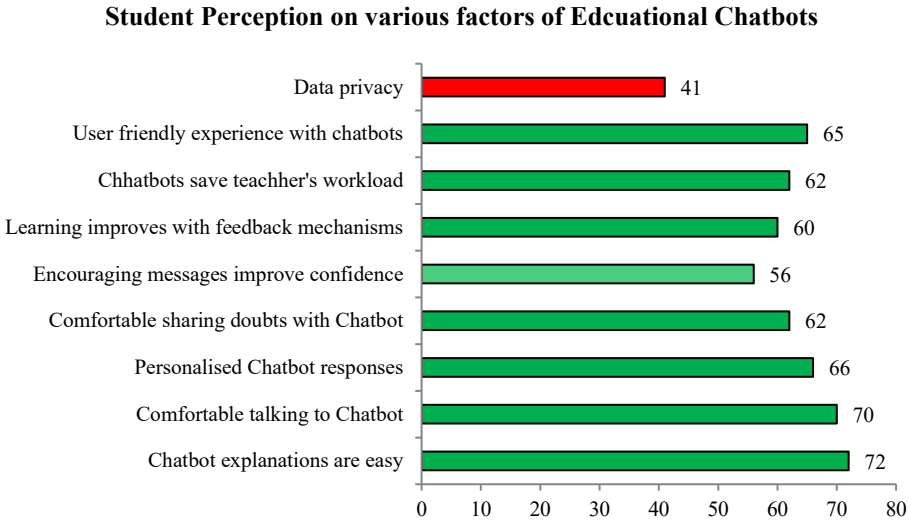
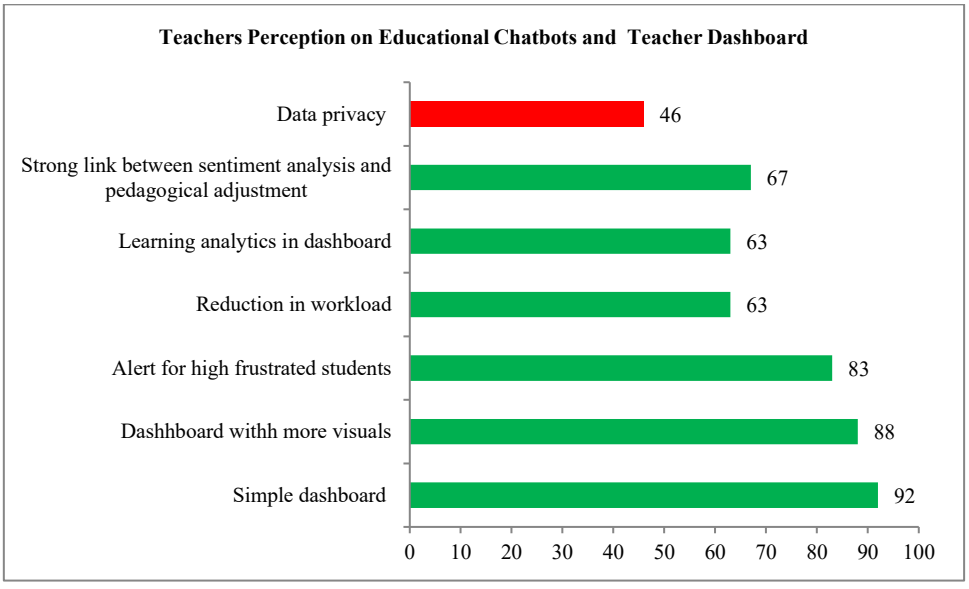


Teachers Perception

91.7% of teachers recommended simple dashboard with more visuals (87.5%). 83.3% teachers have acknowledged that alerts are very important for high frustrated students. 62.5% teachers have agreed that the chatbots reduce their workload and that the dashboard should provide learning analytics, to improve students' learning experience. 66.7% of teachers perceived that there is a strong link between sentiment analysis and pedagogical adjustment. There was a lower agreement (45.8%) that data privacy is a significant concern. This matches the student finding.



Similarities and Differences in Perception

Both students (61.6%) and teachers (62.5%) agreed that the chatbots can save teacher time, believed that chatbot should recognize and respond to student emotions. Agreement on the importance of data privacy was relatively low (40.5% students and 45.8% teachers) for both students and teachers.

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3.4 Phase 3: Conceptual Framework Formulation (RQ3)

The validated factors from Phases 1 and 2 were synthesised to construct a conceptual framework for an expert system integrating a personalized educational chatbot, a sentiment/emotion analysis engine, a pedagogical feedback loop and a central knowledge base. The framework design was guided by the functional requirements identified in the SLR, empirical validation findings from teachers and students questionnaires and principles of adaptive learning and emotion-aware systems. The resulting framework provides a structured, evidence-based foundation for developing intelligent learning systems capable of:

- Recognizing learner emotions
- Enhancing student engagement
- Supporting teachers in informed instructional decisions

3.5 Ethical Considerations

While conducting the research, strict ethical guidelines were followed throughout the stages of data collection and analysis. No personal identifiers were collected from participant to ensure anonymity and privacy of the respondents. Participation in the study was entirely voluntary and respondents were informed of their right to withdraw at any stage. All responses were treated with strict confidentiality data collected was used solely for the academic and research purpose. These measures were implemented to maintain integrity in accordance with standard research ethics protocols.

The Conceptual Framework

A multi-layered conceptual framework is proposed for an expert system integrating chatbot, sentiment analysis and teacher dashboard, using the validated design factors identified in the SLR. The framework outlines how emotional cues extracted from the student-chatbot interactions can be transformed into meaningful insights to make informed decisions by teachers.

4.1 Layered Framework

The framework consists of four interconnected layers:

a) Student-Chatbot Interaction Layer
b) Sentiment Analysis Layer
c) Teacher Dashboard Layer
d) Pedagogical Feedback Layer

All the layers collectively enable a continuous loop of emotional understanding, data visualization, pedagogical adjustment and targeted interventions.

a) Student-Chatbot Interaction Layer

This layer acts as the main interface where students interact with the expert system. It provides personalized support, conversational assistance, pedagogically aligned interactions and storage facility for storing interaction logs. The chatbot understands student's queries, provide appropriate responses and keeps track of the conversation to understand context. This layer also includes features like asking follow-up questions, sending reminders and asking for feedback, to keep the students engaged. All conversations are stored so that they can be used for later analysis to understand students' emotion trend and their learning needs.

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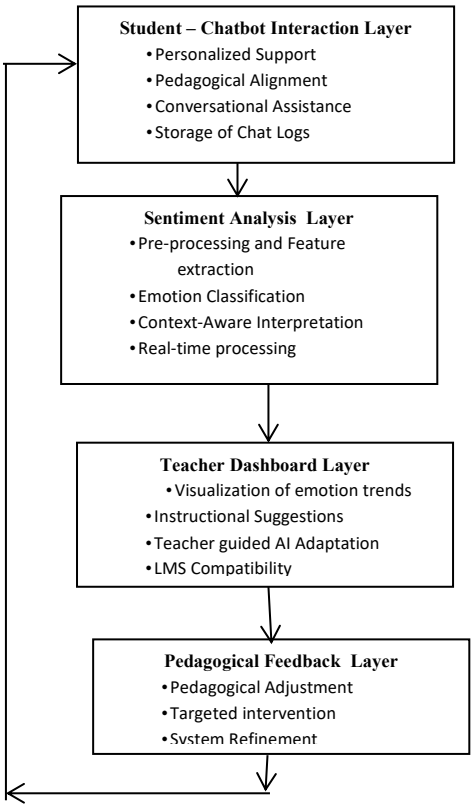

Fig.1: Conceptual Framework

b) Sentiment Analysis Layer

This layer processes the student-chatbot interactions to extract emotional cues for further analysis. The key functions of the layer are pre-processing, feature extraction, sentiment classification and real-time processing. The pre-processing function cleans the text using techniques such as tokenization, stop-word removal and lemmatization. Then, the features are extracted from the text using advanced NLP techniques like Word2Vec or BERT. The sentiment classification function is used to categorize the emotions detected from the conversations into positive, negative, neutral or specific emotions like frustration, confusion, motivation, boredom, etc. The real-time processing function ensures that the chatbot detects the emotions in real-time and adjusts its responses dynamically based on the student's emotional states.

c) Teacher Dashboard layer

The dashboard helps teachers to visualise student emotions and translate those emotions into useful insights to enhance teacher productivity. This layer consolidates student sentiments and learning engagement patterns to support teacher in decision-making. Alert mechanisms are provided to send automated alerts to teachers, about the students who persistently show negative emotions like frustration or disinterest or disconnected. The dashboard provides actionable instructional suggestions, to enable teachers to identify struggling learners and adjust teaching strategies. Teacher-guided AI adaptation allows teachers to customise the chatbot responses and refine system behaviour. Also, the dashboard is designed to be compatible with Learning Management Systems to simplify institutional integration.

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d) Pedagogical Feedback Layer

This layer offers actionable insights to help teachers and administrators to make prompt decisions. It enables teachers to apply targeted interventions based on emotional and learning analytics. The feedback generated through teacher actions is fed back into the system to improve future chatbot responses, thereby improving the system performance.

4.2 Benefits of the Conceptual Framework

The primary benefits of the proposed conceptual framework are:

(i) Enhanced student engagement – to make the students to stay involved, feel more supported and understood and thus learning becomes enjoying.
(ii) Improved teacher responsiveness – to detect patterns of emotional distress or disengagement from the chatbot conversations and alerts from the dashboard, at an early stage.
(iii) Better learning outcomes – to improve academic performances of students as their negative emotions are captured in real-time and interventions are made immediately to enhance student's psychological safety and well-being.
(iv) Data-driven policy making and curriculum improvement – to identify the signals for curriculum redesign, teaching pace adjustments, providing additional resources, revise assessment styles or provide teacher's training for up-skilling.

Conclusion and Future Work

This research has systematically synthesized the critical design factors necessary for the development of an expert system that integrates chatbots, sentiment analysis engine, and teacher dashboard with pedagogical feedback loop. The review was organized around four domains and the findings revealed that current educational chatbots offer benefits like personalization, workload reduction and learner engagement, but, they lack emotion analysis and pedagogical alignment. The current sentiment analysis systems detect emotions, but, lack accuracy, contextual interpretation and fairness. The teacher dashboards visualized the performance without emotional insights or pedagogical recommendations. Further, ethical concerns limited the teachers to adopt the systems. A systematic literature review was conducted to identify the critical design factors for the development of an expert system integrating the three components. The identified design factors were validated with a pilot survey among the students and teachers. Based on the validated design factors, a conceptual framework was designed to develop an expert system capable of enhancing student learning experience and increasing teacher productivity.

This research provided a theoretically grounded conceptual framework for the integrated expert system. The proposed framework should be empirically validated in future and deploy in real-world educational contexts. Multimodal emotion analysis, involving facial expression detection and speech emotion recognition, are to be incorporated for holistic understanding of students emotions. In future, the framework is to be trained on multi-lingual and multi-cultural datasets to ensure correct emotion detection and sentiment analysis. Overall, this research contributes a roadmap for designing next-generation intelligent educational systems that are emotionally aware, pedagogically aligned, ethically grounded and capable of enhancing both student learning experience and teacher productivity.

References

[1] E. Labadze and B. Nadareishvili, "Role of AI Chatbots in Education: Systematic Literature Review," *Int. J. Educ. Technol.*, vol. 18, no. 2, pp. 1–30, 2023.

[2] C. Kooli, "Chatbots in Education and Research: A Critical Examination of Ethical Implications and Solutions," *Sustainability*, vol. 15, no. 7, p. 5614, 2023.

[3] H. Guan, Y. Zhao, and L. Xie, "How Educational Chatbots Support Self-Regulated Learning? A Systematic Review," *Educ. Inf. Technol.*, vol. 30, pp. 1–23, 2025.

[4] M. Wollny, B. Schneider, and T. Kauffeld, "A Systematic Literature Review on Chatbots in Education," *Int. J. Educ. Technol. High. Educ.*, vol. 18, p. 51, 2021.

[5] G. Roca, P. Musabende, and A. García, "The Impact of a Chatbot Working as an Assistant in a Course to Support Students' Learning," *Comput. Appl. Eng. Educ.*, vol. 32, no. 1, pp. 150–163, 2024.

[6] Y. Su and L. Chen, "Pre-Service English Teachers' Perceptions of Chatbots," *Sage Open*, vol. 15, no. 4, pp. 1–12, 2025.

[7] Z. Yan, J. Zhang, and M. Yu, "Practical and Ethical Challenges of Large Language Models in Education: A Systematic Scoping Review," *arXiv preprint arXiv:2303.13379*, 2023.

[8] F. Merelo et al., "Chatbots and Messaging Platforms in the Classroom: An Analysis from the Teacher's Perspective," *arXiv preprint arXiv:2201.10289*, 2022.

[9] M. Verma, R. S. Baker, and W. Shute, "Multimodal Emotion Recognition in Learning Environments," *IEEE Trans. Affect. Comput.*, vol. 12, no. 3, pp. 289–302, 2021.

[10] T. Liu, S. Lu, and J. Wong, "Context-Aware Affective Computing for Educational Environments," *J. Educ. Data Mining*, vol. 14, no. 2, pp. 45–63, 2022.

[11] S. Aguilar, P. Nussbaum, and L. Rodriguez, "Teacher Dashboards in Adaptive Learning Systems: A Systematic Review," *Comput. Educ.*, vol. 182, p. 104441, 2022.

[12] X. Li, J. Chai, and P. Sun, "Sentiment Analysis for Student Feedback Using Deep Learning Approaches," *IEEE Access*, vol. 10, pp. 12045–12059, 2022.

[13] K. Chan and L. Pang, "AI-Enhanced Pedagogical Decision-Making: A Review," *Brit. J. Educ. Technol.*, vol. 55, no. 1, pp. 114–135, 2024.

[14] R. T. Alemi and M. Shiva, "Pedagogically-Aligned Conversational Agents in Higher Education: A Review," *Comput. Educ.*, vol. 200, p. 104632, 2023.

[15] P. Azevedo and E. de Jong, "Emotion-Sensitive Learning Environments: A Meta-Analysis," *Learn. Instr.*, vol. 89, p. 101654, 2023.

[16] D. Molenaar and R. J. Fischer, "Teacher Use of Analytics Dashboards: A Review of Adoption Barriers," *Learn. Anal. Rev.*, vol. 9, no. 1, pp. 45–67, 2022.

[17] M. Farrow and E. O'Connor, "Affective Learning Analytics: Supporting Emotion-Informed Instruction," *J. Learn. Sci.*, vol. 31, no. 4, pp. 555–580, 2022.

[18] K. Hoffmann and A. L. Smith, "Human–AI Co-Regulation in the Classroom," *Comput. Educ.*, vol. 207, p. 104770, 2023.

[19] Y. Kim, L. Nguyen, and J. Tran, "Bias, Transparency, and Explainability in Educational NLP Systems," *IEEE Trans. Learn. Technol.*, vol. 16, no. 2, pp. 220–235, 2023.

[20] A. Thomas and H. George, "Personalized Learning with Conversational Agents: A Meta-Synthesis," *Educ. Res. Rev.*, vol. 38, p. 100468, 2024.

[21] Caldarini, G., Jaf, S., & McGarry, K. (2022). A literature survey of recent advances in chatbots. Information, 13(1), 41.

Journal of Information Systems Engineering and Management
2025, 10(63s)
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https://www.jisem-journal.com/

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[22] Yin, J., Goh, T. T., & Hu, Y. (2024). Interactions with educational chatbots: the impact of induced emotions and students' learning motivation. International Journal of Educational Technology in Higher Education, 21(1), 47.

[23] Zhu X, Juanatas RA. Auxiliary Teaching and Student Evaluation Methods Based on Facial Expression Recognition in Medical Education. JMIR Hum Factors. 2025 May 22;12:e72838. doi: 10.2196/72838. PMID: 40402552; PMCID: PMC12121541